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ENVIRONMENTAL IMPACT STATEMENT

MISSISSIPPI RIVER AND TRIBUTARIES
MISSISSIPPI RIVER LEVEES AND CHANNEL IMPROVEMENT

PREPARED BY

U. S. ARMY ENGINEER DISTRICT
VICKSBURG, MS.
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Mississippi River and Tributaries
Mississippi River Levees and Channel Improvement

( ) Draft   (X) Final Environmental Statement

Responsible Office: U.S. Army Engineer District, Vicksburg, Mississippi

1. Name of Action: (X) Administrative   ( ) Legislative

2. Description of Action: The Mississippi River Levees and Channel Improvement project and related projects on more than 900 miles of river between Cairo, Illinois, and Venice, Louisiana, are designed to make the Mississippi River more navigable and prevent flooding by utilizing channel training devices such as dikes and revetments, levees, and maintenance and construction dredging of the mainstem and key harbors in Arkansas, Illinois, Kentucky, Louisiana, Mississippi, Missouri, and Tennessee. The proposed action addressed by the statement is the maintenance of the existing project features and the completion of those authorized.

3. a. Environmental Impacts: The proposed action would insure the existing and continued improvements in flood protection and in the transportation capacity of the river and their associated economic benefits and social well-being. Construction and maintenance activities would disrupt fish and wildlife habitat and temporarily damage water quality.

b. Adverse Environmental Impacts: Dredging and material disposal would have limited adverse effects on water quality and fishery habitat. Construction activities would cause the loss of 2,500 acres of cropland and 30,500 acres of woodland and the associated wildlife habitat. Slackwater areas of the river would be reduced in the upper reaches of the river.

4. Alternatives: No action; alternative maintenance measures; maintenance of existing project efficiency; storage of excess floodwaters in reservoirs; dredging to increase the hydraulic capacity of the river; additional cutoffs to increase the hydraulic capacity of the river; diverting flood flows; widening existing floodways; and alternative construction and maintenance methods.

5. Comments Received:

Environmental Protection Agency
Soil Conservation Service, USDA
Forest Service
Advisory Council on Historic Preservation
Department of the Interior
States of Arkansas, Illinois, Kentucky, Louisiana, Mississippi, Missouri, and Tennessee
Department of Health, Education, and Welfare
Department of Housing and Urban Development
Department of Commerce
Department of Transportation

6. Draft statement to CEQ 30 September 1974.
Final statement to CEQ 8 April 1976.

This Environmental Impact Statement was prepared by

the Vicksburg Engineer District

for the Mississippi River Commission

assisted by

the Memphis Engineer District

and

the New Orleans Engineer District

MISSISSIPPI RIVER AND TRIBUTARIES
MISSISSIPPI RIVER LEVEES AND CHANNEL IMPROVEMENT

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1. PROJECT DESCRIPTION

1.01. General. The main stem flood control and navigation features of the Mississippi River and Tributaries (MR&T) Project are located in the Lower Mississippi River Valley, between Cairo, Ill. and Venice, La. The Alluvial Valley, historically subject to overflow from the Mississippi River and its tributaries, is a broad lowland beginning at Cape Girardeau, Mo., and extending about 600 miles to the Gulf of Mexico. Main stem project features are found along the Mississippi River in Kentucky, Illinois, Tennessee, Missouri, Arkansas, Mississippi, and Louisiana. Also included are the levees along the Arkansas River below Pine Bluff, Ark.

1.02. History of the Project.

a. The necessity of flood control was recognized by early settlers in the Lower Mississippi River Valley. When Bienville founded New Orleans in 1717, his engineer, de la Tour, opposed the location because the settlement would be periodically overflowed by the river. Bienville overruled this objection, so de la Tour constructed the first levee system on the Mississippi. The levee, completed in 1792, was 3 feet high, 5,400 feet long, and 18 feet wide at the top, and had a roadway on its crown.

b. As settlements developed along the river, the levee system was extended. By 1735, the levee lines on both sides of the river extended from 30 miles above New Orleans to 12 miles below the city. This system was constructed by those who owned land fronting the river. The works were of insufficient strength and were crevassed at many points by the flood of 1735, which lasted for almost six months. In 1743, the French colonial government required landowners to complete their levees by January 1, 1744, or forfeit their lands to the French Crown. By 1812, when Louisiana was admitted to the Union, the levee system extended up to Baton Rouge on the east bank and to the vicinity of Morganza, 40 miles upriver from Baton Rouge, on the west bank. By 1844, in spite of several damaging floods, the levee system was continuous, except for a gap at Old River, from 20 miles below New Orleans to the mouth of the Arkansas River on the west bank and to Baton Rouge on the east bank.

Many isolated levees also extended along the lower part of the Yazoo Basin. These efforts to control Mississippi River floods had been almost entirely local in nature, with individual landowners bearing all costs.

c. Federal efforts to improve the Mississippi River for navigation began in 1820, when Congress appropriated funds for the preparation of a survey, maps, and charts of the Ohio and Mississippi Rivers. By this time, river navigation was well developed; the steamboat had made its appearance eight years before, and the need for navigational improvements on the nation's major rivers was becoming increasingly apparent.

d. In 1824, the Corps of Engineers began removal of snags in the Mississippi River below the mouth of the Missouri. Intermittent surveys and attempts at navigation improvements followed. As the importance of the river grew and the country expanded, Congressional attention was increasingly directed to river improvements as a Federal responsibility, but the emphasis remained almost entirely on navigation. By the mid-1840's, flood control was also considered, and began to gain official recognition through conventions and proposed legislation.

e. The destructive floods of 1849 and 1850 created widespread concern in the Lower Mississippi Valley, focusing national attention on the problem. The result was Congressional passage of the Swamp Act of 1849 and 1850. These acts granted States all unsold swamp and overflowed lands within their borders and provided that funds derived from sale of these lands be applied to drainage, reclamation, and flood control projects. This attempt to secure flood protection failed from lack of coordination between the States and the levee districts involved.

f. In 1850, as a further expression of national interest, Congress appropriated $50,000 for a river survey by the Corps of Engineers.

g. During the War Between the States, flood control work halted and many levees were destroyed by floods or by the contending armies. By 1878, hundreds of miles of main line levee had disappeared entirely or been rendered inoperative.

h. The need for more substantial coordinated Federal participation in navigation and flood control improvements was generally recognized by 1879. On 28 June of that year, Congress established the Mississippi River Commission (MRC) " . . . to take into consideration and mature such plan or plans and estimates as will correct, permanently locate, and deepen the channel and protect the banks of the Mississippi River; improve and give safety and ease to the navigation thereof; prevent destructive floods; promote and facilitate commerce, trade, and the postal service . . ."

i. In 1880, in its first report, the MRC recommended navigation and flood control improvements. The following year Congress appropriated $1 million to the MRC for the construction of improvement works, stipulating that the funds be spent only for deepening or improving the river channel.

j. Levee work for channel improvement began in 1882 and marked the beginning of construction of a coordinated levee system for the Lower Mississippi River. By 1906 navigation improvement of the lower reaches of the river had been effected by dredging, bank protection with heavy willow mattresses had been successfully developed, and extensive levee work was being conducted below Cairo. However, flood control benefits remained incidental.

k. As a result of the devastating floods of 1912 and 1913, the President directed the MRC to submit a special report on flood prevention. This report considered levees, reservoirs, cutoffs, outlets, diversion channels, and reforestation, with levees identified as the only practical method for immediate relief. Congress did not authorize a comprehensive flood control plan for the alluvial valley, and MRC operations remained limited primarily to levee repair and navigation channel maintenance.

l. The 1916 flood resulted in passage of the first Flood Control Act, approved on 1 March 1917. This act authorized levee construction for the control of floods. It also defined the role of local interests, providing that they furnish rights-of-way, contribute a substantial percentage of construction costs and maintain completed works. The MRC was authorized to spend Federal funds for work on tributaries as necessary to protect the upper limits of any alluvial basin from flooding.

m. The second Flood Control Act, passed in 1923, clarified the jurisdiction of the MRC.

n. The flood of 1927 was the most disastrous in the history of the lower Mississippi River Valley, inundating about 26,000 square miles. This disaster emphasized the need for flood control in the Lower Valley and resulted in the Flood Control Act of 15 May 1928, which committed the Federal Government to a definite program of flood control. This Act authorized general and progressive channel stabilization and river regulation from Cape Girardeau, Missouri, to Head of Passes, Louisiana, including a 9-foot by 300-foot navigation channel from Cairo, Illinois, to New Orleans, Louisiana. Stabilization for levee protection is being accomplished by revetmens and contraction works and channel dredging where appropriate. The present project dates from this Act, which authorized the expenditure for $325 million, for construction of a

Federal project to provide flood control in the alluvial valley of the lower Mississippi River and navigation from Cairo to New Orleans. Local interests were charged with furnishing rights-of-way for levees and maintaining them after construction.

o. Subsequent legislation and the experience of four major floods have resulted in many modifications to the 1928 Act.

p. Of particular recent importance is the flood of 1973, which indicated that significant reductions have occurred in the flood capacity of the river.

1.03. Project Features.

a. The flood control plan of the MR&T Project is designed to control the "project flood." The project flood is 11 percent greater than the 1927 flood at the mouth of the Arkansas River and 29 percent greater, or 3,030,000 cubic feet per second, at the Red River Landing, about 60 miles below Natchez.

b. The comprehensive flood control plan includes several features which, when completed, will protect a large part of the alluvial valley from the project flood.

c. The four major elements are: levees for containing flood flows; floodways for passage of excess flows past critical reaches of the Mississippi; channel improvement and stabilization works for stabilizing the channel to provide an efficient navigation alignment, increase the flood-carrying capacity, and protect the levee system; and tributary basin improvements for major drainage and flood control, such as dams and reservoirs, pumping stations, diversion channels, etc.

d. The two primary types of improvement, levees and channel improvements, act together to produce flood control and navigation benefits. Although these benefits can be evaluated, no logical method has been developed to assign values to each of the features that combine to produce them. In evaluating project justification, the premise has been adopted that a balanced plan of flood control and navigation features exists and that total benefits will not be realized until the project is complete.

e. This environmental statement covers certain portions of the Mississippi River and Tributaries Project generally referred to as main stem features and certain other appurtenant projects. Specifically excluded from this statement are the tributary projects, the Old River control structures and lock, the Morganza and Atchafalaya Floodways, and the portions of the overall main stem project and related projects that have already been completed. Thus this statement covers only that portion of the main stem project that remains to be constructed, remaining appurtenant projects, and Federal operation and maintenance of the main stem project. The components of this authorized project include basically levees, river training devices, and construction and operation and maintenance dredging.

1.04. Levees.

a. The Mississippi River levees are designed to protect the Alluvial Valley against the project flood by confining flow between the levees except where it enters the natural backwater areas or is diverted purposely into floodway areas. The main stem levee system, consisting of levees along the river and floodways, floodwalls, and control structures, is more than 2,000 miles long. The levee line on the west bank begins just south of Cape Girardeau and, except where the waters of the St. Francis and the Arkansas-White join the Mississippi, with its incorporated structures, extends unbroken to Venice, La. On the east bank of the river, levees alternate with high bluffs to give protection from floods. The longest continuous levee line in the Mississippi River and Tributaries Project begins at high ground near Pine Bluff and continues for more than 650 miles to Venice, Louisiana.

b. When major floods occur and the carrying capacity of the Mississippi River leveed channel is exceeded, relief outlets through the Birds Point-New Madrid, Morganza, and Bonnet Carre Floodways are utilized as well as the storage capacity of the flood lowlands at the junctions of tributaries with the Mississippi. These backwater areas act as mid-river reservoirs which store water during time of flood.

c. The levees are constructed by the Federal Government and, upon completion, local interests are advised of their responsibility for operation and maintenance. Major maintenance, emergency assistance, and periodic maintenance inspections are provided by U. S. Army Corps of Engineers.

d. The authorized project will upgrade the levees to provide minimum freeboard above the revised 1973 flood flow line. To accomplish this goal, approximately 461 miles of levee must be raised along the main stem Mississippi River between Cairo and Venice. Upgrading the levees and their associated landside and riverside berms involves several operations. The existing ground and levee surface on which additional fill is to be placed is prepared to receive the material. Fill material is obtained from borrow areas generally located riverside of the levees. The fill is placed on levees and berms are constructed with it. All material is compacted according to specifications and then sodded or seeded with protective vegetation. These same operations apply to cases where upgrading includes moving the levee away from the river because of instability caused by the cutting action of the river.

e. The permeability of levees can be controlled by proper selection and compaction of available material. For this reason, direct seepage through the levees is not usually a major problem. The recent alluvium which forms the levee foundation consists of an impervious clay and silt topstratum underlain by a thick pervious substratum of sands and gravels. Where the alluvial topstratum is thin or absent, active underseepage can develop through the foundation during overbank stages. The underseepage emerges landside of the levee, sometimes at distances exceeding one mile, depending upon river stage. The seepage water collects on the ground surface and severely affects agricultural operations and can damage roads and other man-made structures. Where sufficient hydrostatic head is developed, sand boils may form immediately landside of the levee and enough fine sand and silt may be removed from the alluvial substratum to cause failure of the levee foundation. The principal means of ensuring levee stability against this condition include landside berms, generally of semipervious materials, to increase the path of percolation and reduce effective net hydrostatic head; riverside berms of impervious materials, often involving refill of borrow pits; cutoff trenches backfilled with impervious materials; sublevees to impound seepage and reduce the effective hydrostatic head; and drainage wells to reduce dangerous substratum pressures. While these measures, especially landside and riverside berms, are highly effective in protecting the levee against sand boils and uncontrolled underseepage, they do not alleviate the landside seepage described above.

1.05. River Training Devices.

a. The MR&T project provides for realignment of the river channel to increase its flood-carrying capacity, and for construction of revetments and dikes to stabilize the improved channel and control its natural tendency to meander. Channel improvement also protects the levees from destruction by caving banks which result from meandering of the river into the levee line. These measures tend to maintain and improve the regimen of the low-water navigation channel. The use of foreshore protection in that portion of the river below Baton Rouge also acts to protect the levees from wave erosion. Detailed maps showing the proposed location of authorized river training works are contained in public notices for revetment, dike construction and/or foreshore protection prepared by each District Engineer in compliance with requirements of Section 404 of Public Law 92-500 (FWPCA). These notices were published and widely distributed in March 1976; additional copies are available from the office of the District Engineer having jurisdiction over that portion of the work in question (see Appendix E).

b. Revetment is used essentially to stop the river's meandering and bank caving. Channel stabilization and protection of the riverbank protect flood control features and provide an acceptable alignment and channel depth for navigation.

c. To date, the most economical and effective means of protecting the banks to prevent caving and erosion is revetment composed of an articulated concrete mattress under water and stone (riprap) paving above the low water placed on a stripped and graded bank. The mattress is composed of sections of 20 concrete blocks or slabs, each 4 feet long, 14 inches wide, and 3 inches thick, cast into unit squares 4 feet wide and 25 feet long, using corrosion-resistant fabric to hold the blocks together and provide flexibility. These unit squares are assembled on the launching ways of a specially designed mat sinking plant, fastened together with machine-applied wire wraps to form a mattress 140 to 156 feet in width. After the first launch is anchored to the bank and lowered by moving the barge out into the river, another launch is assembled on the deck, fastened to the first, and the barge again moved out into the river. This method of assembly is repeated until a mattress is long enough to extend to the deepest point in the channel. The procedure is then repeated with each succeeding mattress overlapping the previous mattress until the desired degree of protection is obtained. Normally, the river bank is revetted from the upstream point of river current attack to where the channel crosses to the opposite bank.

d. As of June 1973, there were 643 miles of revetment in the project area. The proposed project requires approximately 325 additional miles of revetment in 154 locations.

e. Dikes direct the channel into a favorable alignment, and are also employed to assist in closing secondary channels and chutes. The existing project includes 348 dikes in 83 fields within the project area. To obtain and maintain the desired river alignment, 574 additional dikes have been proposed for 165 locations (June 1973 projections). Present construction methods involve dumping stone off barges. The dike slopes from the top of the river bank to the ALWP (Average Low Water Plane) at its riverward end. The process generally involves only minor bank preparation to properly tie the dike into the river bank.

f. Ninety-four miles of foreshore protection presently exists in the project area. Approximately 74 miles of additional foreshore protection are required at 52 locations in the proposed project. Foreshore protection construction is similar to dike construction in that large stones are dropped from barges close to and parallel to the river banks and little or no bank preparation is required. Foreshore protection systems are used downstream of Baton Rouge to protect the levees from wave wash resulting from the passage of ships and barge tows. These protective systems consist of continuous dikes aligned parallel to the river banks which minimize the erosive action of waves on the levees and river banks, and trap sediment which rebuilds and extends the foreshore.

1.06. Dredging.

a. Dredging is employed to maintain navigable depths in the main channel. Cutterhead and dustpan dredges are used to remove material from the channel. In the section between Cairo and Baton Rouge, development of a navigation channel is part of the general channel stabilization program. Channel alignment is designed to provide and maintain increased flood-carrying capacity, and to provide alignment that will permit maintenance of a dependable navigation channel.

b. The channel between Baton Rouge and the Head of Passes has natural depths and widths generally in excess of those required for sea-going commerce except at a few crossings where dredging is required occasionally following high water seasons. Development of this generally adequate channel has been assisted by levees which confine the flow of the river to a single, relatively narrow channel when compared to channels north of Baton Rouge.

c. The most serious difficulties encountered in maintaining the present 9-foot channel lie in the section between Cairo and the Arkansas River. The principal reasons are divided channels around islands or bars, in which the main channel has not been fully developed and stabilized, and excessively straight reaches in which no definite concentration of flow exists.

d. The program of additional stabilization works above Baton Rouge has been laid out for the dual purposes of flood protection and navigation. The proposed works include corrective dredging to correct alignment and confine flow to selected channels. Revetments and dikes will stabilize the location of the navigation channel, reduce erosion and deposition of bar forming material, and concentrate the flow in selected channels.

1.07. Related Projects.

a. The Slough Landing levee (Madrid Bend levee) is located on a peninsula within a large bend in the Mississippi River at about river mile 899. Enlarging some 4,700 feet of this levee will help protect approximately 18,000 acres within the peninsula from being cut off by extreme high water which tends to cross the neck of the peninsula.

Total area involved in this project is 45 acres, 21 of which are now levee base or borrow area and 24 acres of which are now devoted to soybeans. The improvement would be made under the authority of the Flood Control Act of 15 May 1928, as amended, and supplemented.

b. Osceola Harbor was authorized by Section 107, River and Harbor Act of 14 July 1960, as amended by Section 310, River and Harbor Act of 1965 and construction is complete. The harbor improvements are 9 by 250 feet and extend upstream 6,500 feet to the old chute through Island No. 20, to river mile 785.4. A 250-foot radius turning basin is located at the upper end. Projected harbor tonnage is 209,000 per annum.

A 97-acre flood-free industrial park will be developed into two phases. In the first phase of development, a levee will be constructed by local interests to protect 30 acres at the north end of the proposed harbor for construction of port facilities. A second phase will utilize dredged material to raise the elevation of the remaining 67 acres to above the project flood flow line. Local interests will be responsible for construction of all necessary bulkheads and dikes, prior to dredging to contain the dredged material.

c. The Mud Lake project is located in Lake County, Tennessee, and southwest of the town of Ridgely, Tennessee. The facility will consist of a 150-cubic-feet-per-second pumping station and associated inlet and outlet channels on a 27-acre plot at about river mile 857. The inlet channel will commence about 2,000 feet upstream from the existing Mud Lake culverts in a northerly direction to the Mississippi River levee.

The facility is being designed to begin evacuation of interior run-off when the Mississippi River stage approximates 260 feet, mean sea level, and the high stage prevents gravity drainage. This project will offer flood protection to 1,075 acres of agricultural land. Principal crops of the area include soybeans, cotton, and corn.

d. An outlet for Long Lake Bayou through the Mississippi River main line levee was approved under authority of Section 10(p) of the Flood Control Act of 24 July 1946 (Public Law 79-526). The plan provides an outlet channel from Long Lake Bayou to the Mississippi River, including a gated concrete box culvert with four 6-foot by 6-foot barrels through the main line Mississippi River levee. In addition, an overflow dike, located in Quarles Canal between the proposed outlet channel and Old Town Lake, will be provided to prevent lowering of the water level in Old Town Lake.

e. The Tiptonville-Obion Levee Extension feature of the Mississippi River Levees Project was authorized by the Flood Control Act of 24 July 1946 (Public Law 526, 79th Congress) and, subsequently, modified by the River Basin Monetary Authorization Act of 1971 (Public Law 92-222). This project, located on the left bank of the Mississippi River in Lauderdale County, Tennessee, includes the extension of the Mississippi River levee for about 7.6 miles from the Dyer-Lauderdale County line at the Obion River to the mouth of the Old Forked Deer River channel. Since the levee extension will block the existing outlet for the Obion and Forked Deer Rivers, the authorized plan includes a diversion channel 10.7 miles long to transport headwater flows to empty into the Mississippi River downstream from the extended levee. An additional project feature provides for placement of excavated material from the diversion channel to form a continuous spoil bank on the east side of the diversion channel for its entire length, to protect the low-lying area southeast of the channel from excessive flooding and siltation. The project sponsors are exploring available alternatives for construction of a levee north of Highway 88 along the south side of the Forked Deer River tying into the spoil bank at the confluence of the Obion and Forked Deer Rivers and extending to the bluffs near Porters Gap. This would provide added protection from headwater flooding and further reduction of siltation.

The proposed levee extension will prevent overflows from the Mississippi River from spreading directly eastward across the alluvial valley. Floodwaters will be able to reach the study area only by backing up around the downstream end of the new levee where the new Obion River outlet will be located. Since the average Mississippi River elevation is about seven feet lower at the new Obion River outlet than at the existing outlet, floodwaters in the benefited area will be reduced by approximately seven feet.

Extension of the main line Mississippi River levee into Lauderdale County as proposed will extend complete protection from the 100-year flood to an additional 31,000 acres of primarily agricultural lands, and partial protection to another 56,000 acres. The diversion channel along with the proposed continuous spoil bank on its left bank will contain all but abnormally large headwater flows and would thus reduce overbank flooding and concomitant siltation on lowlands to the southeast of the diversion channel.

Construction of the project will require about 3,050 acres of rights-of-way and will result in the clearing of approximately 1,350 acres of woodlands to facilitate construction and spoil placement; however, about 550 acres of that total may be reforested subsequent to construction.

(1) Present Conditions. Topographically, the area ranges in elevation from 240 to 260 feet, mean sea level. It is bordered on the east by high bluffs and on the west by the Mississippi River which by its past meandering and flooding created this valley. Stream flows are sluggish and overbank flooding is frequent. Wetland forests occupy the lower area, but much of the land above 250 feet, mean sea level, has been cleared and put into agricultural production. Water pools in the lowest areas create small ponds and two lakes. Chisholm Lake is crescent-shaped and during periods of low water, approximately 2 1/2 miles long and 230 acres in surface area. Open Pond, near the southern limit of the study area, consists of approximately 1,200 acres of surface water.

Located on the right bank of the Obion River, generally between river miles 4 and 8 and extending to the Tiptonville-Obion levee, is the 3,300-acre Moss Island Waterfowl Management Area owned and maintained by the State of Tennessee. Below the mouth of the Obion River and between Chisholm Lake and Open Lake is the Anderson-Tully Wildlife Management Area. These 17,400 acres are owned by a private timber company but are leased by the Tennessee Game and Fish Commission for public recreation. These are the only major tracts of uncleaned lands remaining in the study area. Also, the Anderson-Tully tract is the largest single tract of woodlands remaining along the eastern bank of the Mississippi River in Tennessee. A study (30) was made of the flora of the Obion and Forked Deer Rivers Basins in 1973 which includes the study area of this project as well as species from the eastern hills. The dominant plant species associated with the wetlands of these river basins include overcup oak, swamp chestnut oak, pin oak, willow oak, swamp Spanish oak, green ash (var. subintegerrima), pumpkin ash, box elder, red maple (var. drummondii), river birch, sweetgum, September elm, baldcypress, tupelo gum, black willow, cottonwood, and sugar maple (30).

The fish populations of this area are similar to those found in the Obion-Forked Deer Rivers Basin as a whole. Between 1971 and 1973, approximately 150 collection sites were sampled in the basin revealing over 100 species. Data show that populations are dominated by such forage fish as gizzard shad, golden shiner, bluntface shiner, creek chub, blackspotted topminnow and mosquitofish. Other common species include bowfin, spotted gar, carp, black and yellow bullhead, channel catfish, green sunfish, bluegill, and white crappie (30).

The list of amphibian and reptile fauna expected to occur in the Obion-Forked Deer Rivers Basin was prepared from collections made by the University of Tennessee at Martin and from published sources and totals 74 species. The common ones include Fowler's toad, cricket frog, bullfrog, marbled salamander, snapping turtle, painted turtle, stinkpot, and grey rat snake (30). The study area of the Obion River diversion and Tiptonville levee extension project does not contain dry upland habitat as is characteristic of the headwater area of the Obion-Forked Deer Rivers Basin. Therefore, the wetland-type species are dominant in the study area.

A prepared list of the birds known to occur in the Obion-Forked Deer Rivers Basin totals 249 species, of which only 65 are considered to be transients (30). Based on the type of habitat and the relative abundance of the species in the whole basin, the more common species in the study area likely include great blue heron, mallard, ring-necked duck, yellow-billed cuckoo, downy woodpecker, eastern wood pewee, common crow, Carolina wren, wood thrush, yellowthroat, redwinged blackbird, cowbird, swamp sparrow, and song sparrow.

Nongame mammals in the Obion-Forked Deer Rivers Basin which make extensive use of overflow bottomlands, wooded swamp and sloughs such as found in parts of the study area include the marsh rice rat, white-footed mouse, cotton mouse, and golden mouse. Cropland does not support an abundance of mammals, but those species which do make use of this habitat include woodchuck, hispid cotton rat, and the house mouse (30).

A 1969 state report ranks fishing and waterfowl hunting first and fifth, respectively, on a list of the most popular recreational activities on public and private lands in Lauderdale County. Together, these activities account for 21 percent of the recreational experiences in the County. In Dyer County, they account for 6 percent of all recreational activities (30). Because the study area is a part of these counties, encompassing two large public wildlife management areas, Moss Island and Anderson-Tully, and at least two private sportsman clubs, Open Lake Club and Chisholm Lake Club, they probably provide more than the counties' average number of hunting experiences.

Primary game fish in the Obion-Forked Deer Rivers Basin include channel catfish, bluegill, sunfish, spotted bass, largemouth bass, black crappie and white crappie.

Mallards are by far the most abundant of wintering duck species in the Obion-Forked Deer Rivers Basin. They also represent the species most often killed in hunting activity. Most mallards wintering in this area come from breeding sites in pothole country of north central United States and west central Canada. They and other wintering species such as black duck, pintail, wood duck, American widgeon, and teal use the water and bottomland forests for feeding, roosting, and resting. The only species of duck that nests in the area in significant numbers is the wood duck (30).

All game species of mammals in the Obion-Forked Deer Rivers Basin make extensive use of the overflow bottomlands, wooded swamp and sloughs which describe parts of the study area of this project. The species include eastern cottontail, gray squirrel, raccoon, striped skunk, beaver, muskrat, gray fox, mink, bobcat, and white-tailed deer. Cropland in the study area is food habitat for opossum, striped skunk, raccoon, eastern cottontail, and red fox (30).

A list of the threatened or endangered wildlife possibly in the Obion-Forked Deer Rivers Basin totals 17 species. It is possible that some or all of these species are making use of the study area of this project. Refer to Table 22, Appendix C.

There are 22,400 acres of existing woodlands in the 100-year floodplain. An additional estimated 17,400 acres exist in the Anderson-Tully tract and surroundings. Most of these forests are managed by their private owners for commercial timber production. The major species of bottomland hardwood in the commercial forests are oak, gum, and cypress (30).

None of the sites listed on the "National Register of Historic Places" are located in the Tiptonville-Obion Levee Extension project area. Neither are any of the sites on the "National Registry of Natural Landmarks" to be found here. The American Forestry Association's "Social Register of Big Trees" (29) does not list any champion specimens as being located in the study area. There are 10 known archaeologic sites in the study area, 9 of which are below the mouth of the Obion River. These sites are the remains of early Indian villages and encampments (28).

(2) Expected Future Conditions Without Project. If no levee extension and river diversion is contracted in the study area, backwater flooding from the Mississippi River will continue to occur. Despite this fact, private owners are expected to convert about 3,200 acres of woodlands into croplands. The average annual flood damages to agricultural production will increase due to the rising cost of crops and the fact that additional croplands will be flooded.

In the future, if no project is constructed, it is estimated that there will be 19,200 acres of woodlands and 67,800 acres of croplands in the 100-year floodplain. No change is expected in the operation of the aquatic, bottomland forest, and cropland ecosystems. As a result of the clearing of 14 percent of the existing woodlands in the 100-year floodplain, there will be a shift in the relative abundance of forest animals.

Those which have become adapted to live in the proximity of man's activities and even make use of the agricultural lands will increase in relative abundance. Conversely, species which are incompatible with agrarian activities will diminish. However, the overall reduction in habitat will result in reduced populations of most forest species.

Both a Corps of Engineers report and the Tennessee Outdoor Recreation Plan estimate that the Obion-Forked Deer Rivers Basin will have a need for additional recreational opportunities in the future as a result of estimated population growth and loss of wildlife habitat (31).

Additional agricultural activity in the study area will cause some increase in water pollution due to fertilizer and pesticide runoff. There will also be increased discharges of air pollutants from farm equipment. However, the amount is not significant and air pollution is not expected to become a problem in the future.

Archaeological sites will not be affected by failure to complete a project in the study area.

The loss of woodlands will contribute to the scarcity of this resource and adversely affect the esthetics. In an area where the dominant scene is flat cropland, the loss of woodlands will mean fewer opportunities for people to enjoy getting out into nature. Also, there will be less relief to the landscape.

(3) Future With Project. An extension of the Tiptonville-Obion levee has been authorized since 1946. The necessary construction would consist of continuing the levee across the Obion River about 10 miles, ending at a road in what is presently the Anderson-Tully Wildlife Management Area. The Obion River would be blocked by this levee construction but a new outlet would be provided by digging a new channel with a 180-foot bottom width, diverting the flow southward parallel to the levee extension and around its southern end. The diversion channel would begin at about mile 3 on the Obion River and end at an outlet on the Mississippi River at mile 803.7. The mouth of the Obion River will have been moved approximately 15 miles downstream on the Mississippi River.

The levee extension will prevent overflows from the Mississippi River from spreading directly eastward across the alluvial valley. Floodwaters will be able to reach the study area only by backing up around the southern end of the new levee where the new Obion River outlet will be located. Since the Mississippi River elevation is about 7 feet lower at the new Obion River outlet than at the present outlet, floodwaters in the study area will be reduced by approximately 7 feet. With the authorized project in place, a flood with a frequency of once in two years will inundate approximately 9,000 acres outside the levee, of which about 6,000 acres will be wooded. The 10-year frequency flood will cover approximately 27,000 acres, of which 12,000 will be wooded. Higher floods will back water up to points farther north in the alluvial valley where the land is more extensively cleared. The 30-year frequency flood will inundate about 24,000 acres of cleared land and 13,500 acres of woodlands.

Chisholm Lake, which will be near the southern end of the levee extension, will receive backwater flooding at about the same frequency as present. The lake is not expected to suffer from a lack of water supply and with the proposed spoil bank levee in place, siltation should be reduced.

Construction of the project will require clearing of about 900 acres of bottomland forest, many of these acres being part of the Anderson-Tully tract.

The project will induce the clearing of approximately 4,700 acres of forest away from the construction site. This land will be replanted with row crops, most likely soybeans. Annual plowing and planting will prevent any return of the natural vegetation on these lands.

Reduced backwater flooding in the upper end of the study area will diminish the area over which fish can feed and reproduce, thus reducing their number.

Construction of the diversion channel will actually lengthen the Obion River, providing more river miles available for fishing opportunities. However, an artificial channel with most of the adjacent vegetation cleared is known not to support a very attractive sport fishery (31). Therefore, fishing opportunity in the Obion River will not be enhanced by the project. A few fishing sites in the path of the construction will be destroyed by the project. Lands above the existing mouth of Obion River, where full flood protection benefits will be realized, will notice a loss in fishing opportunity.

After the project is built, the hunting in the remaining 13,500 acres of woodlands will likely be somewhat less successful than at present due to the fact that some of the surrounding habitat which produced game animals has been removed and overall production is down.

This fact is offset by the fact that reduced flooding on remaining woodlands will be beneficial to certain game species that make extensive use of annual mass production. Species which will find more food available include turkey, deer, and squirrel. On the other hand, waterfowl are expected to suffer from reduced flooding on wetland habitat. The proejct will have a greater effect on the backwater flooding at the Moss Island Waterfowl Management Area than in the Anderson-Tully Management Area farther south. Some of the Moss Island Area receives backwater flooding every year and nearly all of the wooded land in the area is inundated by the 2-year frequency flood. After the project is constructed, the same degree of flooding will occur only once in 8 years. This will substantially reduce waterfowl populations and hunting opportunity in this area. Some private hunting areas will likely suffer the same effect.

A recent reconnaissance by Smith (28) of the Obion-Forked Deer Rivers Basin revealed one archaeological site near the proposed channel diversion. If construction takes place over this site, it will be lost as a historic and cultural resource. At present, it is not expected that the construction will come near enough to damage this site; however, as final alignment is being drawn, efforts will be made to assure that no damage is caused to any archaeological site in the project area.

f. For safe passage of major floods in the lower Mississippi River system below Old River, the U. S. Army Corps of Engineers has modified a portion of the natural Atchafalaya Basin overflow area to convey floodwater in excess of the capacity of the leveed Mississippi River. A flood producing flow in the Mississippi River Below Old River of more than 1 1/2 million cubic feet per second will require the controlled ingress of flow into the Atchafalaya Basin beyond that which will enter through the Atchafalaya River.

Modifications to the Atchafalaya Basin overflow area include construction of protection or "guide" levees to the east and west of, and parallel to, the Atchafalaya River main channel. The Morganza Floodway, which is 20 miles long and 5 1/2 miles wide, serves as a controlled intake and is located on the east side of the Atchafalaya River below Morganza and Krotz Springs, Louisiana. The West Atchafalaya Floodway, a second intake, is 35 miles long and 7 miles wide, and extends from Simmesport to Krotz Springs, Louisiana. The Atchafalaya Basin Floodway is the southern extension of these intakes; it is 65 miles long and 15 miles wide, and lies on either side of the Atchafalaya River main channel from Krotz Springs to Morgan City, Louisiana. At the lower end of the Atchafalaya Basin Floodway, all flow is discharged into Atchafalaya Bay and the Gulf of Mexico through the Lower Atchafalaya River at Morgan City, Louisiana, and Wax Lake Outlet, an artificial channel at Calumet, Louisiana, about 10 miles west of Morgan City, Louisiana.

At the latitude of Old River, the project design flood is computed to be 3,030,000 cubic feet per second. This floodflow is to be routed to the sea by passing 930,000 cubic feet per second from the Red River Backwater area into the Atchafalaya Basin Floodway at the latitude of Simmesport, Louisiana. Of the latter amount, a discharge of 680,000 cubic feet per second is to enter the Atchafalaya Basin through the main channel of the Atchafalaya River and a discharge of 250,000 cubic feet per second is to pass through the West Atchafalaya Floodway. A discharge from the latitude of Old River of 2,100,000 cubic feet per second, is to be carried down the Mississippi River to the head of the Morganza Floodway, where 600,000 cubic feet per second is to be diverted through the Morganza control structure into the Atchafalaya Basin Floodway. A total of 1,530,000 cubic feet per second is inputted to the Atchafalaya Basin Floodway with 30,000 cubic feet per second going into storage and 1,500,000 cubic feet per second passing on through the Atchafalaya Basin Floodway (Figure 2).

An environmental statement is being prepared by the U. S. Corps of Engineers, New Orleans District, covering the above described feature. This environmental statement includes those features of the Mississippi River and Tributaries project pertaining to the Atchafalaya Basin diversion plan which are so interdependent or interrelated as to make a composite statement appropriate. Included are (1) the overall project, Atchafalaya Basin, Louisiana, with its intakes and integral components, (2) the Old River project with its integral components, including navigation, and (3) the Lower Red River (Levee) project. The major work required to complete the Atchafalaya Basin project is to raise existing levees up to design grade, complete the Atchafalaya Basin main channel, and rebuild the Morgan City and Berwick floodwalls to design grade.

g. The Cache River Pumping Station, authorized by the Flood Control Act of 28 June 1938, Public Law 761, is located at the mouth of the Cache River, adjacent to the existing Cottonwood Slough station. The existing Cache River Culvert drains the Cache River area, which is comprised of approximately 9,000 acres, and overflow from the Mounds Creek area during high stages. The pumping station will handle these waters plus interior waters from Mound City, which comprises about 350 acres. The Federal Government will construct outlet ditches for Mound City, while Mound City will construct its interior ditches for diverting its drainage to the proposed pumping station. Waters will be pumped over the Ohio River Project levee and discharged directly to the Ohio River. The capacity of the new pumping station will be 200 cubic feet per second.

h. Mississippi River, Baton Rouge to the Gulf of Mexico, Louisiana. This navigation project provides for maintaining channels of specified dimensions in the Mississippi River and passes from Baton Rouge, Louisiana, to deep water in the Gulf of Mexico. The action consists principally of maintenance dredging at eight crossings in the Mississippi River, New Orleans Harbor, South and Southwest Passes and bar channels; regulating and contracting works at the Head of Passes and in South and Southwest Passes; regulating and controlling of outlets below New Orleans; and maintenance of jetty systems at the seaward ends of South and Southwest Passes.

Maintenance of the deep channel provides access by oceangoing ships to the Ports of New Orleans and Baton Rouge. The Louisiana parishes which border the river below Baton Rouge enjoy direct economic benefits from the project. However, the volume of commerce serviced by this deep-water channel represents extended economic gain throughout the Mississippi River vally and the Nation.

A final Environmental Impact Statement on this project has been prepared by the U. S. Corps of Engineers, New Orleans District, and has been filed with the Council for Environmental Quality.

1.08. Construction works are summarized in Table 1.

1.09. The estimated benefit-cost ratio of the Mississippi River levees and channel improvement is 10.6 (see attachment following appendices).

2. ENVIRONMENTAL SETTING

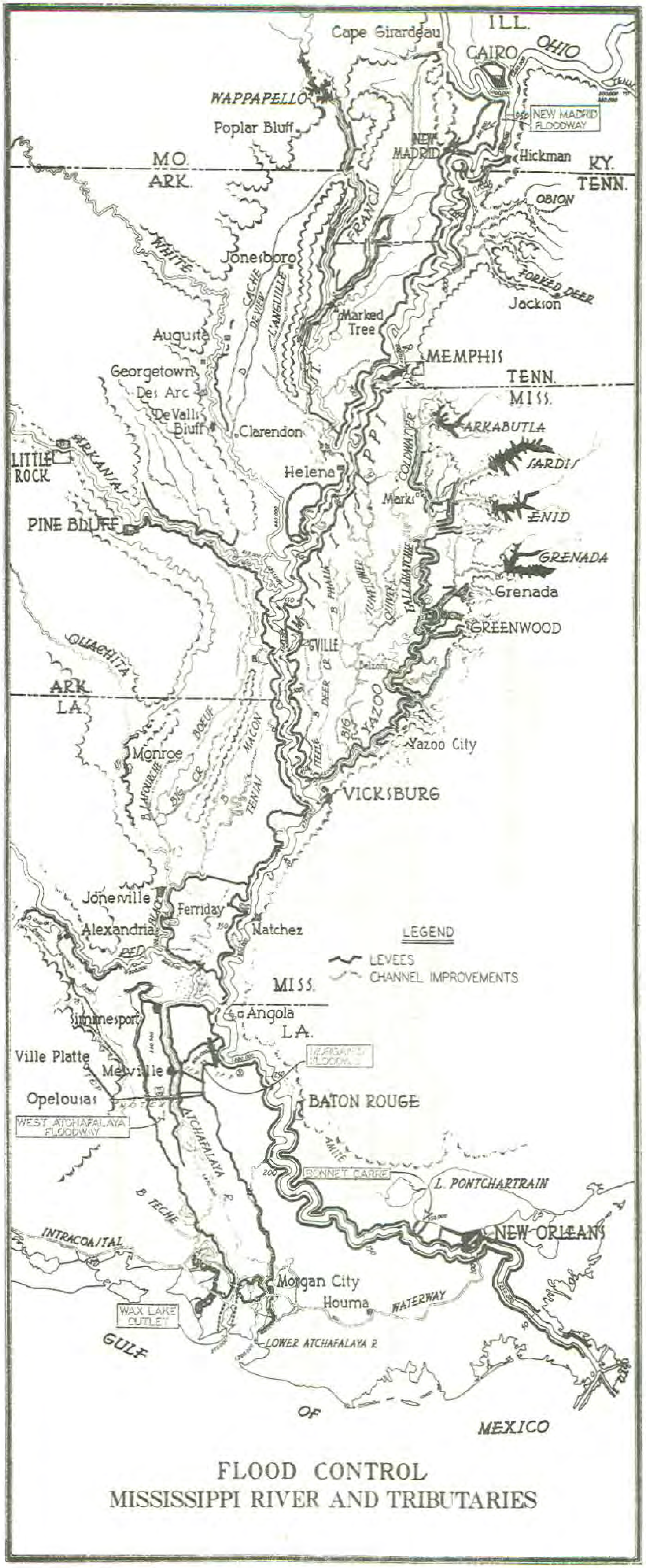
2.01. General. (Description of project area and study area)

a. The project and study areas, shown in Figure 1 and additional project map included in Appendix E, extend along the Mississippi River from Cairo, Illinois to Venice, Louisiana. The project area includes the mainstem Mississippi River, the Arkansas River between Pine Bluff, Arkansas, and the confluence with the Mississippi River, the adjacent land and waters between the mainline levees, and, in areas where there are no levees, the lands within the project flood flowline. The study area is located within the Lower Mississippi Region, defined by the U.S. Army Corps of Engineers to include the drainage area of the Mississippi River south of the Ohio River at Cairo, Illinois, except for the White, Arkansas, and Red Rivers above the effects of Mississippi River back-water and the Arkansas River downstream from Pine Bluff, Arkansas. The region also includes the Louisiana coastal area and the flood-protected area at Cairo, Illinois. In all, the region occupies portions of seven states: Arkansas, Illinois, Kentucky, Louisiana, Mississippi, Missouri, and Tennessee.

TABLE 1
LEVEE AND CHANNEL IMPROVEMENT FEATURES

District	Levees Below Projected 1973 Flowline (lin. mi.)	Dikes		Revetments		Foreshore Protection		Harbors (No.)	Floodgates (No.)
		In place 30 June 1973 No. locations/ lin. ft.	Additions Required No. locations/ lin. ft.	In Place 30 June 1973 No. locations/ lin. mi.	Additions Required No. locations/ lin. mi.	In Place 30 June 1973 No. locations/ lin. mi.	Additions Required No. locations/ lin. mi.		
Memphis	65*	56/478,000	93/496,000	98/314.0	41/41.0	0/0	0/0	5	2
Vicksburg	196	27/227,000	71/342,000	63/209.4	36/79.9	0/0	0/0	4	0
New Orleans	200	0/0	1/10,000	45/119.3	77/204.6	87/93.9	52/74.0	2	0
Total	461	83/705,000	165/848,000	206/642.7	154/325.5	87/93.9	52/74.0	11	2

* Includes the Long Lake and the Mud Lake Floodgates.



FLOOD CONTROL
MISSISSIPPI RIVER AND TRIBUTARIES

FIGURE 1

b. The lower Mississippi River region is located in the Central Gulf Coastal Plains, one of the major physiographic divisions of North America. The region contains three major land forms: the Alluvial Valley which constitutes the study area, the coastal plain uplands, and the coastal marsh area.

c. The Mississippi River Alluvial Valley averages approximately 60 miles in width. It projects inland from the Gulf of Mexico to the confluence with the Ohio River and gradually decreases in width upstream to about 40 miles at the confluence of the Ohio River. The Alluvial Valley is divided into a series of basins and sub-basins which have influenced development in the valley. Other prominent features include the steep bluffs that border portions of the valley and the uplands such as Crowleys and Sikeston Ridges which occur within the valley.

2.02. Physical Features of the Present Environmental Setting.

a. The River. The Mississippi River is the heart of the project area and its dominant water resource. In terms of navigation, the Mississippi River is unquestionably the most important river in the United States. Major barge traffic extends throughout the project area, and ocean-going vessels utilize the river upstream to Baton Rouge and beyond, transferring cargo at many intermediate points.

(1) The mean annual discharge of the Mississippi River below Tarbert Landing is approximately 451,000 cubic feet per second (1964-1973), or about 75 percent of the total flow discharged in the study region. The remaining 25 percent approximatley 150,000 c.f.s. is diverted from the Mississippi River to the Atchafalaya River through the Old River Outflow Channel.

(2) In addition to the flow received from the Ohio River and the portion of the Mississippi River above Cairo, the lower Mississippi receives inflow from the tributaries between Cairo, Ill., and the Gulf of Mexico.

(3) Because of its own high annual runoff and the flow of large rivers that enter it from other areas, the Lower Mississippi Region has great groundwater potential. It contains some of the most extensive and productive aquifers in the United States, most of which are capable of yielding at least 50 gallons per minute (GPM) of fresh water containing not more than 200 parts per million (ppm) of dissolved solids to individual wells. Exceptions are in north central Louisiana, where the area is underlaid by tightly consolidated rocks of early Tertiary age, and the coastal areas of Louisiana, where much of the groundwater is saline.

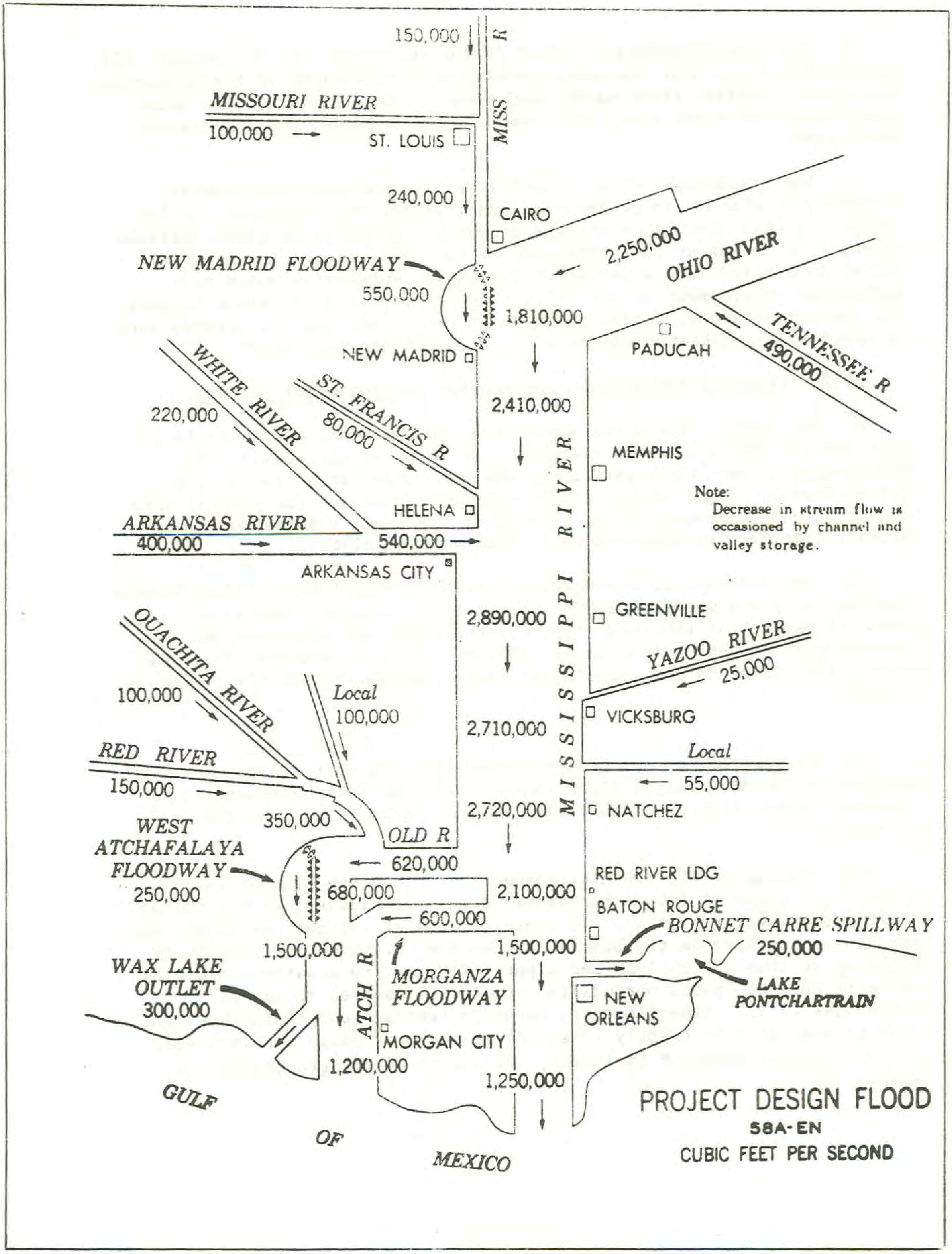

150,000
MISS R
MISSOURI RIVER
100,000
ST. LOUIS
240,000
CAIRO
2,250,000
OHIO RIVER
NEW MADRID FLOODWAY
550,000
1,810,000
TENNESSEE R
490,000
PADUCAH
NEW MADRID
WHITE RIVER
220,000
ST. FRANCIS R
80,000
2,410,000
MEMPHIS
Note:
Decrease in stream flow is occasioned by channel and valley storage.
HELENA
ARKANSAS RIVER
400,000
540,000
ARKANSAS CITY
MISSISSIPPI RIVER
2,890,000
GREENVILLE
YAZOO RIVER
25,000
OUACHITA RIVER
100,000
Local
100,000
2,710,000
VICKSBURG
Local
RED RIVER
150,000
55,000
WEST ATCHAFALAYA FLOODWAY
250,000
350,000
2,720,000
NATCHEZ
OLD R
620,000
680,000
2,100,000
RED RIVER LDG
BATON ROUGE
600,000
BONNET CARRE SPILLWAY
250,000
1,500,000
1,500,000
WAX LAKE OUTLET
300,000
ATCH R
MORGANZA FLOODWAY
NEW ORLEANS
LAKE PONTCHARTRAIN
MORGAN CITY
1,200,000
1,250,000
GULF
OF
MEXICO
PROJECT DESIGN FLOOD
58A-EN
CUBIC FEET PER SECOND

FIGURE 2

(4) Principal aquifers in the region are beds of coastal plain sands and locally occurring gravels. Groundwater throughout the region is abundant and at generally shallow depths. Supplies of deeper artesian water are available throughout most of the region, and, in many locations, from more than one waterbearing formation. In some areas of the region, such as St. Tammy Parish in southeastern Louisiana, fresh water has been encountered at depths of more than 3,500 feet.

b. Other Water Bodies.

(1) The water resources of the project area include the mainstem Mississippi River, 25 tributary streams and 242 major lakes of 20 acres or more in size. The majority of these 242 lakes in the project area are located in the middle portion of the project area. The largest of these is Raccourci-Old River in Pointe Coupee Parish, La., with 4,160 acres. The Louisiana portion of the study area includes 67 major lakes, 4 of which have an area of more than 1,000 acres: Yucatan Lake in Tensas Parish (2,000 acres), Marengo Bend (1,158 acres) and Glasscock Lake (2,310 acres) in Concordia Parish, and Palmyra Lake (1,150 acres) in Tensas Parish. One hundred eleven of the 242 lakes in the study area are located in Mississippi, the largest of which are Lake Mary in Wilkinson County (2,250 acres), Tunica Lake in Tunica County (3,152 acres), DeSoto Lake in Coahoma County (1,525 acres), Lake Whittington in Bolviar County (3,564 acres), and Lake Lee in Washington County (1,800 acres). Arkansas contains 44 major lakes, the largest of which are Horseshoe Lake in Crittenden County (3,036 acres), Council Lake in Lee County (960 acres), Millwood Lake in Phillips County (810 acres), and Paradise Lake in Chicot County (900 acres). The remaining lakes are located in the Tennessee, Kentucky, and Missouri portions of the study area. Most of these lakes are relatively small. Other water bodies include tributaries, low-lying inundated areas, borrow pits, and harbors.

(2) There are 25 tributary streams, 8 of which are considered major. The larger streams and rivers have their confluences with the Mississippi River in the center of the project area, in the large Arkansas and Mississippi alluvial plain. St. Johns Bayou in New Madrid County is the only tributary stream in Missouri and is relatively small. Mayfield Creek in Carlisle County, Obion Creek, and Bayou Du Chien in Fulton County, all relatively small, are the only tributaries in the Kentucky portion of the area. Tennessee contains seven of the tributaries found in the study area. These are located in Dyer,Lauderdale, and Shelby Counties. Both the Obion River and the Hatchie River are major tributary streams. Arkansas contains only three tributary streams, all of

which are major tributaries, in the study area. They include St. Francis River in Phillips County and the White and Arkansas Rivers in Desha County. Nine tributary streams occur in the Mississippi portion of the study area in Claiborne, Warren, Jefferson, Adams and Wilkinson Counties. The Yazoo River in Warren County, the Big Black River in Claiborne County, and the Homochitto River in Adams County are major tributary streams. Louisiana contains two Mississippi River tributaries, neither of which are of major importance, and several outflow channels, which include Morgan City-Port Allen Waterway, Intra-coastal Waterway, Harvey Canal, Algiers Canal, Old River Control Structure, and Baptiste Collette Bayou.

(3) Inundated lowlands in the Lower Mississippi River region can be divided into three categories: riverines, fresh to brackish wetlands, and saline wetlands. Riverines are concentrated in low, poorly drained areas of alluvial sediments along the river's flood plains. They are subject to frequent and prolonged flooding as a result of local rainfall, stream overflow and backwater flooding (1). Fresh to brackish wetlands and saline wetlands are generally located landside of the Mississippi River levees and are not included in the detailed project area. Low-lying inundated areas cover a large portion of the land along the Lower Mississippi River between Vicksburg and Baton Rouge and in the delta. In the project area between Baton Rouge and Venice, low-lying inundated areas are not prominent because of relatively thin strips of batture land between the levees and the main stem river. However, there are extensive low-lying inundated areas landside of the levees along this section of the river. Water bodies less than 20 acres in size cover approximately 40,600 acres. This acreage consists primarily of borrow pits that generally occur riverside of the levee. Some of the borrow pits are constantly filled with water, while others hold water only during periods of high flow.

(4) Harbors included in the project area are located along the main stem of the river, such as Hickman, Ky., and New Orleans, La., or on a water body associated with the Mississippi such as a chute (Tennessee Chute, Memphis Harbor) and tributaries (Yazoo Diversion Canal, Vicksburg Harbor).

2.03. Water Quality.

a. The seven states in the study area have established water quality criteria applicable to the Mississippi River, including minimum dissolved oxygen concentration, allowable pH range , maximum rate of pH change, maximum temperature and rate of temperature change and maximum coliform number. Other regulated parameters include specific conductance, dissolved solids, hardness, sulfate, chloride, fluoride, and color. The established water quality criteria for six of these states are summarized in Table 2. Water quality criteria for Illinois are not included in Table 2 as the state was excluded in the source document (1).

TABLE 2

STATE WATER QUALITY CRITERIA FOR MISSISSIPPI RIVER

Parameter	State					
	Louisiana	Mississippi	Arkansas	Tennessee	Kentucky	Missouri
Dissolved Oxygen (Minimum) mg/1	4	4	4	5[a]	6[a]	5
pH (Range) Units	6.5-9.0	6.0-8.5	6.0-9.0	6.5-8.5[a]	6.0-9.0	6.5-9.0
pH (Maximum Change/24HRS)	-	-	1	1	-	-
Temperature (Maximum)	34^{o}c	34^{o}c	34^{o}c	30.5^{o}c	31.7^{o}c	32.2^{o}c
Temperature (Maximum Change/24HRS)	3^{o}c	5.5^{o}c	2.8^{o}c	2.8^{o}c	2.8^{o}c	2.8^{o}c
Coliforms Colonies (Per 100ml)	11600[c]	-	5000[c]	1000[c]	1000[c]	2000
Specific Conductance (Maximum Microohms/cm)	-	1000	-	-	800	-
Dissolved Solids (Maximum Monthly Average) mg/1	-	750	-	500	500	-
Hardness (Maximum) mg/1	225	-	-	-	-	-
Sulfate (Maximum) mg/1	100	-	-	-	-	-
Chloride (Maximum) mg/1	75	-	-	-	-	-
Color (Maximum) mg/1	50	-	-	-	-	1.2
Fluoride (Maximum) mg/1	-	-	-	-	-	1.2

a Based on aquatic life classification.
b Maximum monthly average or less than 5,240 in 20% of samples per month.
c Maximum monthly average or maximum in 20% of samples per month.

b. Comparison of water quality values from Mississippi River to the water analysis criteria reported in Table 1 indicates that the lower Mississippi River water quality generally meets state standards. A strict comparison of the values is difficult to make, however, for two reasons. First, the dynamic nature of the river causes its characteristics to change with location on the river as well as with time at a given location. Second, analytical methods used to determine the water quality values do not correspond in all cases to methods suggested by the individual states for determining compliance with their criteria. However, several trends in surface water quality were observed. The concentration of iron was found to vary a great deal along the river. Upstream average concentrations were 885 ug/l (micrograms per liter) and downstream concentrations were 28 ug/l. The calcium bicarbonate, sulfate and magnesium concentrations, pH and total alkalinity varied only slightly along the river. Downstream increases were found in chloride and nitrate concentrations as well as in specific conductance. The upstream average dissolved oxygen concentration of 8.5 mg/l was found to drop to an average of 7.7 mg/l between St. Francisville and New Orleans, a drop which may be attributed to oxygen consuming wastes discharged to the river in the region.

c. The Mississippi River between St. Francisville and New Orleans, shows the effect of industrial and municipal waste discharges. Inorganic wastes amounting to approximately 20,000 tons per day and organic wastes of about 500 tons per day are discharged into the Mississippi River. The effect is an increase in chloride, sulfate, sodium, calcium, and dissolved solids concentrations with a corresponding decrease in dissolved oxygen content.

d. The total coliform average was 13,978 colonies per 100 ml and the total fecal coliform was 4,097 colonies per 100 ml. These values were determined, however, from samples taken during periods of below average discharge at each sampling point. Greater dilution and, therefore, a lower count, may occur during higher flow periods.

e. In determining surface water quality, consideration was also given to the effect of the major tributaries on this portion of the Mississippi River. Water quality of the tributaries was comparable to that of the Mississippi River with the following exception. Dissolved oxygen content of Arkansas, White, and Loosahatchie Rivers was in excess of 8.2 mg/l, the average low flow concentration in the Mississippi River. In addition, the St. Francis and Hatchie Rivers displayed dissolved oxygen content between the minimum level established by the states but below 8.2 mg/l of the Mississippi River, while the Wolf River had a low flow dissolved oxygen average above the minimum set for Tennessee. The Hatchie River was also found to have average pH values below Tennessee's standard range. Nonconnah Creek, a minor tributary, did not meet state standards for pH, dissolved oxygen, and dissolved solids.

f. Chemical and physical data taken in 1973 indicated that the Obion and Forked Deer Rivers can be characterized as having comparatively low pH, dissolved oxygen concentration below saturation, and relatively low alkalinity and hardness. Samples taken in 1972 and 1973 showed very high turbidity and total phosphate measurements. Waters in these rivers receive pollution effluent from sewage treatment and industrial plants, agricultural fertilizer runoff, and to a small degree, livestock which contribute to organic pollution (30).

g. Typical water quality of permanent lakes has also been determined. The average turbidity of these lakes is 21 mg/l. The pH of the lakes averaged 7.7 pH units and varied only slightly from one lake to another. The average concentration of dissolved solids is 146 mg/l, with little variation noted. The specific conductance of waters, a good indicator of the amount of dissolved solids present, averaged 243 microohms/cm. The dissolved solids content is usuall about 62.5 percent of the conductance, which if applied to the collected data would be 152 mg/l. The concentration of dissolved oxygen averages 6.5 mg/l and varies from a high of 7.9 mg/l to a low of 4.8 mg/l. This parameter is partially dependent upon the temperature and depth. Groundwater tends to be harder and have a higher mineral concentration and lower nitrate and BOD concentrations than surface water in the project area. There may be some local dilution of groundwater during flooding which may have a temporary effect on its quality.

2.04. Climatology.

a. The climate of the study area varies from humid and subtropical in the lower portion to humid and continental in the upper portion. The region is generally protected from polar continental air masses by the Appalachian and Ozark Mountains, and is subject throughout its entirety to the warm Atlantic tropical air stream. Precipitation ranges from approximately 40 inches annually in lower Missouri to 64 inches annually along the Louisiana coast. Damaging floods occur on the average of two to four times a year in the northern portion of the region, and from three to five times a year in the southern portion.

Tropical storms, tropical depressions, and hurricanes are especially damaging along the coastal area between May and October. Snowfall in the region is very light and has little or no effect on the hydrology of the area, however, snow melt from upstream drainage areas does contribute to spring floods in the study area. Hail storms are not a major problem, but glaze storms occasionally occur from Baton Rouge northward.

b. The average annual temperatures range from approximately 60^{o} F in the upper region to 70^{o} F in the lower region. Temperature averages for January are 40^{o} F and 55^{o} F for the upper and lower regions, respectively, while July has average temperatures of 80^{o} F in the upper region and 82^{o} F in the lower region (2). Temperature variations and extremes are presented in Table 3.

c. The absolute and relative humidities are high throughout the region, producing sultry weather conditions during summer months. Precipitation records are presented in Table 4.

d. The southern part of the region below Baton Rouge experiences periods of torrential rains and high intensity winds from May through October, which is considered to be the hurricane season (3). The remainder of the region experiences heaviest rainfall during late winter and early spring. The region is also subject to a high frequency of tornadoes, with maximum occurrence in spring.

2.05. Geology.

a. The lower Mississippi River region is located in the Central Gulf Coastal Plain, one of the major physiographic sub-divisions of the North American continent. The Gulf Coastal Plain developed primarily as a result of a general slow outbuilding of shallow-water deltaic deposits during a number of marine encroachments onto the continental land mass during the Mesozoic and Cenozoic Eras of each history. These deltaic deposits together with the marine sediments deposited by the seas formed the continental shelf areas of the ancient oceans. Although the development of the Coastal Plain was affected by a series of marine encroachments, the existing Gulf Coastal Plain generally represents the erroded remains of the continental shelf left behind by the gradually retreating oceans. Existing structural features of the continental land mass and later tectonic adjustments such as downwarping along the axis of the Mississippi Structural Trough have also influenced the development and configuration of the Central Gulf Coastal Plain. As a result of its mode of origin, the Central

Gulf Coastal Plain is a region of low topographic relief characterized by gently rolling hills and relatively level areas situated at elevations well below the Paleozoic uplands which border the Gulf Coastal Plain. Elevations in the Gulf Coastal Plain range from approximately 500 feet msl near the border with the Paleozoic uplands to near sea level at the southern limits of the area. Abrupt relief of more than 200 feet within the Gulf Coastal Plain is somewhat uncommon. The materials which comprise the Central Gulf Coastal Plain overlie marine sediments (usually limestones, shales and sandstones) of Paleozoic age which dip with increasing steepness towards the Gulf of Mexico. Sediments of the Gulf Coastal Plain consist primarily of unconsolidated sand, clay, gravel, loess and glacial materials which usually dip gently southward at about ten to thirty feet per mile.

Portions of the study area represent all three of the principal physiographic sub-divisions of the Central Gulf Coastal Plain. These are 1) the alluvial valley, with meander belt ridges and backswamp lowlands, 2) the coastal plain uplands which lie just beyond the limits of the alluvial valley and 3) the coastal marsh area extending along the Louisiana coast and stretching about 50 miles inland from the Gulf of Mexico.

Gulf Coastal Plain is a region of low topographic relief characterized by gentle rolling hills and relatively level areas. [illegible] [illegible] [illegible] the relatively uplands which border the Gulf Coastal Plain. Elevations in the Gulf Coastal Plain range from approximately [illegible] feet near the border with the [illegible] to sea level at the [illegible] margin of the area. Average [illegible] is no more than [illegible] within the Gulf Coastal Plain is somewhat [illegible]. The materials which comprise the [illegible] [illegible] [illegible] primarily [illegible], [illegible] and sandstones of [illegible] which dip with increasing gradients towards the Gulf of Mexico. Sediments of the Gulf Coastal Plain [illegible] [illegible] [illegible] [illegible] [illegible].

Portions of the study area [illegible] of the [illegible] [illegible] of the [illegible]. These [illegible] alluvial valleys [illegible] [illegible] which [illegible] beyond the limits of the [illegible] [illegible] [illegible] along the [illegible] [illegible] miles [illegible] the Gulf of Mexico.

TABLE 3
TEMPERATURE VARIATIONS AND EXTREMES

Station	January		July				
	Aver. Daily Minimum (°F)	Aver. Daily Maximum (°F)	Aver. Daily Minimum (°F)	Aver. Daily Maximum (°F)	Minimum Recorded Temp. (°F)	Maximum Recorded Temp. (°F)	Period of Record (Yrs.)
Cairo, Ill.	30.2	44.6	71.8	90.3	-5	104	29
Vicksburg, Ms.	40.5	57.4	73.2	90.4	2	101	29
Baton Rouge, La.	42.3	63.5	73.4	92.0	10	102	13
New Orleans, La.- Airport	44.8	64.4	72.6	90.6	14	100	25

TABLE 4
PRECIPITATION VARIATION AND EXTREMES

Station	Normal			Extremes		
	Ave. Wettest Month (inches)	Ave. Driest Month (inches)	Ave. Annual (inches)	Wettest Month (inches)	Driest Month (inches)	Maximum in 24 hours (inches)
Cairo, Ill.	4.79	2.88	45.23	14.95	Trace	7.56
Vicksburg, Ms.	5.73	2.04	49.50	16.58	Trace	9.97
Baton Rouge, La.	6.27	2.45	54.46	14.51	0.06	12.08
New Orleans, La.- Airport	6.72	2.84	53.90	19.09	0.00	9.86

(1) The steep bluffs that border extensive portions of the alluvial valley are probably the region's most prominent geomorphic feature. These bluff escarpments range from 75 to 200 feet above the flood plain on the eastern side, and from less than 50 to 150 feet on the western side.

(2) A number of upland ridges constitute another landform of the region. Most prominent is Crowley's Ridge, which rises above the surrounding floodplain with a width of up to 10 miles. It extends from the head of the valley to Helena, Arkansas. Other highlands include Sikeston, Walnut, and Macon Ridges.

(3) The alluvial valley is generally divided into a series of drainage basins which have heavily influenced developmental patterns in the region. These basins developed as drainage patterns within the alluvial valley matured, having been influenced by pre-existing geologic features and the configuration of pre-historic drainage. These drainage basins are delineated by meander-belt ridges and intervening backswamp or flood-basin lowlands. The meander-belt ridges are, in reality, natural levees formed by deposition of sediments during high stream stages. As a result, the more fully developed natural levees, such as those of the Mississippi River, have occasionally served to influence the location and development of tributary streams.

(4) Development of the physical characteristics of the alluvial valley and of the course of the Mississippi River has been influenced by pre-existing geologic conditions, such as the nature and configuration of the underlying bedrock and amount and type of sediments available to be carried into the alluvial valley by tributary streams. Although pre-existing geologic conditions influenced the location of the Mississippi River and helped to shape the alluvial valley, the influence of such conditions upon the present river system is probably limited to local reaches, since the Mississippi River is presently situated on a flood plain built up by deposition of sediment from the river itself.

(5) Tectonic processes operating in the mid-continent area have also affected the development of the Mississippi River and the alluvial valley. The presence of two major downwarps, the Mississippi Structural Trough and the Gulf Coast Geosyncline have probably influenced the development of the existing river system. Although the exact role which these structural features have played in determining the position of the river is not thoroughly understood, the present Mississippi River course roughly coincides with the axis of the Mississippi Structural Trough while the Gulf Coast Geosyncline may have influenced the distribution of deltaic deposits at the mouth of the river. Lesser structural features such as the Monroe Uplift (in the vicinity of the Arkansas-Louisiana boundary), the Jackson Dome (near Jackson, MS), and the Southern Mississippi Uplift have probably influenced the general location of the river to some extent.

b. The Lower Alluvial Valley of the Mississippi River, which ranges from about 30 to 80 miles in width, lies within the central portion of the Central Gulf Coastal Plain. The Central Gulf Coastal Plain is a regional physiographic sub-division of the southern United States and includes parts of Alabama, Mississippi, Louisiana, Arkansas, Texas, Tennessee, Kentucky, Missouri and Illinois. North of the 34th parallel, the Central Gulf Coastal Plain narrows considerably to a width of about 280 miles and projects northward for a distance of about 225 miles to the confluence of the Ohio and Mississippi Rivers. This projection, generally referred to as the Mississippi Embayment, gradually decreases in width northward to a width of about 100 miles near Cairo, Illinois.

c. Much of the Gulf Coastal Plain topography consists of alternate hill and valley regions, or belts. These belts have been formed by the erosion of gently dipping beds of differing resistance. The resistant beds from the outcrops along the hill belts and the less resistant rocks form the valley belts. This belted topography parallels the margin of the embayment and coastal plain, although the continuity of the belts is broken by the Mississippi River Valley.

d. The slope and surface distribution of strata within the Mississippi Embayment result from the Mississippi Structural Trough which has a general southwest trend within the Mississippi Embayment. Near Yazoo City the trough axis curves eastward around the Monroe Uplfit, but in southwestern Mississippi, it curves westward around the Southern Mississippi Uplift.

e. South of the embayment, underlying the coastal plain, is the east/west trending and deeply downwarped Gulf Coast Geosyncline, the major structural feature of the Gulf Coast. It lies close to the coast line and continues westward from Louisiana through Texas. The thickest sedimentary deposits in the coastal plain are found along the axes of the two major troughs, that is the east/west Gulf Coast Geosyncline and the north/south Mississippi Structural Trough.

f. Fisk (4) made the following conclusions concerning the Lower Mississippi Alluvial Valley:

(1) The configuration of the alluvial valley is to a large extent determined by the distribution and structure of the strata in the Central Gulf Coastal Plain.

(2) The Mississippi River is a relatively recent event in the history of the Gulf Coastal Plain. It did not exist until early glacial time, at which time the streams of the central lowlands of the United States were diverted southward by the advance of the glaciers.

(3) Remnants of as many as four ancient flood plains each exhibiting characteristics similar to the present alluvial surface but situated at

successively higher elevations suggest that the Mississippi River has occupied alluvial plains at these higher elevations during post-geologic time and that each ancient flood plain was slowly eroded by down-cutting caused by a lowering of sea level and a new flood plain established when sea level became stable. These ancient flood plain remnants or terraces correlable with the periods of stable sea level between the four North American ice ages. The periods of erosion which created the terraces correspond to periods of lowered sea level which occurred during the glacial advances.

(4) The lower sea level which resulted from the last glacial advance on the North American continent - the Wisconsin glaciation - increased the existing stream gradient and caused the Mississippi River system to erode large amounts of material from the continent and to form an entrenched valley system.

(5) The rise in sea level and corresponding decrease in stream gradient which followed the retreat of the Wisconsin glacier caused the streams of the entrenched valley system to gradually lose sediment carrying capacity. As a result, large amounts of gravel and coarse sand were deposited by the streams in the floor of the entrenched valley. Further loss of sediment carrying capacity caused the streams to deposit finer materials - fine sands, silts and clays - above the coarser materials. This depositional process gradually filled the entrenched valley system with sediment and resulted in the typical present-day alluvial sequence of an alluvial sub-stream composed of coarse sands and gravels overlain by an impervious topstratum of silts and clays.

(6) Tributary streams have controlled the type of alluvium deposited and the manner in which the entrenched valley had been filled. Alluvial sand deposits radiate from the mouths of the tributary valleys and comprise the greater part of the alluvium. These fans control the flood plain drainage and determine the nature of the sediment which reaches the mainstem river.

(7) The occurrence of widespread alluvial fans at the confluence of the mainstem and various tributaries is the result of the dissipation of tributary stream volume due to widening of the tributary valley at the confluence.

(8) Remnants of the alluvial fans above the present flood level around the mouth of each tributary valley indicate a recent entrenchment of streams.

(9) The entrenchment of streams resulted in the readjustment of drainage to the present sea level and diversion of the Mississippi River from its course west of Crowley's Ridge to its present confluence with the Ohio River.

(10) The present character of the drainage results from the integration of the stream system by a long and complicated series of shifts of the tributaries and main streams.

g. The Mississippi River can presently be described as a sinuous stream with a length nearly twice that of the alluvial valley in which it flows. The river experiences high flood stages and has developed natural levees. These levees tend to be highest on the outside river bends which increases flood capacity and, therefore, the efficiency of the channel. The depth of the low water channel increases southward as the slope of the valley decreases. The nature of the present stream is determined by three principal factors: (1) discharge, (2) valley slope, and (3) character of the alluvium through which it flows. A fourth factor is the entrance of tributary streams, since they contribute to the alluvium carried by the mainstem. The mainstem reflects the composite effect of these factors. Fisk (4) made the following conclusions on the character of the present Mississippi River:

(1) The character of the Mississippi River reflects the type of sedimentary materials through which it flows.

(2) The slope of the combined Mississippi/Ohio Rivers in the northern part of the valley is the lowest slope which the Mississippi River has attained. It is the slope developed by the Ohio River before the diversion of the Mississippi to its present confluence with the Ohio.

(3) Because both sea level and the location of the confluence of the Mississippi and Ohio Rivers has remained relatively stable since the end of the Wisconsin glaciation, the Mississippi River has become poised and is neither agrading or degrading to any significant degree.

(4) The principal factor controlling the meandering of the river is the character of bank materials.

(5) The present natural Mississippi River channel alignment is the most efficient for both flood control and navigation.

h. The material - or alluvium - which has been deposited by the river since the end of the Wisconsin glaciation now fills the entrenched valley system. The alluvium is a heterogenous collection of deposits but in general consists of a pervious substratum of gravels and coarse sands which is overlain by a relatively impervious topstratum of silts and clays. The coarser materials such as gravels and coarse sands usualy occur at the base of the substratum and the materials become progressively finer upward with fine sands usually occurring near the upper part of the substratum. The quantity of gravel and coarse sand increases with distance from the Gulf of Mexico. Although the thickness of the alluvial substratum varies somewhat, the substratum sequence underlies the entire Lower Mississippi Alluvial Valley and constitutes an aquifer of engineering significance in the design of levees and other hydraulic structures. The fine sands of the upper substratum grade irregularly upward into the silts and clays of the topstratum. The topstratum, including the immediate surface, is usually the most important part of the alluvium in terms of engineering and environmental considerations. The physical properties, distribution and thickness of the topstratum materials are important considerations related to the character of the river and, in turn, to any land uses considered along the river. The substratum and topstratum each are of varying thickness depending upon location and type of alluvial deposit. However, the entire alluvial sequence averages approximately 125 feet thick, ranging in thickness from a few feet near the head of the alluvial valley and along the extreme eastern and western edges of the valley, to more than 350 feet near the Gulf of Mexico.

i. Geomorphic features in the alluvial valley are closely associated with alluvial materials deposited in varying alluvial environments of deposition. Natural levees are created by deposition during stream overflow and usually comprise the highest parts of the floodplain near the stream channel. Natural levees consist of silts, silty sand, and clay. Point bars, low ridges built up by migrating river bends, are common in the study area. The point bar deposits are usually sandy but may include deposits of silt and silty clay and may be covered with laminated silty clay. Swales, low areas which alternate with the point bar ridges following the curvature of the old river bends, are usually filled with clay and silty clay. Abandoned meander loops form oxbow lakes which generally later fill with fine silt and clay and become low swampy areas. Further filling of the abandoned channels produces a "clay plug." abandoned stream courses produce similar swampy areas although the longer abandoned stream courses usually become filled with interbedded clay, silt and fine sane. Backswamp areas, low areas beyond the limits of the natural levees, usually become filled with thinly laminated clays and silty clays with high proportions of organic material.

j. The sand and gravel deposits of the alluvial substratum comprise an important aquifer throughout most of the Lower Mississippi River Alluvial Valley. Although largely undeveloped, the alluvial aquifer is capable of yielding large amounts of groundwater for irrigation and industry or, when properly treated, for minicipal use. The recent alluvial sequence is underlain by sedimentary formations of Palezoic and Cretaceous age in the extreme northern part of the study area and by sedimentary formations of Tertiary age in the central and southern portion of the study area. The suballuvial formations comprise a varied lithology including gravels, sands, sandstones, clays, limestones and lignites. Many permeable zones of varying thickness within the suballuvial sequence are capable of yielding good quality groundwater in quantities ranging from a few gallons per minute to several hundred gallons per minute. Some suballuvial aquifers are important only locally while some (principally those of Tertiary age) comprise important, highly developed sources of groundwater for a large region.

(1) Quality and availability of groundwater in the suballuvial aquifer is influenced by several factors, including character, thickness and areal extent of the aquifer. Other factors which may influence groundwater are the presence of confining beds and relationship of the aquifer to structural anomalies such as faults or uplifts.

(2) Groundwater levels in the alluvial aquifer throughout the project area are directly influenced by river stage and by seasonal changes. Alluvial groundwater levels are also influenced to a lesser

extent by relationships of the various types of alluvial deposits, local and regional elevation, and withdrawal by pumping. During normal river stages, groundwater levels along the Mississippi River usually exist at about the same elevation as the river and slope slightly upward with distance from the river. High river stages reverse this condition, however, and significantly elevate the groundwater table for several miles on each side of the river and, when water is impounded against the levees, the piezometric surface may exist above the ground surface over an extremely large area landside of the levee. This condition causes groundwater or "seepage" to stand on the land surface for extended periods, causing damage to agricultural operations, roads, and structures.

(3) Precipitation is dependent on seasonal changes. Generally, the heaviest rainfall occurs from March to April and December through January, during which rainfall usually averages more than six inches per month. During other periods of the year, rainfall usually averages three to four inches per month.

(4) Penetration of rainfall into the alluvial aquifer is affected by topography (fast runoff) and by surface soil type. Penetration will be slowed and water will pool in areas of impermeable top soil such as clay; where top soil is permeable (sand and gravel), penetration may occur quickly enough to form local highs in the water table.

(5) The loss of water or lowering of the water table in the alluvial aquifer by evaporation is dependent on seasonal weather patterns and the relative location of the water table to the ground surface. In the coastal areas of the Mississippi River where the ground water level is near the ground surface, loss due to evaporation can be appreciable; however, since continuous flows help maintain the water tables, the ground water level is not appreciably affected. Where the ground water level is more than one or two feet below the surface, evaporation does not have a significant effect on water levels.

(6) Transpiration can have a considerable effect on the water table level where vegetation draws on water at or below the water table or where the ground water level is several feet below the surface and vegetation prevents a significant portion of surface water from penetrating to the ground water level.

(7) Withdrawal by natural (groundwater flow into a tributary) or artificial means (pumping) can appreciably lower the water table temporarily or permanently. In general, this has not occurred in the alluvial aquifer along the mainstem Mississippi River although local conditions have been noted in the Memphis District.

k. The plane and profile geometry of the Lower Mississippi is primarily related to natural factors including valley slope, discharges, sediment load and nature of bed and bank materials. Modification of river morphology may occur as the river reacts to man-made changes including cutoffs, dredging, stabilization and training structures.

l. The elevation of the alluvial valley surface of the Mississippi River at Cairo, Ill., is approximately 300 feet, m.s.l. The valley profile slopes approximately 0.8 foot per mile between Cairo, Ill., and Donaldsonville, La. The slope of the Deltaic plain itself exhibits a significant change in character as it averages 0.2 foot per mile to the Gulf of Mexico.

m. In general, steeper upstream slopes are reflected by a more divided flow which, in turn, is characterized by wide, shallow channels. The varying slope of the valley and the location of discharge into the Gulf of Mexico have influenced river length. The present meander belt is approximately 2,000 years old and it is believed that the combined flow of the Ohio and Mississippi Rivers has been in one channel from Cairo, Ill., to the Gulf of Mexico during this period.

n. The sediment load is dependent on discharge, slope, velocity, distribution and nature of bed and bank materials. The suspended load of silts and clays has little effect on channel geometry, with the exception of the delta marshlands, while coarse sediments, transported as bed load, have a significant effect. The processes of meander loop and bendway cutoff development indicate that channel geometry changes attributable to bed load migration are primarily local.

(1) The scarcity of sand deposits and meanders in the extreme southern reaches of the river in comparison with the northern reaches indicates that the Mississippi River contributes primarily fine sands and clays to the delta plain. Fine grained silt and clay materials are more resistant to bank erosion than are sandy materials. Hence, silt-clay banks, predominant in the southern reaches of the river are more stable and less conducive to meander loop development.

(2) The depth of river crossings is greatly affected by bed load migration. Crossings fill with sediments during periods of flooding, when the current sweeps sediments from point bars and redeposits them in the crossings. This presents a problem for river navigation when the river recedes and may require dredging to free the channel to river traffic. The channel will generally reopen when the main thread of current moves back into the deep channel trace and scours out the recent deposits in the crossings.

(3) In straight reaches of the river, sediments are not transported in as definite a pattern as in reaches with well developed meanders. In straight reaches, the channel tends to be more shallow, partially due to increased channel widths.

(4) The magnitude of sand transport varies yearly by locale. When flooding occurs, massive amounts are moved in bed load transport. During low stage flooding, low water channels in the recently deposited sands are reformed. The sand deposition and the low stage channel development may significantly affect bed forms and the cross section of the channel.

2.06. Man-Made Structures. Man-made structures and structural effects include those features and activities such as levees, dredging, dredge spoil disposal, channel improvements, and harbors which occur in the project area.

a. Levees. Levees on the west side of the river are nearly continuous in the project area except where major tributaries such as the Arkansas River enter. On the east side of the river, large gaps occur in Kentucky, Tennessee, Mississippi, and Louisiana and do not require levees because of the high relief. There are approximately 2,000 miles of levee along the Mississippi River.

Numerous public and private authorities have assumed responsibility for levee construction and have made intermittent changes in grade. Since the first flood control act passed by Congress in 1917, the Federal Government has been active in the construction and maintenance of levees within the project area. Physical characteristics of the levees are dependent on the nature of the river's flow and soil conditions at that location. Levee districts are responsible for maintenance of the levees, including maintaining suitable vegetation, replacing materials in holes and wash out areas and maintaining levee crown roads.

b. Dredging Operations. Dredging operations in the project area help maintain navigation depths in the river channel and harbors and, in some cases, assist in realigning the channel. At present, the navigation channel is maintained by periodic dredging of more than 100 areas of the river channel and habors between Cairo, Ill. and the Gulf of Mexico. Areas to be dredged are determined by periodic channel patrols which sound the depth of the channel. The number of crossings dredged as well as the amount of material displaced to maintain the channel is largely dependent on the river stage and the duration of low water stages. There is an average of 75 million cubic yards of material dredged annually. Removal of materials is usually accomplished by dredges with dustpan or cutterhead units capable of removing 3,500 to 4,000 cubic yards of material per hour.

At present dredge material is spoiled in the Mississippi River sufficiently near to operations to minimize costs and yet not interfere with the channel being dredged. Dredge spoils are a slurry and contain a larger volume of water than sediment. Analysis of water quality downstream of dredge operations indicates that the associated degradation of water quality is temporary and local in nature. Solids in the spoils consist of fine to coarse grained sands, gravel and debris, with grain size and type of material influencing the physical properties of the spoil. Organic materials, more prominent in the delta regions, are generally inferior in an engineering sense and may create an odor problem or a temporary depletion of dissolved oxygen during dredge operations.

c. Channel Improvements. Channel improvements include the placement of revetments and dikes to protect levees and to improve navigation conditions on the main channel. Dikes and revetments occur throughout the Lower Mississippi River but dikes are most prevalent in the Vicksburg and Memphis Districts where meandering is more of a problem. In the New Orleans District, the channel is deeply entrenched and revetments alone suffice to stabilize the banks and channel.

(1) The revetment is a mattress of concrete blocks held together by corrosion resistant wire fabric. The mattress is anchored to the prepared bank by plate anchors and generally extends to the deepest point of the channel. Approximately 643 miles of revetment had been installed along the lower Mississippi River as of 30 June 1973.

(2) By June 1973 more than 135 miles of various types of dike had been been constructed along the Lower Mississippi River in the Memphis and Vicksburg Districts. Dike systems in the New Orleans District are primarily restricted to the Southwest Pass. The systems in operation include stone, stone and pile, and pile dikes.

(3) River stabilization downstream of Baton Rouge is different from upstream due to the changed character of the river and the materials over which the river flows. Stage variations are lower and velocities are generally less than those concountered in upstream reaches. In general, the river acts as an estuary during low flows and as a large river during high flows. Though bank caving is slower below Baton Rouge, bank recession is still a major problem since the width of usable, extensively developed land is quite narrow. Hence, erosion of the foreshore between the river bank and the levees is critical. The most effective measure to retard foreshore erosion has been the concrete revetment and foreshore protection consisting of stone or broken concrete dikes aligned parallel to the bank line. These dikes break wave action and limit the amount of damage to the levees, and rebuild the foreshore by trapping sediment.

d. Harbors. Harbors considered in this study include Hickman, New Madrid, Memphis, and Helena in the Memphis District; Greenville, Natchez, Vicksburg, and Lake Providence in the Vicksburg District; and Baton Rouge and New Orleans in the New Orleans District.

(1) Harbors are generally located in developed areas near population centers where there is a requirement for port facilities to take advantage of river transportation. Harbor areas are industrial developments requiring extensive protection such as revetments, levees, and floodwalls, from high river stages and channel migration. Harbors require periodic dredging to maintain navigable conditions. Because of the lack of spoil disposal sites in developed harbor areas, spoil materials may be reintrained in the main channel during harbor dredging or other construction activities.

(2) Hickman Harbor is located at about river mile 922 in Fulton County, Kentucky. The harbor was constructed under the authority of Section 107 of the River and Harbor Act of 1960. Project dimensions include an improved channel 9 feet deep, 250 feet wide, and extending for 5,800 feet along the city front. Also included is a 600-foot turning basin. Principal commodities include grains, sand, gravel, lumber, and petroleum products.

(3) New Madrid Harbor is located in Missouri, north of New Madrid Bend between river miles 888 and 891. The harbor is situated along the outside bend of a large meander loop which partially encircles Toney's Towhead. The harbor is isolated from the main channel of the river by two bars. On the east side of the harbor is Morrison's Towhead, a bar approximately one mile long where the river side bank is protected by the Laforge Revetment. At the harbor entrance is an unnamed bar which is approximately 4.5 miles long and nearly one mile wide at its widest point. The bank of the harbor itself is protected by the New Madrid Revetment, the Rock Groins and the New Madrid Bend Revetment.

(4) Memphis Harbor is located in Tennessee south of the confluence of the Wolf and Mississippi Rivers between river miles 725 and 741. The harbor is divided into two sections, Wolf River Harbor and McKellar Lake Harbor. McKellar Lake Harbor is connected to the main channel by the Tennessee Chute.

(a) The Wolf River Harbor is on the northwest end of Memphis along the outside bend of the main channel. The harbor is protected by the Loosahatchie - Memphis Revetment.

(b) The McKellar Lake Harbor entrance is located at the southwest end of Memphis and is an extension of the Tennessee Chute, a channel which enters McKellar Lake at the south end of President's Island #45. The McKellar Lake Harbor is protected by the Tennessee Chute Revetment and by the President's Island Dike Retards.

(5) Helena Harbor is located in Phillips County, Arkansas, between river miles 659 and 663. The project provides for dredging and maintenance of the upstream 0.6 mile along the Helena waterfront to a 9-foot project depth, and for maintenance of a 9-foot access channel. In 1972 a total of 2,672,209 tons of cargo moved through the harbor.

(6) Greenville, Ms., Harbor is located on the east bank of the river between river miles 537 and 544. The harbor is situated on the east bank of Lake Ferguson, a meander loop that was the former channel for the Mississippi River. The harbor entrance is near the confluence of the Mississippi River and Lake Ferguson, about four miles southwest of the city of Greenville.

There are several bar deposits between the main channel and Lake Ferguson. These include Tarpley Neck, Point Chicot, Archer Island, LaGrange Towhead, and several smaller deposition areas that are unnamed. Within these deposition areas there are several named and unnamed lakes, including Archer Lake and Blue Hole. The bar deposits between the main channel and Lake Ferguson are, at their widest point, approximately 3 miles wide and extend for 7 1/2 miles.

(7) Vicksburg, Ms., Harbor is located on the east side of the Mississippi River between river miles 435 and 438. The harbor is situated along the outside bend of a main channel meander loop at the confluence of the Mississippi River and the Yazoo River Diversion Canal. Within the vicinity of the harbor, there are several large necks of land, including DeSoto Island, the result of the formation of the main channel Mississippi River, Centennial Lake, Yazoo Diversion Canal, and the Vicksburg Harbor Project. In addition, there are two unnamed bar deposits in the main channel west of the harbor entrance. Portions of the city are protected by a floodwall.

(8) Natchez, Ms., Harbor is located on the east bank of the Mississippi River between river miles 360 and 365. The harbor is situated on the outside bank of a relatively gentle bend in the main channel and is protected by the natural topography of the east bank of the river.

(9) Lake Providence, La., Harbor is located on the west bank of the Mississippi River between river miles 482 and 486. The harbor is situated in a secondary channel formed by Big Bar on the west side of the main channel. Within the vicinity of the harbor and on both sides of the river are several named and unnamed bars including Big Bar, Stack Island, and Ajax Bar. The harbor area is protected by main and secondary levees. Water filled borrow pits arranged in linear fashion extend for approximately two miles between the main and secondary levees.

(10) Baton Rouge, La., Harbor is located on both banks of the Mississippi River between river miles 225 and 235. The harbor is situated in a relatively straight reach of the main channel immediately downstream of a sharp bend in the channel at mile 235. Several inland waterways join the main channel at each end of the harbor. At mile 235, the Baton Rouge Harbor (Devil's Swamp) channel joins the main channel as does the Morgan City - Port Allen Intracoastal Waterway at mile 228. The harbor area is protected by a levee beginning at approximately mile 231 and continuing downstream past the harbor. In addition, the Port Allen and Arlington Revetments provide channel stability.

Baton Rouge Harbor (Devil's Swamp), authorized by the River and Harbor Act of 24 July 1946 and transferred to Flood Control, MR&T, under Flood Control Act of June 1948, provides a slackwater channel for barge traffic and an industrial expansion area for the port of Baton Rouge, Louisiana. Authorized channel dimensions are 12-foot depth, 300-foot width, and 5-mile length. Dredging of the first 2.5 miles of channel to project dimensions was completed 2 July 1959. The remaining 2.5 miles of authorized channel improvements would be completed when development of the initially constructed portion warrants expansion to project limits. No definite plans have been developed and, accordingly, if and when expansion to project limits is warranted, the EIS would be amended to reflect expansion plans and associated environmental impacts.

(11) New Orleans, La., Harbor is located on both banks of the main channel between river miles 86 and 105. The harbor is situated along a series of meander bends which include Carrollton, Greenville, Goldsboro bends and Third District Reach. Within the harbor, three waterways enter the main channel: Algiers Canal, Interharbor Navigation Canal, and Harvey Canal.

e. <u>Floodways</u>. Two floodways along the mainstem Mississippi River are considered in this report: the Birds Point-New Madrid Floodway in the Memphis District and the Bonnet Carre Floodway in the New Orleans

District. The primary purpose of a floodway is diversion of flows during flood stages, when specific areas may be threatened by inundation. The Birds Point-New Madrid Floodway would relieve a flood situation threatening Cairo, Ill., and was last operated in 1937. The Bonnet Carre Floodway, last operated in 1975, helps to protect the City of New Orleans and downstream areas from inundation.

(1) The Birds Point-New Madrid Floodway is located on the west bank of the Mississippi River below Cairo, Ill. The floodway includes approximately 200 square miles and is inclosed by levees with the exception of a 1500-foot gap at the lower end (App E, map 1-8(1)). This gap provides a drainage outlet and inlet for flood backwaters. Levees which inclose the floodway include the Birds Point-New Madrid front line and setback levees. The front line levee consists of an 11-mile long upper fuse plug section, a 5-mile lower fuse plug section, and the section separating the two fuse plugs. The floodway setback levee extends from Birds Point, where it joins the front line levee to the confluence of St. John's Bayou, and the Mississippi River near New Madrid. The floodway is designed to carry 550,000 c.f.s. during a project flood flow of 2,410,000 c.f.s. This capacity would lower the river stage at Cairo by approximately 7 feet. The floodway is intended to be in operation when the river stage at Cairo reaches 58 feet and >60 feet is projected on the Cairo gage. The floodway has been operated once, during the 1937 flood when the river stage at Cairo reached 58 feet.

The land use within the floodway is almost entirely agricultural with soybeans the dominant crop. This land use largely restricts noncultivated vegetative cover to grasses and shrub plants. Few tree stands occur. The restricted habitat type and extent is reflected by the limited number of faunal inhabitants. Statistics for deer harvest within the floodway counties remain constantly low. Borrow pits which occur in and adjacent to the floodway contain primarily rough fish although catfish, crappie, and bass are occasionally taken.

Operation of the floodway is expected to severely disrupt the biotic community. Plants would begin reinvasion within a comparatively short time after floodway operation. Fauna communities would not recover as quickly. The impact of floodway use would depress the social and economic status of the local area with the magnitude of impact directly related to the crop status and the number of residences flooded.

(2) The Bonnet Carre' Spillway is located near the site of the old Bonnet Carre' crevasse and in the straight reach of the Mississippi River approximately 25 miles above New Orleans, Louisiana. The width of the opening at the Mississippi River is 7,000 feet with guide levees gradually expanding to 12,400 feet at Lake Pontchartrain, approximately 6 miles away. The floodway covers about 62,000 acres and is designed to handle 250,000 c.f.s. It is designed to protect New Orleans from Mississippi River floods by discharging excess floodwaters into Lake Pontchartrain and thence into the Gulf of Mexico. The spillway has been operated five times (1937, 1945, 1950, 1973, and 1975).

The area of the spillway nearest the river has an abundant weed flora which is suggestive of disturbances through human activities. The central floodway is open with a few scattered trees and shrubs and is clothed with many weedy and wetland species. Trees near the batture are sandbar willow, black willow, roughleaf dogwood, cottonwood, and sycamore. Cypress-tupelogum swamp located on both sides of the floodway contains trees such as baldcypress, tupelogum, pumpkin ash, green ash, sweetgum, Nuttal oak, and Drummond red maple.

Animal life in the spillway is varied especially in the wetland portions. The borrow pits and to some extent the adjoining swamps contain largemouth bass, bowfin, gizzard shad, crayfish and smaller sunfish species. Also occupying similar habitat are numerous snakes, frogs and turtles. The swampy areas also provide excellent habitat for numerous waterbirds including egrets, herons, and ibises. Songbirds are found throughout the wooded portions of the spillway. Mammals known to be present include cottontail and swamp rabbits, raccoons, opossums, and squirrels.

In the event that rising river stages exceed 12.4 feet on the Carrollton Gage at New Orleans, Louisiana, with the probability that river stages will exceed 17.4 feet at Carrollton, dredging of the spillway forebay is performed. The dredged material is disposed of in the turbid swift river waters sufficiently riverward of the forebay to insure that those materials will be transported away from the site. In this reach of the river in the allowable time frame available for maintenance, the re-suspension and transport of sediment would impose minor environmental impact.

A number of impacts associated with spillway operations have been observed during and after past operations. Herbaceous plants are usually destroyed and revegetation occurs within 2-3 months. Some shrubs, such as eastern baccharis and elderberry, are also destroyed; however, no adverse impacts upon trees over 6 inches in diameter has been observed.

Operation of the spillway appears to enhance crawfish production. The area provides good sport crawfishing opportunity and the harvest is usually excellent after spillway operations. The impacts upon most inhabitants of the spillway are unknown; however, a migration of snakes out of the area has been observed.

Mississippi River waters discharged through the spillway suppress salinity levels in Lake Pontchartrain, Lake Borgne and Mississippi Sound. The areal extent of the influence is dependent upon the volume of water flowing through the structure and the duration of the operation. During periods of low salinity, many estuarine fishes and crustaceans migrate from the Lake Pontchartrain system as the salinity content decreases to a level below their respective tolerances. Accordingly, the number of fresh water organisms increases as the lake becomes favorable for their occupation. Sessile species such as commercial oysters cannot migrate to more favorable waters and many perish. Oyster mortality has been observed in Lakes Pontchartrain and Borgne and Mississippi Sound. However, the influx of river waters enhance oyster production on the oyster beds south of the area of mortality by reducing high salinities and supplying nutrients.

Historically, flooding of the Pontchartrain - Borgne Basin occurred each time the Mississippi River topped its natural levees. These occurrences provided sediments and nutrients to a dynamic eco-system and nourished estuarine flora and fauna. In essence, the discharge of Mississippi River water into the Lake Pontchartrain-Borgne-Mississippi Sound system by operation of the Bonnet Carre' Spillway influences short and long term benefits and detriments as did natural flooding many years ago.

f. <u>Pump Stations</u>. There are six pumping stations, four in the Memphis District and two in the Vicksburg District; Goose Pond, Cottonwood Slough, and two Cairo pumping stations in the Memphis District, and McKinney Bayou and Wilson Point pumping stations in the Vicksburg District. These stations are presently complete with the exception of the Cairo and Wilson Point stations. Pump stations relieve blocked drainage landside of the levees by pumping water over the levees into the main channel.

(1) The Goose Pond Pumping Station, authorized by the Flood Control Act of 1968, Public Law 90-483, is located approximately one mile north of the city of Cairo, Ill., adjacent to the Ohio River levee. The drainage area served by the facility covers approximately 910 acres and is included in the southern portion of the Cairo Drainage District. The area is surrounded by levees on the Mississippi, Ohio, and Cache Rivers and storm runoff waters are collected in a 111-acre

sump area, Goose Pond, from which they are discharged through a 48-inch gravity outlet with a maximum capacity of 120 c.f.s. to an elevation of 296.0 feet, m.s.l. Facilities include three pumps, currently scheduled for replacement, with a cumulative capacity of 110 c.f.s.. which are sufficient to provide protection against the 50-year frequency flood and seepage at 307.0 feet, m.s.l. The station is unattended, has no facilities for sanitary wastes, and is electrically operated to eliminate the need for fuel storage. A stilling basin at the discharge point has been provided.

(2) The Cottonwood Slough Pumping Station is located near Mound City in southern Illinois north of the confluence of the Mississippi and Ohio Rivers, near Cairo, Ill. Cottonwood Slough drains a major part of the Cairo Drainage District by a route through a culvert and gravity outlet in the Cache River levee to a 50 c.f.s. pumping station near the Ohio River levee. Waters are pumped over the project levee and discharged directly to the Ohio River. The Cache River, which was blocked by the construction of the Ohio River levee, has been partially diverted through a new channel to the Mississippi River. At present, runoff from the entire Cottonwood Slough area of approximately 4,620 acres overflows at high stages into the Goose Pond area. Approximately 1,829 acres are in the Cottonwood Slough flood plain. Cottonwood Slough overflows into Goose Pond at an elevation of 210.7 feet, m.s.l., on an average of once in three to four years.

(3) City of Cairo Pumping Stations are authorized by Public Law 90-483. Two new 65 c.f.s. pumping stations are being constructed on plots adjacent to existing facilities within the city. Also included in the plan is the improvement of the existing gravity outlet at 10th Street and the construction of a new gravity outlet at 28th Street. The existing outlet at 38th Street will be plugged; however, city officials will continue to maintain the existing pump for possible future use. New pumps are designed to correlate with the improved drainage/sanitary sewerage operations which have been adopted by the city. Improvements will enhance the drainage of approximately 1,300 acres.

(4) McKinney Bayou Pumping Station is in Tunica County, northwest Mississippi, at river mile 675 and about 40 miles south of Memphis, Tenn. The drainage area is 12 miles long and 3 miles wide with its major axis extending in a northeast-southwest direction. The west side of the drainage area is bordered by the east bank of the Mississippi River levee between miles 18 and 39. The McKinney Bayou Pumping Station is part of the Yazoo Headwater Flood Control Project. The project utilizes three 250-c.f.s. capacity pumps to drain 37 square miles. The project required excavation of 0.74 mile and

enlargement of 2.80 miles of McKinney Bayou Channel to reduce differences in two sump levels and provide maximum inflow for pumping. Pumped water is discharged into Tunica Lake through pipes across the top of the levee.

(5) The proposed Wilson Point Pumping Station was authorized by subparagraph (p) Section 10 of the Flood Control Act of 1946, Public Law 526. The proposed station is located on the west bank of the Mississippi River, 3 miles northeast of Lake Providence at river mile 490, at Wilson Point Frontline Levee approximate station 785+00 in East Carroll Parish, La. The station is part of the Mississippi River Levee Project and will consist of an improved inlet ditch from the Jack Falls Canal to the frontline levee, a 50-c.f.s. pumping station, an improved outlet ditch from the frontline levee to the Mississippi River, a 6-foot by 6-foot by 315-foot reinforced concrete box culvert, and a 2-lane bridge across the inlet ditch. The purpose of the project is to supplement existing facilities constructed by local interests to restore drainage for approximately 10,800 acres, which was blocked by construction of a setback on the controlling levee across Jack Falls Canal. The outlet ditch will empty into a natural drain to the Mississippi River one mile north of Lake Providence, La.

2.07. Biological Overview.

a. General.

(1) The Mississippi River and its tributaries represent the largest river system in North America, both in terms of length and volume of flow. The lower portion of the river, from Cairo, Illinois, to the Gulf of Mexico., has a low slope, falling from approximately 300 feet at Cairo to sea level over some 955 miles of river. The climate of this lower portion of the river ranges from humid and continental near Cairo to humid and subtropical near the Gulf of Mexico. Mean annual temperatures range from 60^{o} F. near Cairo to 70^{o} F. in the lower reaches. Precipitation averages 40 inches annually in southeastern Missouri and 64 inches annually at the Louisiana coast.

(2) These conditions combine to yield a highly diverse and in some ways, unusual biological area. Plant affinities throughout the area are strongly southeastern. The river valley is a major flyway for migratory birds and provides appropriate habitat for many kinds of waterfowl. Bellrose (1968) estimated that up to 500,000 diving ducks, and up to 3,000,000 dabblers use the lower Mississippi Valley during migration periods. There is "heavy density" of blue and snow geese during the same periods. Canadas are in fewer numbers due to

suitable lay-over spots in southern Illinois, Tennessee, Missouri, etc. The project area marks the eastern or western boundaries for a number of animal species. The northern end of the project area lies at the limits of northern or southern distributions for other species. The project area terminates in a great delta estuary system projecting into the Gulf of Mexico where many ocean-ranging animals (birds, marine turtles, porpoise, fishes) make occasional visits. The estuarine areas of the delta are critical to most of the important commercial and sport species of Louisiana. It is the area where juvenile development takes place in many species such as shrimp. It is a spawning area for other species and is the only area where certain species such as the American oyster (*Crassostrea virginica*) are found. The current situation in the estuarine delta of the river is not a natural one because of earlier actions which cut off sections of the delta from annual overflow and because of the fact that the river is routed more directly into the Gulf than had once been the case. The current project contains no plans to change this situation so no new impacts are expected as a result of the project.

(3) The project area is characterized by agriculture in the northern portion, woodlands over the central portion, a bordering industrial corridor between Baton Rouge and New Orleans, and a marsh/estuary system, most of which is outside the detailed study area on the Gulf coast. Figures 3 and 4 and Table 5 illustrate how the project area contains primarily terrestrial habitat in the northern and central portions at mean low water plane and is equally divided between aquatic and terrestrial habitat in the southern portion. The relative amount of forested terrestrial habitat for wildlife per river mile is very different in each of the three sections, being most extensive in the central section. Half of the aquatic habitat in the northern and central portions of the project area is deep, fast water which is low in productivity. Almost 85 percent of the aquatic acreage south of Baton Rouge is deep mainstem channel.

(4) A characteristic of the project area with significant biological implications is the fact that the area is subject to periodic inundation by the river. Analyses of river stage records for four gages in the project area are summarized in Table 6. Figure 5 presents a typical set of data from which Table 6 was derived. It also includes the data for 1973 to illustrate the effect of an extreme flood year. The bulk of the unprotected floodplain is lower than the bankfull reading due to the presence of natural levees at the river bank. These natural levees are generally not effective in preventing flooding of the floodplain by near bankfull river stages.

TABLE 5
DISTRIBUTION OF FISH AND WILDLIFE HABITAT IN PROJECT AREA BY RIVER SECTION*

RIVER SECTION	TOTAL RIVER MILES	TERRESTRIAL HABITAT				AQUATIC HABITAT			
		TOTAL ACREAGE	LAND ACREAGE PER RIVER MILE	TOTAL WOODLAND[a]	WOODLAND ACREAGE PER RIVER MILE	TOTAL ACREAGE[b]	WATER ACREAGE PER RIVER MILE	TOTAL GOOD, PERMANENT AQUATIC HABITAT[c]	GOOD AQUATIC HABITAT PER RIVER MILE
Cairo-Memphis	235	520,400	2,210	136,200	580	118,600	505	41,500	175
Memphis-Baton Rouge	465[d]	1,289,300	2,770	709,500	1,530	251,200	540	98,500	210
Baton Rouge-Venice	245	76,000	310	31,700	130	75,000	305	8,500	35

* Acreage at average low water plane.

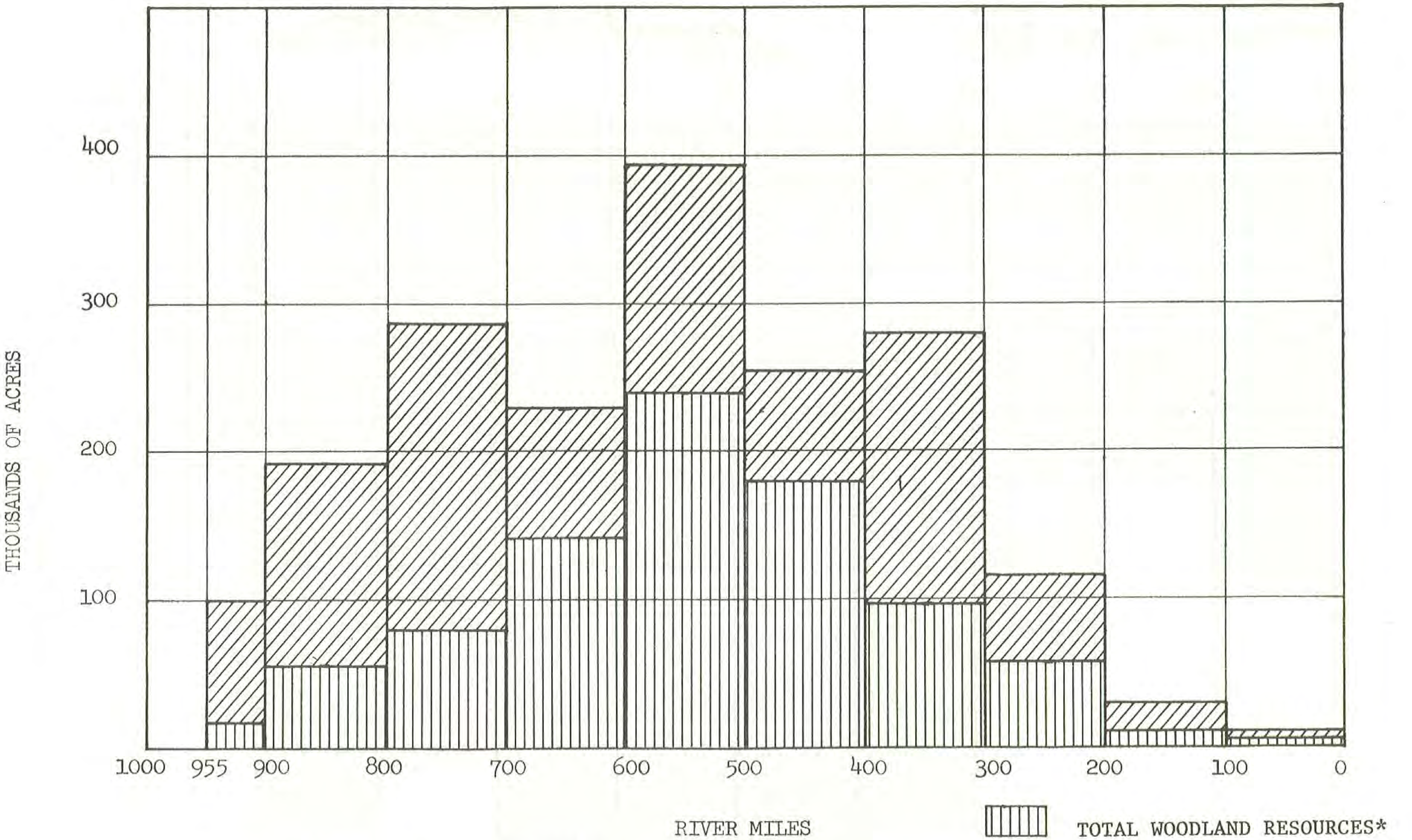
a Includes early and late successional woodlands, mixed bottomland hardwoods, and swamp forest.
Excludes edge habitat, transitional land, levee grasslands, and plantations, which provide habitat for some terrestrial animals, but are subject to more disturbance and provide less cover.

b Includes intermittently water-filled borrow pits.

c Includes mainstem channel less than 5 feet deep, chutes, slackwaters, lakes, permanently water-filled borrow pits.
Excludes mainstem channel greater than 5 feet deep and intermittently water-filled borrow pits.

d Exclusive of Arkansas River from Mississippi River to Pine Bluff.

Source: Planimetry of project area maps by Ryckman/Edgerley/Tomlinson and Associates, Inc., and Gulf South Research Institute.



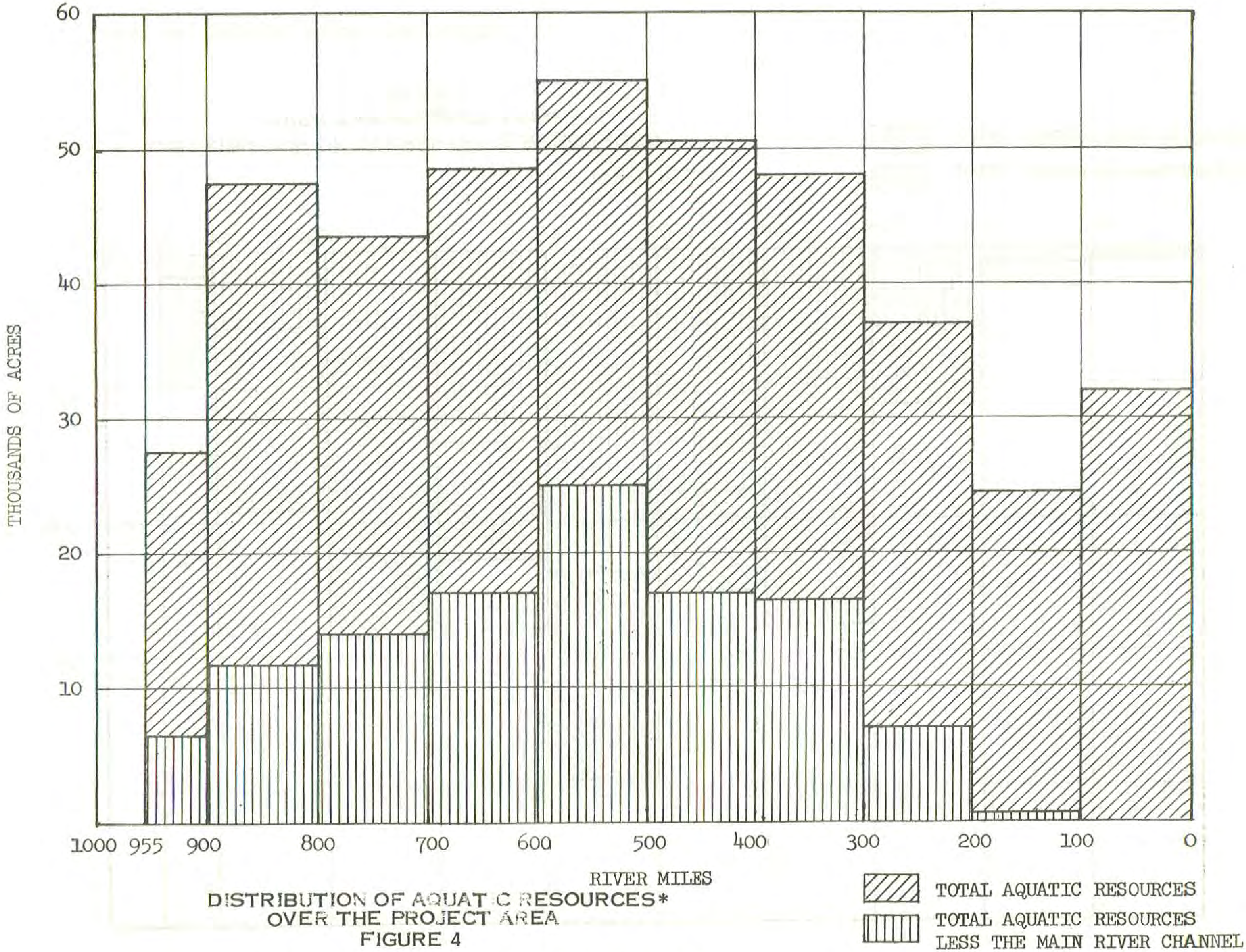
TOTAL WOODLAND RESOURCES*

TOTAL TERRESTRIAL RESOURCES

DISTRIBUTION OF TERRESTRIAL RESOURCES OVER THE PROJECT AREA
FIGURE 3

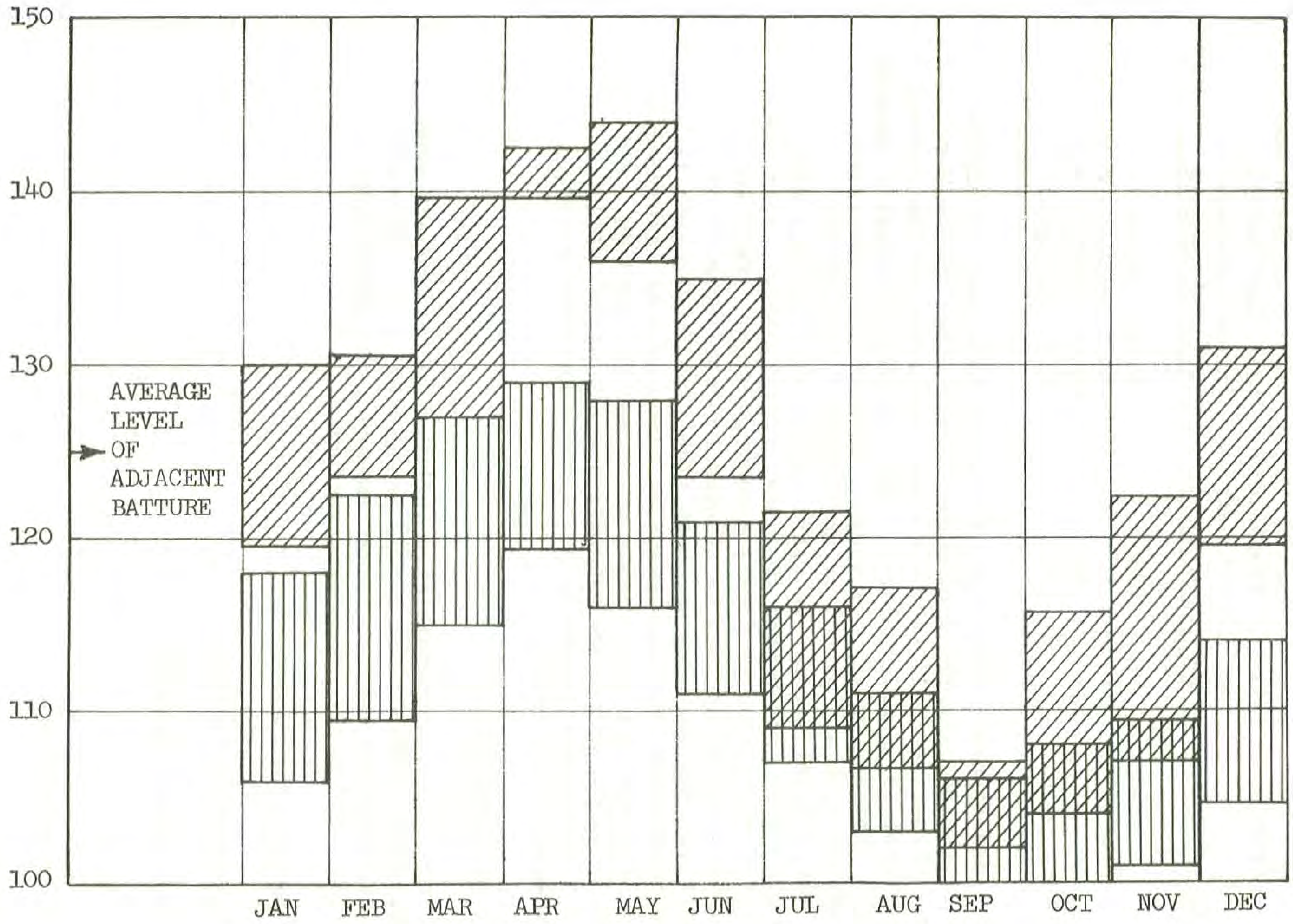
* DOES NOT INCLUDE TIMBER PLANTATIONS

FIGURE 3



DISTRIBUTION OF AQUATIC RESOURCES*
OVER THE PROJECT AREA
FIGURE 4

* DOES NOT INCLUDE INTERMITTENTLY FILLED BORROW PITS



MONTHLY RANGE OF RIVER AVERAGE LEVEL OF ADJACENT BATTURE (1944 to 1973 AVERAGE MONTHLY MAXIMA AND MINIMA AND 1973 MAXIMA AND MINIMA)

1973 MONTHLY RANGE

30 YEAR AVERAGE OF MONTHLY MAXIMA AND MINIMA (1944 - 1973)

FIGURE 5

TABLE 6
AVERAGE BATTURE FLOODING

Gage	Bankful (ft.,m.s.l.)	Average Level of Floodplain in Area of Gage (ft., m.s.l.)	Months in Which Ave. Max. Gage Reading Exceeds Average Level of Batture
Cairo	314.5	310	March & April
Arkansas City	140.7	125	March, April & May
Vicksburg	89.2	80	March, April & May
Red River Landing	46.5	40	March and April

(5) Table 6 and Figure 5 show that, for an average year, a significant portion of the unprotected floodplain is inundated during March, April, and May. This effectively converts vast stretches of the project area from terrestrial to aquatic habitat. Such widespread aquatic habitat occurring at this time of the year provides a tremendously increased area for the reproduction and growth of most aquatic species but restricts many terrestrial forms. In years of severe flooding, many terrestrial animals will suffer from the lack of high ground, shortage of food, and/or the disruption of normal breeding cycles. Herb and shrub layers within the batture may be removed by fast currents or buried under silt and debris. The southern floodplain vegetation is well adapted to reinvasion, but this requires time and some herbivorous animals may not fare well in recolonizing after severe flooding. A serious decline in rodent and shrew population would affect predator populations. The subsequent recession of floodwaters would tend to concentrate the aquatic resources.

b. Terrestrial Communities.

(1) Due to the large geographic area included in the project area, terrestrial communities between the levees are divided into six vegetation categories, with the habitat format employed throughout the biological section. These six categories include:

(a) Early successional woodland

(b) Late successional woodland

(c) Mixed bottomland hardwoods

(d) Swamp forest

(e) Edge and transitional

(f) Other areas

(2) The inherent danger of over-simplification through this categorization is recognized, but, due to the vastness of the project area and climatic, topographic and hydrologic variations within that area, the habitat format was judged to be the best method of treating the biotic communities.

(3) Early successional refers to pure stands of willows or cottonwoods. The late successional category refers to habitats dominated by cottonwood, sycamore, and willow, which also include many other species, such as hackberry, American elm, boxelder, silver maple, pecan and ash. Dominants of mixed bottomland hardwood include oaks, hickories, pecan, ash and locust. Cypress and tupelogum (and associates) are considered as a separate entity only where this type appears as relatively homogeneous stands, such as in permanent swamps, sloughs, certain oxbows, and old borrow areas. Edge and transitional communities include edge habitats, brushland and old field succession. Other areas include plantations, cropland, levee grassland and sandbars.

(4) Swamps are treated as terrestrial habitat since many birds, mammals, and reptiles found there are not primarily semi-aquatic. Also, the swamp is characterized by a well-developed forest of cypress, tupelogum, swamp cottonwood, and many understory elements. These lands are frequently inundated over most of their extent, providing habitat for both aquatic and terrestrial species. The swamps are low producers of phytoplankton because of the canopy which tends to reduce sunlight at the water's surface. The waters are loaded, however, with decaying vegetation which provides quantities of detritus which occupies a position at the bottom of the food chain and supports a vast number of organisms which in turn are food for larger species. This step by step process in swamp ecosystems may ultimately provide more than 10 times the fish protein of lotic waters (Wharton [6]).

c. Aquatic Communities.

(1) The largest aquatic resource in the project area is that portion of the mainstem river with an average depth of greater than 5 feet. This vast area is inherently low in primary productivity on a per acre basis because of high turbidity. The low productivity, characteristically shifting substrates, and high current velocities combine to support a poor benthos. The deep main river channel is the habitat of large predaceous fishes, some plankton feeders, and a group of omnivorous species.

(2) The area along the channel, averaging less than 5 feet in depth, represents only a limited percentage of the main channel, but is an extremely productive area for all trophic levels. Factors which increase the productivity include reduced current velocity, increased availability of cover, and existence of substrates exposed to sufficient light to allow algae growth. Fishes that may be found in this habitat include minnow, catfishes, carp, carpsuckers, and sunfishes. Clams, many dipterans, and mayflies are some representative invertebrates.

(3) River chutes, which may be as shallow as 5 feet but are often deeper, provide good habitat for species requiring continuously moving water, but not strong deep river currents.

(4) Areas of slackwater behind the main channel are very slow moving and shallow, providing important spawning and nursery sites for fishes and abundant food in the form of benthos and plankton. These slackwaters are valuable for both commercial and sport fishing, although their true productive capacity has not been adequately measured.

(5) Lakes and borrow pits (lentic waters) may be the most productive waters of the project area. While not as diverse in fish species as slackwaters off the main channel, these relatively stable water bodies support large aquatic populations of plants and animals. The growth of higher plants around these waters may reduce phytoplankton growth near the edges; however, the effect is generally minor and shad (gizzard and threadfin), frequently dominant species, may be supported largely by phytoplankton. The higher plants around these water bodies are also important primary producers in that a significant amount of leaf litter, branches, and other organic matter may wash into these lakes and borrow pits during high water conditions, becoming a source of detritus.

d. Major Community Interrelationships. As previously stated, the area between the levees is periodically inundated and the interaction between terrestrial and aquatic ecosystems is, in some situations, both intensive and extensive.

(1) Succession in the terrestrial community of the Lower Mississippi Valley starts at the river's edge and the river remains the dominant influence on all habitats in the unprotected floodplain. Animal communities are closely tied to habitat structure and food availability. The vegetation is influenced by the course, current and flooding potential of the river, and the river's ameliorating effects on ambient air temperatures. The river, its slackwater and lakes provide habitat and food for a number of non-aquatic vertebrates.

(2) The complex network of relationships involved in feeding is best described as a "web" of interrelationships between predators and prey rather than as a simple food chain. Size or age class, reproductive stage, health, habitat or social structure are factors which determine the consumer and the prey at any given time. As a result, there is a complex interrelationship between members of the terrestrial and aquatic communities that cannot be expressed as a food chain.

(3) In the aquatic community, primary production and the utilization of basic nutrients is provided by phytoplankton, rooted and floating higher aquatic plants, and allochthonous detritus. Primary consumers, such as zooplankton, many aquatic insect larvae, and some fishes, harvest the crop of phytoplankton and other carbon-based energy resources. Most aquatic primary consumers are filter feeders such as clams, micro-crustacea, and certain fish species such as shad.

(4) Many otherwise secondary consumers directly utilize the results of primary production during their life cycle. Largemouth bass and frogs are examples of organisms which shift from being principally primary consumers to secondary or tertiary consumers during their development. All predaceous insect larvae, large and small fishes, and many omnivorous feeders selectively feed on herbivorous insect larvae, shrimp, scuds, and isopods in the aquatic system. Many birds, amphibians, shrews, lizards and young snakes feed upon a host of various invertebrates in the terrestrial system. Most larger fishes, generally regarded as the top of the aquatic food chain, and many intermediate-sized mammals can feed at several points within the food web.

(5) Many higher vertebrates utilize aquatic as well as terrestrial environments in their daily activities or at specific times in their life cycles. Aquatic snakes, for example, eat primarily fish or amphibians. Mammalian elements (mink, raccoon, muskrat, nutria, otter) heavily utilize the aquatic resource but under certain circumstances may derive their food elsewhere.

e. Species Diversity. Species diversity by habitat is presented for the project area in Table 7. Many species shown occupy more than one habitat, and birds not breeding in the study area and bats have been excluded. These figures are not based on actual field observations or quantitative enumeration of species present, nor do they reflect the abundance of animals within these habitats which must also be considered in examining the relative productivity of the various communities. Thus, no "index" of species diversity is implied or possible with these data.

TABLE 7
SPECIES DIVERSITY IN PREFERRED HABITATS
FOR HIGHER VERTEBRATES OF PROJECT AREA

Habitat	Number of Species: Amphibians	Reptiles	Birds	Mammals
Woodlands				
Early-late Successional-woodland	15	19	66	18
Mixed bottomland hardwoods			64	17
Swamp forest	14	38	40	9
Openlands				
Edge-transition	9	15	65	19
Grassland				20
Aquatic				
Lotic water	4	20	0	1
Lentic water	5	24	1	7
Number of species considered	20	45	120	38

Source: RETA (adapted from tables for habitat preference by class in Appendix C).

Table 7 is intended to provide a relative indication of the importance of different habitats in terms of the species diversity the habitats are capable of supporting. The aquatic habitat, for instance, is more important to the reptiles as a group than to the other classes represented although availability of this habitat is critical for breeding amphibians. The amphibians and reptiles make more use of the swamp than do birds and mammals on the basis of species numbers. There appears to be no difference in the number of species of birds and mammals utilizing the successional stages and the mature forest.

f. Terrestrial Communities. Surface extent of the various terrestrial habitats in the project area are presented in Table 8. These measurements are based upon planimetry of 1972 aerial mosaic photographs and navigation maps of the area. Community elements presented in this section are intended as characteristic of the habitat being discussed and are presented to describe these habitats. They are not all-inclusive lists. Habitat preferences and species lists are included in Appendix C. Throughout the terrestrial community section, the absence of invertebrate elements is due to the lack of data for this group, rather than a disregard for their importance in these communities.

(1) Early Successional Woodland Communities. (105,000 acres)

(a) The early successional community is the first habitat established on the fine-textured soils that are periodically deposited, modified, or removed by the river. Therefore, it usually occurs immediately adjacent to the water edge. Various willow species are the dominant plants in this habitat and are known for their flood tolerance. There is very little understory in this community.

(b) Few faunal elements utilize willow bars compared to other terrestrial communities. Semi-aquatic mammals, including furbearers (otter, mink, muskrat, nutria, beaver) may utilize early successional habitats. The raccoon frequently forages in the shallow water associated with willow stands.

(c) The mourning dove, catbird, warbling vireo and red-winged blackbirds are some of the small number of bird species which breed in these early successional habitats. These species are typical of other disturbed or transitional habitats. They may reach very high breeding densities in this community. Other species found in this habitat would be the yellow-billed cuckoo, yellow warbler, American redstart, Baltimore oriole, and the cardinal.

(d) Herpetofauna known to occur in early successional communities are limited in species numbers. Aquatic species such as water snakes

TABLE 8
TERRESTRIAL HABITAT IN THE PROJECT AREA
(IN ACRES ALWP)

River Section	Early Successional Woodland	Late Successional Woodland	Mixed * Bottomland Hardwoods	Swamp Forest	Edge and Transition	Other **	Total
Cairo-Memphis	13,300	54,500	68,400	0	76,800	307,400	520,400
Memphis-Baton Rouge	73,200	298,200	320,800	17,300	191,400	388,400	1,289,300
Baton Rouge-Venice	18,400	7,100	6,200	0	10,700	33,600	76,000
Total	104,900	359,800	395,400	17,300	278,900	729,400	1,885,700

Total Woodlands (including timber plantations)	901,000
Edge and Transitional Land	278,900
Other (not including timber plantations)	705,800

* May include small patches of swamp forest.
** Includes cropland, levees, sandbars and plantations (559,500; 69,800; 76,500; and 23,600 acres overall, respectively).

SOURCE: Ryckman/Edgerley/Tomlinson and Associates, Inc., Planimetry of study area (5).
Gulf South Research Institute (1).

and turtles must deposit their eggs on dry land and therefore, can be found in willow communities as well as other habitats associated with aquatic communities during the reproductive seasons.

(2) Late Successional Community. (360,000 acres)

(a) Cottonwood, sycamore, hackberry and elm characterize the vegetation in late successional woodland habitats. This habitat has significant understory and is less affected by flooding than willow dominated communities. The soil contains a greater amount of organic materials than early successional soils.

(b) Mammalian elements of this community include woodland mice, white-tailed deer, swamp rabbit, striped skunk, larger carnivores (coyote, red fox, gray fox, bobcat) and, to some extent, species also found in more mature woodlands (i.e. squirrels). The amount of ground litter available probably determines the distribution of ground dwelling forms, particularly small rodents. The cottontail rabbit is also an inhabitant of late successional areas to the extent that understory cover and food plants are available. White-tailed deer prefer woodlands in close association with open areas for feeding, but occur in late successional areas. The common striped skunk and the scarce spotted skunk are also found in cottonwood-sycamore areas as well as other habitats. The extent to which the panther and coyote occur in the batture is questionable, but if found, they would likely utilize late successional habitats with the more common bobcat and foxes. Late successional habitat contains a breeding bird community consisting of two principal elements; (1) a group of birds belonging to the breeding bird community of the deciduous forest, and (2) a group of aquatic foragers which breed in the forests, often, as in the case of herons, in large mixed-species colonies. The deciduous forest element is characterized by such species as the Mississippi kite, pileated and red-bellied woodpeckers, great crested and Acadian flycatchers, eastern wood pewee, Carolina wren, wood thrush, red-eyed vireo, and parula and Kentucky warblers. The second element of the late successional habitat contains a number of herons and two ducks. The herons which are colonial breeders include the great blue heron, American egret, black-crowned night heron and, in coastal areas, the Louisiana heron. These species typically breed in large colonies in the tops of large trees in remote tracts of alluvial forests. They generally prefer the swamp forest but may be found in tracts of other undisturbed woodlands. The wood duck and the hooded merganser are both ducks which nest in holes in trees. This habitat provides a principal breeding site for the common wood duck. The hooded merganser is less common as a breeding species in the area.

(c) Terrestrial woodland snakes and salamanders occur in late successional habitats and mixed bottomland hardwoods. Characteristic snakes are the racer, eastern garter snake, copperhead, and rat snake. Many salamanders (e.g. the spotted salamander, tiger salamander, dusky salamander, dwarf salamander) occur in the leaf litter and rotting vegetation on the forest floor of late successional and mixed bottomland hardwood. The only terrestrial turtle which can utilize the cottonwood-sycamore habitats within the project area is the box turtle. Tree frogs are usually associated with moist conditions in most woodland habitats.

(3) Mixed Bottomland Hardwood Community. (395,000 acres)

(a) The most mature woodlands in the project area, the mixed hardwoods, consist of a rather diverse population of trees and understory. Oaks, water hickory, ashes, and elms are frequently dominant tree species in this habitat.

(b) The diversity of plant species is mirrored in the diversity of faunal elements found in mixed bottomland hardwood habitats. Mammalian species include most forms which also inhabit late successional habitats (woodland mice, rabbits, white-tailed deer, skunks, larger carnivores) as well as fox and grey squirrels, flying squirrels and chipmunks, which prefer more mature woodlands where mast trees are plentiful. The spotted skunk, the grey fox, the woodrat, and the short-tail shrew are particularly fond of this habitat type. The long-tailed weasel, which prefers a deep forest habitat, occurs in this and other habitat types. Large areas of mixed bottomland hardwoods are particularly important for the larger carnivores (e.g. Florida panther, bobcat) which prefer extensive tracts of undisturbed woodlands. Many species of bats roost in trees in all types of woodlands, including mixed bottomland hardwoods.

(c) The bird community of this habitat is typical of the deciduous forest climax. Species such as the chuck-will's-widow, black-and-white warbler, worm-eating warbler and summer tanager which are rare or absent in the late successional habitat may be found in this habitat. This habitat also contains some aquatic foragers which breed in woodlands, such as the herons and ducks described in the preceding habitat.

(d) The herpetofauna of mixed bottomland forest habitats is similar to the late successional group, though skinks, certain salamanders and lizards are more apt to occur in this habitat because of the increased likelihood of ground cover and the differing soil conditions as well as the obvious floral differences.

(4) Swamp Forest Community. (17,300 acres)

(a) Swamp forests occupy land covered by standing water throughout the year, except during droughts. Principal tree species are cypress and tupelo gum. Pockets of swamp forest may exist in relatively large stands of mixed bottomland hardwood. This habitat is not found to any extent north of Memphis, Tennessee. The classification of these wetlands according to the Fish and Wildlife Circular 39, "Wetlands of the United States," is a type 7 - Wooded Swamps.

(b) The mammalian element characteristic of swamp forest may include semi-aquatic species such as muskrat, nutria, swamp rabbit, mink, and beaver. Other mammals either widely distributed in many habitats (e.g. raccoon) or found in other habitats closely associated with swamps (e.g. squirrels, deer) also utilize this wetter habitat type.

(c) The swamp forest bird community also contains many representatives from other deciduous forest communities, such as the pileated woodpecker, great crested and Acadian flycatchers, eastern wood pewee, yellow-throated vireo, and parula warbler. In addition, some species exhibit a marked preference for this habitat, although they may be found in other wooded habitats. The prothonotary and yellow-throated warblers would be examples of such species. The aquatic foragers mentioned in relation to some of the above habitats prefer the swamp forests for breeding, where they are available. In addition, such aquatic foragers as the anhinga and white ibis are primarily birds of the swamp forest. The anhinga forages as well as breeds in this habitat.

(d) This forested semi-aquatic habitat is of particular importance to the American alligator which is listed as an endangered species on the national list. Certain snakes, such as cottonmouth and some water snakes, are found here and prefer the heavy vegetation and semi-aquatic environment of swampland. Tree frogs, aquatic salamanders, and aquatic turtles are also found in this habitat.

(5) Edge-transitional Community. (279,000 acres)

(a) Because of the interaction between two distinct ecosystems, the edge habitat is frequently very productive. Certain species have adapted well to the edge-transition areas and seem to prefer the large amount of cover and the variety of vegetation characteristic of this community. Land clearing within the project area has created additional edge-transitional habitat.

(b) Edge-transitional mammals within the project area are the prairie vole, least shrew, harvest mice, cottontail rabbit, and woodchuck. The red fox also seems to prefer edge habitats for hunting. The opossum adapts well to many habitats and utilizes edge habitats to some extent.

(c) The edge-transitional habitat is occupied by a rather distinct group of bird species common to disturbed or transitional habitats, and by many of the woodland species with very broad habitat ranges. Typical of the former group are the eastern kingbird, warbling vireo, yellow warbler, indigo bunting, and song sparrow. The latter species include the bobwhite, downy woodpecker, Carolina chickadee and cardinal. The construction of levees has greatly increased the amount of edge habitat, and hence has resulted in a marked increase in the abundance of edge species birds. Included in this category are the economically significant red-winged blackbird and common grackle, and the game species bobwhite and mourning dove. (Blackbirds and grackles are economically significant insofar as they are often pest species during the non-breeding season when they flock together and frequently feed on cash grain crops.)

(d) Grassland edge is the principal habitat for the eastern meadowlark, grasshopper sparrow and lark sparrow.

(e) Toads and certain openland snakes such as corn and hognose snakes occur in edge, transitional, and grassland habitats. The fence lizard and six-lined racerunner also prefer this type of habitat.

(6) Other Communities. (652,900 acres)

(a) This catch-all category includes plantation, managed grassland (including levees) and cropland (559,500 acres). The vegetation is self-explanatory for these habitats and their significance in terms of wildlife is small compared with other habitats in the project area, although in association with woodlands they may be of great value to wildlife. In places, levees supply additional grazing land for cattle and refuge for terrestrial animals during floods.

(b) The eastern mole and small microtine rodents such as the meadow mouse are probably the only mammals found to any extent in the managed grasslands, although any mammalian species may traverse the area in moving between landside agricultural lands and riverside habitats.

(c) Robins, crows and many other edge birds forage in these areas. The three common introduced species, all associates of man (the rock dove, starling, house sparrow), would be found in this habitat. Meadow larks, grasshopper sparrows and lark sparrows are potential nesters where the grass can achieve considerable height.

(d) Grassland snakes (e.g. prairie kingsnake) might utilize the managed grasslands if there is appropriate cover.

g. Aquatic Communities.

(1) General.

(a) Surface acreages for major aquatic habitats, as presented in Table 9, are based on the average low water plane and, as such, are probably minimal. These habitat distinctions cease to exist for significant portions of the year and much of the project area becomes one aquatic habitat of varied depth and current conditions.

(b) Characteristics of various aquatic habitats are as follows:

Habitat	Physical Features	Substrata
Main channel, river, $>$5 feet in depth	High velocity (3-10 fps)	Coarse material
Main channel, river, $<$5 feet (includes chutes) in depth	Reduced velocity ($<$ 3 fps)	Shifting sand and silt, hard clay
Slackwater	Much reduced velocity (near 0 fps)	Fine silt
Natural lakes, oxbows, borrow pits	No appreciable velocity (except when river is in flood stage)	Variable, usually high in organic matter, fines

Many different kinds of aquatic life are confined solely or in part to those different types and will be discussed in subsequent sections.

TABLE 9
AQUATIC RESOURCES IN THE PROJECT AREA *

River Section	Total River Miles	River (339,700 Acres)				Standing Water (105,100 Acres)			Total Aquatic Resources
		Main Channel		Chutes	Slackwaters	Lakes	Borrow Pits (<20 Acres)		
		>5 ft. deep	<5 ft. deep			>20 Acres	Water-filled year round	Water-filled intermittently	Resources
Cairo to Memphis	235	65,700	14,000	5,700	9,300	11,300	1,200	11,400	118,600
Memphis to Baton Rouge	465[a]	132,000	17,700	10,300	12,400	48,700	9,400	20,700	251,200
Baton Rouge to Venice	245	64,500	7,400	700	0[b]	400	0[c]	2,000	75,000
Total	945	262,200	39,100	16,700	21,700	60,400	10,600	34,100	444,800

* In acres at average low water plane.

a. Exclusive of Arkansas River from Mississippi River to Pine Bluff.
b. Less than 50 acres of slackwater occur in this section.
c. Borrow pits are drained by levee boards for mosquito control.

Source: Planimetry of project area maps by:
Ryckman/Edgerley/Tomlinson and Associates, Inc. (5).
Gulf South Research Institute (1).

(c) Water quality of the mainstem Mississippi is generally regarded as good (see Section 2.03), a testament to the tremendous assimilative capacity of this river. Nutrients (N, P, K) tend to increase slightly from upstream to downstream stations and are not unduly restrictive to the established biota. General nutrient enrichment supports high biomass in many of the water bodies as they receive overflow waters. The biological oxygen demand is surprisingly low considering the load of organic material received by the river from upstream stations and numerous tributaries. The range in dissolved oxygen is wide, remains generally above 7.0 ppm - more than adequate to support a rich and diverse biota. As is characteristic of most large rivers, dissolved oxygen levels tend to diminish slightly toward lower reaches of the river (3).

(d) While tributaries could supply diversity and biomass to the mainstem, many of the Mississippi tributaries are of degraded water quality. Tributaries may be responsible for specifying water quality in slackwaters and other nearshore resources, as these waters are carried along the shore for considerable distances before mixing with mainstem water. As mainstem waters recede following high water conditions, the tributary waters may influence water quality in quiet waters more than mainstem water.

(e) There are several small swampy areas in the project area. Biologically these are valuable resources and deserve special mention. Regarding these swamps in general, the following has been paraphrased from Wharton (6):

> River swamps have provided a most important natural mechanism for control of water pollution...River swamps have been called "giant kidneys," since they act as buffers against sudden surges of wastes, protecting areas downstream. The Flint River in Georgia, for example, receives massive amounts of pollutants from a variety of sources--a total estimated at 5 million gallons per day. A study of the Flint River...indicated that the cleansing action of six miles of swamp (620 acres) was equivalent to the sewage treatment for a city of 50,000 (100 gallons per capita). Unfortunately, it is not possible at this time to say with exactitude how typical this purgative performance may be... The performances studied have, however, been impressive enough for Wharton to generalize:
>
> > "The value of swamps in regard to water quality is multiple and the effects of wastes are similar to that of the combination of the primary treatment plant plus the treatment afforded by a waste stabilization pond."

(f) In addition to the invertebrates and fish of this river ecosystem, many higher vertebrates utilize the resources found here. Terrestrial insects with aquatic larval stages may feed as adults throughout the aquatic resources of the project area. Emergent and submerged vegetation provide food for a variety of insects and semi-aquatic mammals (nutria, beaver, muskrat); nesting sites for birds (red-winged blackbird); and cover for the previously mentioned furbearers (plus mink, raccoon, weasel, and otter). Insectivorous bats and birds feed above and beside the water bodies, and piscivorous birds, alligators, water snakes, and most turtles utilize the aquatic resources extensively. Frogs and salamanders are dependent upon the availability of aquatic habitats or reproduction. Although the following discussion of aquatic habitats does not refer specifically to most of these organisms, it is understood that they form an important element of the biota.

(g) Due to the great variety of organisms residing in the habitat areas, the major groups will be discussed in detail in relation to the first habitat and thereafter referred to by group names As with the terrestrial communities, the specific organisms presented are intended to describe the characteristic of the various habitats. A species list is presented in Appendix C.

(2) River Main Channel, Greater than 5 Feet Deep. (262,200 acres)

(a) Phytoplankton, essential in primary energy fixation, is somewhat restricted in the main river due to high turbidity. Of the alga species present, the diatoms assume major dominance in the main channel. Diatoms carried into the main channel from tributaries are often similar in composition to main channel forms and seasonal abundance and composition is quite variable. The same diatom genera are represented in both river and standing water areas (see Table 10). Green algae are limited in the mainstem river to a few dominant genera of global distribution: *Chlamydomonas*, *Oocystis*, *Coccochloris*, and *Anacystis*.

(b) Rooted and sedentary plants are restricted in the main river channel by high turbidity and velocity as well as widely fluctuating water levels. Many lakes and borrow pits of the project area may have luxuriant growths of aquatic vegetation and seeds and vegetative debris may be swept from these areas as well as from tributary streams during high water to maintain a small population in the mainstem river. Common aquatic rooted vegetation is listed in Appendix C.

(c) Floating plants, such as duck weed, water meal, water ferns, alligator weed, and water hyacinths, are generally not supported as a resident population in mainstem waters. However, slackwater and other

TABLE 10

DOMINANT PHYTOPLANKTON, LOWER MISSISSIPPI RIVER (MAIN CHANNEL)

STATION	ALGAE OTHER THAN DIATOMS	DIATOMS
Ohio River at Cairo, Illinois	Coccochloris	Melosira granulata
	Oocystis	Melosira ambigua
	Scenedesmus	Stephanodiscus niagarae
	Trachelomonas	Stephanodiscus astraea
	Chlamydomonas	Diploneis sp.
		Synedra ulna
		Coscinodiscus rothii
		Cyclotella meneghiniana
		Tabellaria fenestrata
		Coscinodiscus sp.
Cape Girardeau, Missouri	Trachelomonas	Stephanodiscus hantzschii
	Chlamydomonas	Melosira granulata
	Anacystis	Diatoma vulgare
	Ankistrodesmus	Synedra ulna
	Scenedesmus	Fragilaria crotonensis
	Oocystis	Cyclotella meneghiniana
		Fragilaria capucina
		Synedra acus
		Bacillaria paradoxa
		Stephanodiscus astraea
West Memphis, Arkansas	Trachelomonas	Surirella ovata
	Scenedesmus	Stephanodiscus niagarae
		Synedra acus
		Stephanodiscus astraea
		Cyclotella meneghiniana
		Coscinodiscus sp.
		Gyrosigma sp.
		Bacillaria paradoxa
Vicksburg, Mississippi	Chlamydomonas	Melosira ambigua
	Anacystis	Stephanodiscus niagarae
	Scenedesmus	Melosira varians
		Frustulia sp.
		Synedra ulna
		Cyclotella meneghiniana
		Coscinodiscus sp.
		Gyrosigma sp.
		Coscinodiscus sp.
		Stephanodiscus hantzschii
Delta, Louisiana	Trachelomonas	Melosira ambigua
	Chlamydomonas	Stephanodiscus niagarae
	Other unidentified genus	Stephanodiscus astraea
		Synedra ulna
		Cyclotella meneghiniana
		Coscinodiscus sp.
		Gyrosigma kutzingii
		Synedra acus
		Fragilaria crotonensis
		Denticula sp.
New Orleans, Louisiana	Trachelomonas	Melosira granulata
	Other unidentified genus	Melosira ambigua
		Synedra ulna
		Stephanodiscus astraea
		Melosira varians
		Coscinodiscus sp.
		Stephanodiscus niagarae
		Diatoma vulgare
		Nitzschia sp.
		Fragilaria crotonensis

Source: U.S.D. H.E.W. (7)

quiet areas will support growths of these aquatic plants in extremely high quantities and high water will flush the floating plants into the mainstem river.

(d) Zooplankton are minute animals which feed on phytoplankton, bacteria, and detritus. Important groups of zooplankton are crustaceans (copepods and cladocerans) and rotifers. The latter are intolerant of high turbidity and are relatively limited in the mainstem river channel. See Table 11 for dominant zooplankton of the lower Mississippi River.

(e) Macrobenthos, or bottom fauna, are generally believed to be scarce in the main river channel. Data available on benthic communities of the lower Mississippi River are synopsized in Table 12 and Appendix C. In terms of dominance, the flies (Diptera), mayflies (Ephemeroptera), segmented worms (Oligochaeta), and fingernail clams (Sphaeriids) are important components of bottom-fauna. Caddisflies (Trichoptera) are conspicuously absent from routine sampling, reflective of either a sampling bias or lack of suitable substrata. All of these forms are excellent fish foods.

(f) Invertebrate pelagic elements include the river shrimp, populations of which have flourished from time to time in the river but accurate historical data is lacking to define their present extent or status. Several states report substantial populations in slackwaters and lakes of the project area.

(g) The fishes are presented in detail in Appendix C. One hundred sixty-two species have been identified in the project area. Of this number, one hundred fourteen are freshwater and forty-eight are marine or estuarine and capable of enduring exposure to varying amounts of fresh water. Most of the small fishes are represented simply as present (P) since no estimate of their relative numbers is available. Available commercial fisheries statistics are presented in Table 13 for the study area. These indicate the following species are common throughout the entire project area.

Bowfin	Black buffalo
Spotted gar	Quillback
Gizzard shad	River carpsucker
Threadfin shad	Blue catfish
Carp	Flathead catfish
Bigmouth buffalo	Channel catfish
Smallmouth buffalo	Yellow bass
White crappie	Black crappie
Freshwater drum	

TABLE 11
DOMINANT ZOOPLANKTON, LOWER MISSISSIPPI RIVER

STATION	ROTIFERS	CRUSTACEA
Ohio River at Cairo, Illinois	Keratella Brachionus Polyarthra	nauplii Cyclops Euclops Paracyclops
Cape Girardeau,	Keratella Trichocerca Polyarthra	Daphnia Moina Bosmina Cyclops Euclops Paracyclops
West Memphis, Arkansas	Keratella Polyarthra Trichocerca	nauplii Cyclops Euclops Paracyclops Diaptomus
Vicksburg, Mississippi	Keratella Polyarthra Brachionus Synchaeta	nauplii Cyclops Euclops Paracyclops
Delta, Louisiana	Keratella Brachionus	nauplii
New Orleans, Louisiana	Keratella Brachionus Kellicottia Monostyla Platyias Lecane	Unidentified Cladocera Bosmina Unidentified Calanoida Unidentified Cyclopoida nauplii Copepodids

Source: U.S.D. . H.E.W.

TABLE 12
REPRESENTATIVE AQUATIC INVERTEBRATE DENSITIES (MACROBENTHOS)

Source	Sampling Device	Dominant Group	Aggregate Mean Number per Square Meter	Location
Paloumpis & Starrett (1960)	Dredge	Diptera Oligochaetes Sphaeriids Gastropods	5, 321 - 11,911	Flood plain lakes, Ill.
Bingham, 1969	Dredge	Oligochaetes Sphaeriids Diptera	400 - 587	Wolf & Mossy Lakes, Miss.
Grantham, 1965	Dredge	39 Genera; stream forms, many attached forms	600 - 2,900	Big Black River, Miss.
Miss. Power & Light Co., 1972	Dredge	Chaoboros Gastropods	92 - 4,532	Gin & Hamilton Lakes, Miss.
Slackwater #1	Dredge	Oligochaetes Diptera Mayflies	607 - 4,532)	Mississippi River, Mi. 400-408
Claybank #3	Dredge	Mayflies Sphaeriids	512 - 1,467)	Mississippi River, Mi. 400-408
Claybank #5	Dredge	Oligochaetes Mayflies Diptera Sphaeriids	92 - 142)	Mississippi River, Mi. 400-408
Slackwater #9	Dredge	Oligochaetes Diptera	75 - 182)	Mississippi River, Mi. 400-408
Slackwater #10	Dredge	Oligochaetes Spahaeriids	190 - 532)	Mississippi River, Mi. 400-408

TABLE 13
FISHERY STATISTICS BY STATE (COMMERCIAL HARVEST) FOR
MISSISSIPPI RIVER AND DRAINAGE AREAS
(1969 DATA)

	Arkansas	Kentucky	Tennessee	Mississippi	Louisiana
Bowfin	6,100	NR	25,400	5,400	3,100
Buffalo fish	1,261,100	34,000	446,300	1,726,100	131,400
Carp	68,900	17,500	270,000	391,000	17,300
Catfish and Bullheads	675,200	19,700	246,800	854,200	120,000
Garfish	20,400	NR	NR	45,800	7,700
Paddlefish	40,500	4,300	19,000	22,100	1,500
Quillback	8,100	800	7,500	26,000	NR
Sheepshead	162,200	4,600	201,800	52,500	41,200
Suckers	4,000	100	NR	22,200	NR
Sturgeon, Shovelnose	NR	700	1,000	NR	NR
Crappie	NR	NR	35,600	NR	NR
Yellow Bass	NR	NR	10,100	NR	NR
Shad	NR	NR	NR	NR	100,000

NR = None reported.

Source: U. S. Department of Commerce Fisheries Statistics, Washington, D. C. Government Printing Office 1970

Note: Data not available for project area portion of Missouri.

(h) The main river channel supports many large river species requiring heavy current flow. Benthic studies suggest that bottom feeding potential may be poor due to shifting sand and silt substrate. Larger fishes, including most piscivorous species and many planktonic feeders, will be found here. Main channel fishes include paddlefish, sturgeon, buffalo fish, walleye and sauger. Many fishes will not fight the strong current of the river and tend to reside in areas behind obstructions, near bars, or in holes with reduced current. Most main channel species tend to utilize shallow areas of reduced current during early life stages and spawning.

(3) River Main Channel, Less than 5 Feet Deep. (39,100 acres) Generally the comments made for the deeper portion of the main channel also apply for phytoplankton, rooted and sedentary plants, floating plants, benthic algae, zooplankton and pelagic elements in the shallow portions of the river. Increases in Diptera, Sphaeriid clams and mayflies, which may be associated with clay banks, make this relatively shallow habitat a choice feeding area for many species of fish; however, in addition to the food, the reduced velocity allows many more species to utilize this area. Many minnow species (Cyprinidae); sturgeon; channel, blue and flathead catfish; carpsuckers; carp, and piscivourous species can be found feeding here. Many forage species, including shads, silversides, minnows, and small sunfishes also utilize the area.

(4) River Chutes. (16,700 acres)

(a) Chutes, as defined for biological purposes, are secondary channels which carry a small fraction of the total river flow at that point. They are much narrower, shallower and have significantly lower velocity than the main river channel. This term includes new bypass channels and former main river channels which have been cut off. This definition differs somewhat from the traditional engineering definition, i.e., a short, straight channel which bypasses a long bend in the river.

(b) Chutes, as thus defined, may be as shallow as five feet or less, but often are deeper. Chutes are potentially valuable habitat for a variety of species, usually those requiring significant current but not as strong as that found in the main channel. Many chutes maintain continuous flow and present a different bottom type than that of the main channel.

(c) Phytoplankton found in chutes are similar to those of the main channel; however, a greater elaboration of species is often possible due to the increased habitat diversity. Periphyton may be associated with submerged objects in this habitat.

(d) Because of the relatively shallow water in many chutes and reduced water velocity, several species of rooted plants may be found, although this will vary from chute to chute.

(5) River Slackwaters. (21,700 acres)

(a) Slackwaters, dike structures (especially if pile and rock are used together) accompanied by various depths and some vegetation, provide a very diverse habitat in the midst of an otherwise monotonous river channel and tend to show greater species diversity than that of the main channel. Many species of rooted plants may become established in such cases and it is not uncommon to find heavy growth associated with dike structures and other obstructions. Slackwater areas associated with dike structures are generally assumed to provide the kind of habitat and plant and animal populations associated with slackwater; however, these areas have not been biologically surveyed.

(b) A great variety of phytoplankton forms are often found in slackwaters, sloughs, swamps, oxbows and borrow pits due to quiet water conditions and generally low turbidity. Not only are strictly planktonic forms proliferated under these conditions, but many forms associated with the periphyton community proliferate due to the enhanced light regimen and may subsequently enter the main stem when these areas are flushed out by high waters.

(c) Many floating plants also proliferate in slackwater areas. In the southern portion of the project area, growths of alligator weed and water hyacinth may assume major proportions, seriously limiting photosynthesis by submerged macrophytes and phytoplankton.

(d) Zooplankton development may be much greater in slackwater areas than in the main channel as a result of abundance of phytoplankton and reduced velocity of the current. Heavy use of all planktonic forms is made by young and developing fishes and a wider variety of animals is possible from these areas than from the mainstem.

(e) Slackwaters contain large populations of tubificed worms as well as small numbers of chironomid larva and mayfly nymphs. Benthic organisms present are characteristic of muddy substrates throughout the Mississippi River and include the same dominant forms as in the river channel: segmented worms, flies (midges, mosquitoes, etc.), fingernail clams, mayflies, and other quiet water species. The densities of all or any of these forms may reach thousands per square meter. Their heavy utilization by fishes makes slackwater areas quite productive of fish biomass.

(f) The slackwater areas are extremely valuable resources for fishes for both spawning and the development of fry. Benthic macroinvertebrates, many microbenthos forms, protozoa, and algae, which are necessary to nourish young fish, flourish in these warm, shallower waters. All fishes of the project area are found here at some time in their life histories. Many adult species of deeper water actively forage here due to the abundance of choice food items. Densities of some benthic organisms may exceed several thousands per square meter in these areas and catfishes, drum, carpsuckers, carp, shad, minnows, sunfishes and other forage fishes are commonly found here. The predatory fishes also occur in this area. This portion of the project area is also valuable in that much sport and commercial fishing exist here.

(6) Lakes and Borrow Pits. (105,100 acres)

(a) These water bodies are the most productive aquatic resources of the project area. Annual flooding, rather than being disruptive to species growth, aids productivity through the annual addition of nutrients. While not as diverse in fish species as slackwaters, these standing waters offer the most diversity in terms of all other aquatic species. Borrow pits vary in their vegetative redevelopment, depending on relative depth, drainage, soil types, etc. Proper management and planning could make new borrow pits productive aquatic and/or terrestrial communities.

(b) In contrast to the relatively sparse benthic populations of the main river, flood plain lakes support a rich benthos. Macroinvertebrate collections indicate that these areas are particularly productive in numbers of individuals as well as species. Crayfish, aquatic isopods, amphipods (scuds, *Gammarus* sp.), and the grass shrimp, *Paleomonetes* sp., are often found in littoral zones of lakes or shallow waters of the mainstem river where they are associated with submerged vegetation. They are abundant and highly desirable food items, readily taken by a variety of fishes.

(c) Fishes favored in these quiet waters are bowfin, gar, sunfishes, bass, crappie, carp, buffalo, drum, carpsuckers and a variety of smaller forage fish. Shads are especially common and may account for more than 50 percent of the biomass and numbers of individuals. Carpsuckers, buffalo and drum are commonly found here and are utilized as a commercial resource. The plankton-feeding gizzard shad are particularly favored by the high phytoplankton production characteristic of these waters. These water bodies are deficient in the main river forms such as sturgeon, paddlefish, and walleye.

(d) Other aquatic and semi-aquatic animals may reach their greatest development in these relatively stable areas as discussed briefly in the introduction and in the terrestrial communities section.

(7) Swamps and Sloughs. A few remarks are appropriate here on the aquatic aspects of swamps and sloughs (see the overview and terrestrial communities sections). Heavily shaded areas may produce less phytoplankton than open water areas. However, the combined production of phytoplankton, attached algae, submersed plants, emergent plants, floating plants, and the detrital contribution of trees may result in high aquatic productivity for swamp areas. Periphyton species may develop complex and stable community structures and be more important here than open water forms. The pH of these waters is low as a result of organic acids released from the decomposition of vegetation. These acids are also responsible for the coffee color of the water. Duckweeds and other typical floating plants may assume major proportions but are often restricted by reduced light. River swamps can exert a tremendous localized "cleansing" action on water quality (see page 88) and are a highly productive environment. River swamps are also important as water reservoir areas, as nurseries for fishes and many invertebrates, and for educational and recreational purposes (Wharton) [6]).

h. Game and Commercial Vertebrate Species.

(1) Game Mammals.

(a) Suitable habitat for game mammals in the project area is relatively extensive between Memphis and Baton Rouge but of limited extent both above and below this region. Large contiguous tracts of forest land no longer exist in the upper and lower sections. The relative abundance of game mammals is generally proportional to the available habitat and to hunting pressures. As a result, game animals are most abundant in the Memphis to Baton Rouge section.

(b) Table 14 presents a summary of available data on game mammals. It should be noted that methods of sampling and record keeping vary from state to state and are recorded by river county or management units only, portions of which are included in the project area. Judgements concerning the status of game species were based on these partially extralimital records.

(c) The Cairo to Memphis (river mile 955-735) region of the project area has already yielded much wildlife habitat to cropland. As a result, deer populations are very limited within this section. Harvestable numbers of rabbits and squirrels have increased in Missouri adjacent to the Mississippi River counties and such data are unavailable from other states in the region. Raccoon harvests seem quite stable in all river counties.

(d) Deer populations in the Memphis to Baton Rouge region (river mile 735-255) are apparently good to excellent, particularly in the southern parts. Raccoon and small game species records are inadequate to determine local abundance or population trends.

(e) Game mammals found within the batture below Baton Rouge are the cottontail rabbit, swamp rabbit, gray and fox squirrels and the white-tailed deer. All are very scarce except the cottontail rabbit, which is probably abundant. A list of the regional abundance of all mammals is in Appendix C.

(2) Game Birds.

(a) The Mississippi River is a major migratory corridor for dabbling ducks, diving ducks, and blue and snow geese. A fairly minor corridor for approximately 20,000 Canada geese is established along the river from Cairo to Reelfoot Lake, Tennessee.

(b) The oxbow lakes and slackwater areas throughout the project area are wintering habitats for many dabbling and diving ducks. Flooding conditions create extensive feeding, resting and roosting habitat for mallards and wood ducks.

(c) Rails, coots, and gallinules are principally migrants, but a few species may nest or winter in the area. They utilize various types of water bodies.

TABLE 14
SUMMARY OF AVAILABLE DATA ON HARVEST
OF GAME MAMMALS FROM STATES FOR COUNTIES AND PARISHES
ALONG THE MISSISSIPPI RIVER

State	Deer	Raccoon	Grey Squirrel	Fox Squirrel	Rabbit	Ground Hog	Date Year
Kentucky	"Fairly* good hunting"	4,200	19,026	5,157	15,693	1,907	1963-64
Tennessee	65	-	-	-	-	-	1971-72
Arkansas	3,448	1,650**	-	-	-	-	1973
Missouri	5	-	-	-	-	-	1973
Mississippi	13,406	-	-	-	-	-	1972-73
Louisiana	18,904	-	-	-	-	-	1972

* 1972-73 season
** 1972, not all counties reporting.

Source: RETA (5) from the following:
Kentucky: James Durell, State Game & Fish Commission, 1974, APC
Tennessee: Tennessee Wildlife Resources Agency, 1974, APC
Arkansas: Lew Johnson, Game Biologist II, Arkansas Game & Fish Commission, 1974, APC
Mississippi: Bill Quisenberry, Jr., Wildlife Biologist, Mississippi Game and Fish Commission, 1974, PC
Louisiana: Louisiana Wildlife and Fisheries Commission, 1972-73, Deer Kill Survey

(d) The common snipe is a common migrant and winter resident in the area. Other common residents within the project area are woodcock, turkey, bobwhite quail, and mourning dove. All make extensive use of habitats within the project area with the turkey and woodcock relying heavily on mature bottomland hardwood, while the bobwhite quail and mourning dove occur most commonly in edge, open land and early successional habitats.

(e) Tables of relative abundance of all bird species are in Appendix C.

(3) Furbearers.

(a) Suitable habitat for furbearers in the project area is comparatively extensive between Memphis and Baton Rouge, but is considerably limited both above and below this area. There no longer are any large tracts of forested land in project areas outside of the Memphis to Baton Rouge region. The relative abundance of furbearing mammals is generally directly proportional to available habitat and hunting and trapping pressures.

(b) Opossum, muskrat, mink, and raccoon populations appear to be decreasing from Cairo to Memphis but this may be due to a similar increase in trapping effort. Intermediate sized predators (canids and bobcat), classical furbearers (beaver and otter), skunks and weasel no longer offer commercially viable populations for fur harvest. Nutria, a recent immigrant as far north as the Arkansas River, is not a significant furbearer in this reach of the river. Average pelt prices in Missouri for the 1972-73 season were:

Opossum	$1.05	Bobcat	$12.10
Muskrat	2.05	Striped skunk	1.15
Beaver	9.35	Spotted skunk	1.70
Coyote/Wolf	9.55	Mink	11.10
Grey fox	7.00	Weasel	.50
Red fox	15.35	Raccoon	6.65

Source: Missouri Conservation Commission (8)

(c) Harvests of opossum, mink, and raccoon pelts appear to be best in the Memphis to Baton Rouge section of the Lower Mississippi River Valley, but intermediate-sized predators (canids and bobcat), the large furbearers (beaver and otter), and the skunks and the weasel offer negligible commercial prospects as furbearers, apparently because of declining populations. The Mississippi Forestry Commission, however, reports that areas adjacent to or included in the project area have increasing populations of beaver and heavy timber damage has resulted from this expansion. The extent to which nutria are utilized as a fur resource is unknown from Memphis to Baton Rouge.

(d) Apparently, the only furbearer occurring within the batture in trappable populations from Baton Rouge to Venice is the opossum.

(4) Fishes.

(a) The mainstem Mississippi River is dangerous for sport or commercial fishing. The currents are fast and variable, creating hazardous conditions for both small craft and fishing gear. Also, the fishes are at low densities in the deep main channel. However, the major factors which limit commercial fishing in the main channel are probably the low densities of fish and the difficulty of fishing effort. The shallow mainstem and the chutes are much better sites for fishing than the mainstem and considerable sport fishing is done in the chutes. Some sport fishing is done from the dikes and revetments, especially if they are associated with tributary stream sources. Local residents fish the mouths of tributaries from boats.

(b) Most fishing is carried out in the slower currents of slack-waters and lakes. Most commercial fishing is confined to the slack-waters and there is considerable sport fishing in this habitat. The lakes offer very productive fishing to local residents. The use of these lentic resources is limited only by access. Many of the large lakes have boat docks and the small borrow pit lakes considering their elongated shapes are readily fished from the bank.

(c) In Louisiana, Mississippi, Arkansas and Missouri, those species classified as game fishes such as bass, crappie, sunfish, etc., cannot be legally harvested for commercial sale.

(d) Paddlefish appear in the commercial harvest to a limited extent but do not bring a very good price (generally less than buffalo fishes).

(e) All of the garfish species are considered together in commercial catch statistics and their value is generally low. To sport fishermen they are a nuisance.

(f) Status of the shovel-nose sturgeon as well as the other sturgeon species is much in question. The other sturgeons are regarded as at least threatened but little factual information is available to adequately assess their population strength or viability. Sturgeon are reported in Kentucky and Tennessee fisheries statistics but apparently are not sufficiently important in the other states to warrant inclusion. Market value is generally low (10 to 15 cents per pound).

(g) Market value of the buffalo fishes is relatively high for the fishery as a whole, and catches of these species are the greatest in total pounds in all the states reporting. Over the entire study area, buffalo accounted for nearly 50 percent of the total catch and 42 percent of the total catch value.

(h) Gizzard shad are used in the lower reaches of the river for bait in crab and crayfish traps.

(i) Several catfish species are commonly taken by sport and com mercial fishermen. Of all of the fishes taken by commercial fishermen, these are the most valuable, generally holding a price in excess of 30 cents per pound. In the aggregate, these species are exceeded only by the buffalo fishes in total pounds caught. Channel catfish, blue catfish, and flathead catfish are the most sought after and make up the body of the commercial catch.

(j) Commercial statistics indicate the total catch of bowfin from each of the states of the study area to be generally low. Their dollar value is equally low with the fish bringing about five to eight cents per pound.

(k) Carp make up a significant portion of the total commercial catch. Their dollar value is low, however, with three to eight cents per pound a common market price.

(l) Commercial use of the term "sucker" for the mainstem river is applied to the following species: river carpsucker, highfin carpsucker, and the blue sucker. True suckers of the genus Moxostoma are infrequently found in the mainstem river. Available data suggests that, with the exception of the river carpsucker, all of the named species are scarce in the river, even though they appear in commercial catch statistics. Suckers vary in market value between five and ten cents per pound with the blue sucker probably bringing the higher price. Quillback is reported separately from the others and generally appears to enjoy a slightly better market, around ten cents per pound. All are found in the middle reaches of the river in greater numbers than at extreme lower portions.

(m) Freshwater drum consistently maintain a high total harvest and a reasonable market value ranging from five to twenty cents per pound. Many are taken by sport fishermen but no harvest figures are available.

(n) The largemouth bass is one of the most sought-after game fish of the entire project area. However, no estimates of the harvest from natural bodies of standing water are available, but it can be safely assumed that it is considerable.

(o) Dollar value and total pounds of black and white crappie landed in the commercial catch are variable and usually small compared to the total value of commercial fisheries, due in part to their status as a game fish. The sport fishing potential is generally quite high, however, as these species are second only to bass in the eyes of local sportsmen.

(p) The sunfishes contain some species which are too small to have commercial or sport value as well as species which provide considerable sport fishing opportunities. The following species are important: green sunfish, warmouth, bluegill, longear sunfish, and redear sunfish. No estimates of the total catch of sunfishes from the project area are available but it is assumed that these fishes represent a considerable portion of the total sport fishing catch.

(q) As a general rule, commercial catches receive a slightly higher value for all species in northern reaches compared to southern waters. Arkansas and Mississippi led all other states of the study area in total pounds landed as well as in total dollar value of the catch.

(5) Other Aquatic Resources.

(a) Other aquatic resources exploited commercially in a minor way in the project area are the bull and pig frogs, crayfish, and turtles. Frogs are legal game in most states but statistics are generally not kept on the harvest.

(b) Baby turtles commonly fetch 75 cents to $1.00 each retail, with a market amortized retail value of these animals of about $100,000 per year, a surprising result for only 3,100 pounds reported. This resource may no longer be utilized, however, since turtles transmit the bacterium Salmonella, and legislation is pending to prevent their interstate shipment and sale. It is possible that many more pounds of baby turtles are caught and sold annually than are reported.

(c) Recent interest in the river shrimp, Macrobranchium ohione, may lead to exploitation of this pelagic element as a commercial resource north of Baton Rouge. It has been commercially harvested in the lower portion of the project area for several years.

i. Vectors.

(1) A great number of invertebrate animals can and do contribute to the problem of disease transmission to man. At present, none of these is considered a serious problem in the study area. The biggest single problem is that of the nuisance created by persistent or painful biting species. This should not, however, minimize the potential health hazard of these vectors.

(2) Malaria has been brought from Viet Nam to Kentucky. Kentucky also reports problems with equine infectious anemia and Venezualan equine encephalitis, both of which are spread by mosquitoes (27).

(3) There are no present programs for control of mosquitoes or ticks in Kentucky. Louisiana has problems with ticks and mosquitoes. There is a reasonably large mosquito control program in the state of Louisiana.

(4) Most states in the study area have no continuing program for vector control. Sprays to control larvae and adults are used as local control measures in all states except Mississippi where only adult control measures are used. Ultra low volume aerial and ground spraying or fogging programs are used in most areas. Malathion is the primary chemical used in spraying but diazinon 4-E, dibrom 14, dursban, naled, korlon, baytex, cygon, and diptex are also applied. Rodenticides are used for rats and mice control. Sevin is used to kill ectoparasites such as ticks and fleas. The only other control program used in the actual project area is the draining of standing water areas. In Louisiana, the levee boards are responsible for draining borrow pits on the batture.

j. Rare and Endangered Species.

(1) General. The designation of a species as rare or endangered is not as straightforward as it might appear to the non-biologist. Generally accepted definitions (9) are:

ENDANGERED - "An endangered species or subspecies is one whose prospects of survival and reproduction are in immediate jeopardy... An endangered species must have help, or extinction will probably follow."

RARE - "A rare species or subspecies is one that although not presently threatened with extinction, is in small numbers throughout its range and may be endangered if its environment worsens. Close watch of its status is necessary."

PERIPHERAL - "Peripheral species or subspecies is one whose occurrence...is at the edge of its natural range and which is rare or endangered within [that peripheral area]...although not in its range as a whole..."

STATUS UNDETERMINED - "A status-undetermined species or subspecies is one that has been suggested as possibly endangered, but for which there is not enough information to determine its status. More information is needed."

Several factors complicate the assignment of the designations. A species may be rare at the edge of its range although it is common in the center of its distribution. A species with low reproductive potential or fastidious environmental requirements may never achieve widespread occurrence or high densities. It may have an extensive range geographically and yet be dispersed within that range where individuals are rarely encountered. Populations may have clumped and limited distribution but consist of large numbers of individuals, as in some bat and plant species, which are particularly susceptible to a calamitous reduction. Some species have disjunct distributions, that is, there exists a major range while hundreds of miles away lies an isolated, small population. Thus the existence of subspecies may be threatened while the species as such is not endangered. Nevertheless, protection should be given to populations at the limits of their range and to subspecies because they are often invaluable in the scientific study of a variety of biological processes, they add diversity to an ecosystem, and the existence of their gene pools is important to the health of the species. The length of the Lower Mississippi River Valley, its location at the periphery of the eastern deciduous forest, the fringe of the western prairies, and south of the great glacial advances; and its tendency to form a natural barrier for many species, all combine to make the study area at the limits of the distributions for a large number of terrestrial and aquatic plants and animals. All of these problems occur in designating rare and endangered species for an area as extensive as the Lower Mississippi Valley.

(2) Plants. Of the states along the project area, only Missouri has made a list of rare and endangered plants. Three dozen native species (all angiosperms) on this list may occur within the project area. Virtually all of them have widespread distributions and the project site is at the limits of these ranges. One exception may be *Diplanchne halei*, feather grass, also known as *Leptochloa panicoides*. This plant occurs on marshes and mud-flats along the Gulf Coast, but is very rare inland (10), and the rare Missouri (and Illinois) populations may be relatively isolated. The plant grows on the sandy banks of the Mississippi River in New Madrid County. Three plants on the list require special mention. Styrax and *Cayaponia grandiflora* are considered by Steyermark (11) to be part of the characteristic flora of Missouri's southeastern lowlands. Black tupelo is a dominant species of the southern flood plain forest (12). The current status of these three species in Missouri reflects the great loss of swampland forest in this portion of the study area. Additionally noteworthy is that because of the widespread loss of elms to Dutch elm disease, the state has designated all elm species as endangered. Elms are part of the floodplain biota and occur in the project area.

Two environmental inventories (13, 14) done near the project area dealt with rare and endangered plants (Middle Mississippi River Valley, St. Louis to Cairo; and Nonconnah Basin) and the comments in the above paragraph on range limits apply. Dr. John Thieret (15) is preparing a flora of Louisiana and concurs with Dr. Joe Ewan and Dr. Leonard Thien (17) that *Iris hexagona* var. *giganticaerulea* (small) R. C. Foster which is endemic to southern Louisiana lowlands, is a rare species. Specific locations of this iris within the project are not known to us. The State of Louisiana is preparing a list of rare and endangered species which is expected to be completed in 1975.

(3) Invertebrates. While recognizing that invertebrate species are poorly known, Missouri has made a list of rare species, two of which might occur in the project area. The eastern hercules beetle, *Dynastes tityus*, is found as an adult around the tree stumps in deciduous forests. The fat pocketbook (a mussel), *Proptera capax*, may be extirpated from waters east of the Mississippi River. Illinois and Kentucky also have lists for intertebrates but none of the designated species occur in the project area.

The U. S. Department of Interior is preparing a list of rare and endangered molluscs which is not currently available. The lower Mississippi River aquatic molluscan fauna is very poorly known and any list must be considered with caution when interpreting it for the project area. The mainstem is regarded as very poor habitat for molluscs when compared with the tributaries. *Toxolasma lividumglans* (known from upper reaches of the Arkansas River) may occur in the project area and is rare and endangered (18). *Lampsilis streckeri*, *Dysnomia florentina*, and *D. lefevrei* are forms from inland drainages of Missouri, Arkansas, Tennessee, and Kentucky, which have been listed as rare and endangered species for the bottom reach of the Mississippi and Atchafalaya drainages (19,20). Additional rare and endangered species which may occur in the lower reaches of the project area are:

Lithasia hubrichti	*Fusconia missouriense*
Anculosa arkansensis	*Arkansia wheeleri*
Margaritifera hembeli	*Ptychobranchus occidentalis*

(4) Fishes. In addition to the status definitions given earlier, icthyologists add a category for "depleted" species. Although such species still occur in adequate numbers for survival, the populations are heavily depleted and continue to decline at a rate substantially greater than can be sustained. Table 15 presents those rare and endangered species which might occur in the project area and the appropriate designations by Miller (21) and, by state, rare and endangered lists from Kentucky, Illinois, and Missouri. Mississippi's state list is in preparation and the preliminary draft is expected soon. Louisiana and Arkansas do not have official state lists at this time. None of the rare and endangered species listed by Miller for Arkansas and Tennessee are expected to occur in the project area. Appendix C contains an annotated version of the list in Table 15.

(5) Amphibians and Reptiles. Several species, listed as rare and endangered by state authorities, are basically peripheral to the project area. Strecker's chorus frog and the western (plains) hognose snake are rare species represented in the northernmost portion of the study area by small populations which are disjunct from the major ranges.

The historical range and populations of the alligator have been drastically reduced. Alligators may occur as far north as Memphis in the project area but are more likely to occur south of Vicksburg, Mississippi. It is nowhere common within the project area although it is considered fairly common by Louisiana state authorities who have allowed commercial harvests in 1972 and 1973.

Table 16 presents the designations given by various state agencies and the U.S.D.I. The state of Mississippi's list is in preparation and expected this spring.

TABLE 15
RARE AND ENDANGERED FISHES
OF THE LOWER MISSISSIPPI RIVER VALLEY

	Missouri	Illinois	Kentucky	Mississippi	Louisiana	USDI
	a, b, d;	a, c, e:	a, p	a	a	f,g,h
Southern brook lamprey	r, R					
American brook lamprey	r, R					
Lake sturgeon	e/d, E	E				
Atlantic sturgeon				d		
Pallid sturgeon	e/d, E	R	e		r	
Shovelnose sturgeon			e	d		
Alligator gar	r, R	R				
Alabama shad	r, R	R				
Cypress minnow	e/x,E/X	E/X				
Sturgeon chub	r/e, E	R				
Sicklefin chub	r/e, E					
Pallid shiner	e/x, E/X	E				
Pugnose minnow	r/e, E					
Steelcolor shiner					r	
Bluntnose minnow					r	
Brown bullhead	r,R					
Golden topminnow	e/x, E/X					
Starhead topminnow	d					
Mississippi silverside	r, R					
Banded pygmy sunfish		r, R				
Bantam sunfish	r, R	r, E				
Harlequin darter	r/e,E	r, E	r/e,R/E			
Mud darter			r/e,R/E			
Slenderhead darter			r			
River darter			r			
Stargazing darter			r			
Sauger			d			
Walleye			d			

Key: lower case letters for Miller's list; upper case letters for state lists
r or R = rare; x or X = extirpated; e or E = endangered; d = depleted;
/ (slash) = read "or"; SU = status undetermined; T = threatened (not an official designation)

Source: R.E.T.A. (5) and G.S.R.I (1) from the following:
- a Miller, 1972
- b Pflieger, 1971
- c Smith, Lopinot & Pflieger, 1971
- d Missouri Department of Conservation 1973
- e Illinois Nature Preserves Commission, 1971
- f Kentucky Department of Fish and Wildlife Resources, 1972
- g Federal Register 39(3) Part III:11F5. (4 January 1974).
- h U.S.D.I., U.S. List of Endangered Fauna, May 1974.

TABLE 16
RARE AND ENDANGERED AMPHIBIANS AND REPTILES
OF THE LOWER MISSISSIPPI RIVER VALLEY

	Missouri[a]	Illinois[b]	Kentucky[c]	USDI[d, e]
Eastern narrow-mouthed toad		R		
Bird-voiced tree frog		R	R/E	
Green tree frog		R	R/E	
Strecker's (Ill.)chorus frog		R		
Eastern spadefoot toad		R		
Mole salamander		R		
Two-toed amphiuma			R/E	
Hellbender		E		
Dusky salamander		E		
Long-tailed salamander		R		
Dwarf salamander	E			
Lesser siren			R/E	
American alligator				E
Mud turtle		R		
Alligator snapping turtle	R	E		
Slender glass lizard		R	R/E	
Worm snake		R		
Scarlet snake	R	E/X	R/E	
Canebrake rattlesnake	R	E		
Corn snake		R	R/E	
Mud snake			R/E	
Western (plains) hognose snake	E	R		
Prairie kingsnake (mole)			R/E	
Coachwhip		E		
Green water snake	R	R		
Queen snake	X			
Southeastern crowned snake			R/E	
Flat-headed snake		R		
Western ribbon snake			R/E	
Eastern ribbon snake			R/E	

Source: RETA (5) from the following:
a. Missouri Department of Conservation, 1973
b. Illinois Nature Preserves Commission, Dec 1971
c. Kentucky Department of Fish and Wildlife Resources, 1972
d. Federal Register (4 January 1974) 39(3) Part III:1175
e. U.S.D.I., U. S. List of Endangered Fauna, May 1974

Note: Basic species list is from G.S.R.I., 1973

Key: SU = status undetermined
R = rare
E = endangered
X = extirpated
/ (slash) = read "or"

(6) Birds. Table 17 gives the rare and endangered designations assigned by R.E.T.A. (5) to the birds of the project area. These assignments are based upon the best available information, including the recommendations of state agencies and the United States Department of Interior, Office of Endangered Species and International Activities. No distinction has been made between nesting birds and winter residents.

The length of the list reflects the diversity of bird life in the project area, compared to the other higher vertebrates. There is a general tendency for birds of prey to be suffering declines for various reasons. Several birds have been extirpated from their former ranges. The passenger pigeon and the Carolina parakeet, now extinct, once occupied the Lower Mississippi River Valley.

(7) Mammals. The rare and endangered mammals are listed in Table 18. The project area is within the range of a number of rare and endangered bat species but it is unlikely that they roost there although they may forage. Otherwise, the rare and endangered mammals are mostly the large predators. The black bear and cougar might utilize the project area but they are extremely rare in the states adjacent to the river and individuals would be wide-ranging. The bob-cat has become quite rare in the northern stretch of the project area and uncommon in the southernmost reaches of the river, although it is still fairly common in middle reaches. The otter is extremely rare in the northern section of the river and has been virtually eliminated as a viable furbearer population.

Many southeastern states include the red wolf in their faunal lists although every indication is that the animal has been extirpated from virtually all of its range except for three disjunct distributions located in the Arkansas Ozarks, the northeastern corner of Louisiana (including Davis Island, 50 square miles within Warren County, Mississippi, along the Mississippi River), and along the gulf coast of eastern Texas and western Louisiana, possibly into the Atchafalaya Basin (22). There is some doubt as to whether *Canis rufus* was ever a distinct species, rather than a wolf-dog and dog-coyote hybrid (23). More research is needed to resolve the status of *Canis rufus* as a species.

TABLE 17
RARE AND ENDANGERED BIRDS
OF THE LOWER MISSISSIPPI RIVER VALLEY

Brown pelican	*Endangered (a, c, f)
White pelican	SU (f)
Double-crested cormorant	SU (b, c, f)
Anhinga	Rare (b)
Black duck	
Hooded merganser	SU (c)
Turkey vulture	SU (f)
Black vulture	SU (b, f)
Swallow-tailed kite	Rare (b, e, f)
Cooper's hawk	Rare (b, c, f)
Sharp-shinned hawk	SU (b, c, f)
Marsh hawk	SU (f)
Red-shouldered hawk	SU (b, c, f)
Golden eagle	Peripheral (d, e)
Bald eagle, southern	Endangered (a, b, c, d, e)
Osprey	Endangered (b, c, d, f)
Peregrine falcon, Arctic	Extirpated ? (a, b, c, e)
Pigeon hawk	SU (f)
Great blue heron	SU (f)
Black-crowned night heron	SU (c, f)
American bittern	Rare (c)
Wood ibis	SU (f)
White ibis	SU (f)
Whooping crane	Extirpated (a)
Sandhill crane	Extirpated (a, d, e)
Black rail	Rare (c, e)
American oystercatcher	Rare (e, f)
Snowy plover	Rare (e, f)
Eskimo curlew	Extirpated ? (a)
Least tern	Rare (b, c, e, f)
Barn owl	SU (b, c, f)
Ivory-billed woodpecker	Extirpated (a, e)
Red-cockaded woodpecker	Endangered (a, b, e, f)
Red-headed woodpecker	SU (f)
House wren	SU (f)
Bewick's wren	SU (c, f)
Eastern bluebird	SU (f)

TABLE 17 (Cont)
RARE AND ENDANGERED BIRDS
OF THE LOWER MISSISSIPPI RIVER VALLEY

Loggerhead shrike	SU (c, f)
Swainson's warbler	Rare (b, c)
Bachman's warbler	Extirpated ? (a, b, e)
Le Conte's sparrow	SU (f)
Bachman's sparrow	Rare (b, c, f)

SU= Status undetermined

* These status designations for the project area as a whole have been assigned by R.E.T.A. and are based upon the best available information.

Source: RETA (5) from the following:

a. U.S.D.I., U. S. List of Endangered Fauna, May 1974
b. Missouri Department of Conservation, 1973
c. Illinois Nature Preserves Commission, 1971.
d. Kentucky Department of Fish and Wildlife Resources, 1972.
e. State of Mississippi, manuscript in preparation; c/o Jerome Jackson, Mississippi State University.
f. Blue List of North American Birds (Audubon Society), 1971.

TABLE 18
RARE AND ENDANGERED MAMMALS
OF THE LOWER MISSISSIPPI RIVER VALLEY

	Missouri	Illinois	Kentucky	Mississippi	USDI
Southern longtailed shrew	R	R	R/E	R	
Little brown myotis				R/P	
Southeastern myotis		R	R/E		
Gray myotis	E	R	R/E	R/P	
Keen's myotis	R			R/P	
Indiana myotis	E	E	R/E	E/P	E
Least myotis (small-footed)	E				
Hoary bat				R	
Florida (northern) yellow bat				R	
Rafinesque's bigeared bat	E	R			
Swamp rabbit	R				
Plains pocket gopher		R			
Cotton mouse		E			
Golden mouse		R			
Cotton rat			R/E		
Eastern woodrat		E			
Coyote			R/E	R	
Red wolf	X			E/P	E
Black bear	E		R/E*	E	
Longtailed weasel	R				
Otter	E	R	R/E*		
Spotted skunk			R/E		
Puma (panther)(cougar)	E		R/E*	E	E
Bobcat		E	R/E*		

Key: SU = status undetermined
R = rare
E = endangered
X = extirpated
P = peripheral
/ (slash) = read "or"
* = unofficial, protected by omission from hunting regulations.

Source: G.S.R.I. (1) from the following:
a. Missouri Department of Conservation, 1973
b. Illinois Nature Preserves Commission, Dec 1971
c. Kentucky Department of Fish and Wildlife Resources, 1972
d. Mississippi, manuscript in preparation; c/o James Wolfe, Mississippi State University.

2.08. Social/Cultural Elements of the Present Environmental Setting.

a. History. Although the natural processes have had the greatest effect on the project area, these effects have been altered by man, who, with his technology and his organization, has fashioned the natural environment much to his liking. It is believed that the original inhabitants of the Lower Mississippi Region were American Indians who periodically came down from surrounding hills to hunt big game. During this Paleo-Indian period (c. 15,000 to 6,000 B.C.), river systems and much of the land surface in the region had not assumed their present configurations. As the rivers of the region settled into their general meandering patterns (c. 3,000 B.C.), these peoples developed seasonal migratory patterns and semi-permanent villages. The earliest group, which is well known in the study area, is named after a site at Poverty Point, Louisiana. The culture, which lasted until 500 B.C., was characterized by the use of small baked clay lumps; microliths; materials imported from outside the region; and finely-made ornaments. The first ceramic cultures, generally known as Tchefuncte or Tchula, began to appear in the area by 500 B.C. From 100 B.C. to 300 A.D., the study area was dominated by Marksville cultures, which built elaborate mortuary complexes and conical burial mounds.

(1) Between 300 and 800 A.D. (the Baytown period), corn agriculture was developed, providing a new and more stable economic base; the bow and arrow were introduced into the study area during this period by visitors from the hill country. Thereafter the population gradually dispersed into farm areas, with less central social organization. The valley population increased greatly between 800 and 1,200 A.D. This period, known as Coles Creek, was characterized by a resurgence of ceramic decoration and by large religious ceremonial centers. The period between 1,200 and 1,600 A.D. was marked by an expansion and climax of the Mississippi culture in the study area. This culture developed intensive agriculture, with such crops as corn, squash, beans, melons, pumpkins and tobacco. When the Spanish explorer Hernando DeSoto entered the study area in 1541, population was densely settled into large farm communities. DeSoto introduced the domesticated pig to the Indians whose only domestic source of meat had been the dog. His expedition also introduced European diseases which ravaged the population after his departure. Only a small and scattered population remained in the study area at the end of the seventeenth century when French explorers entered the region.

(2) Early European settlements in and near the study area were temporary military and trading posts established along the river by Robert de LaSalle and other French explorers. All of these, except for Arkansas Post, were closed within a few years. The first permanent settlement was at Natchitoches, Louisiana, on the Red River in 1714. Permanent settlements which appeared in the southern portion of the study area during the next few years were all agriculturally-based, with the exception of New Orleans; nearly all were occupied by the French, who were also the principal early inhabitants of the upper valley, in what is now southeastern Missouri. The study area between French settlments on the lower river and to the north was unoccupied.

(3) The study area remained under French control until 1762, when France ceded to Spain its Louisiana territory west of the Mississippi River, including the Isle of Orleans. A year later, as a result of the French and Indian Wars, England acquired from France the region east of the Mississippi. During the same decade, 4,000 to 5,000 Acadians migrated to the Bayou Teche region of Louisiana after their expulsion from Nova Scotia in 1755. The early French settlements prospered under Spanish control, and under the direction of Governor Bernado de Galvez, the area became an ally of the United States during the American Revolution. After the war, increasing numbers of Americans moved into the central and northern portions of the Lower Mississippi Region and promptly demanded that the Spanish provide an outlet down the Mississippi to New Orleans for their produce.

(4) At the turn of the century, Louisiana changed hands twice, with France gaining title to the area from Spain in 1800, and Napoleon selling Louisiana to the United States in 1803. West Florida, however, remained under the nominal control of Spain for a time (Spain had gained title from France in 1783). Anglo-American settlers were increasingly dissatisfied with Spanish rule after 1803. To undercut the dissent, the Spanish governor authorized a convention to meet in 1809 to allow residents to participate in their governance. Early the next year, the convention voted to remove Spanish military forces from Baton Rouge. The move was implemented and the independent state of Republic of West Florida applied for, and was granted, admission to the United States.

(5) During the War of 1812, a fleet blockaded the mouth of the Mississippi River, and the British army was brought very near to New Orleans. During the winter of 1814-1815, the British army organized an assault on New Orleans with Andrew Jackson leading the defense of the

city. Jackson ordered all troops in Louisiana to New Orleans and offered pardons to Jean Lafitte's pirate band if they would join the fight. The British landed near New Orleans on 22 December and Jackson attacked them that evening. The American forces then withdrew to earthworks they had hastily erected at Chalmette. The British attacked unsuccessfully three times during the next two weeks and finally withdrew. The British fleet bombarded Fort St. Phillip, 80 miles down the river for 6 days and then withdrew, ending the Battle of New Orleans.

(6) From 1815 to 1960, the study area and its surroundings experienced amazing growth. Settlers from the eastern United States poured into the northern portion of the valley after 1803, as Indian claims were extinguished and cotton blossomed in the bottomlands on both sides of the river. By mid-century, elaborate plantation houses began to dot the banks of the river north of Natchez, as they had for fifty years farther down the river.

(7) The steamboat era contributed to the prosperity of the mid-nineteenth century. The first steamboat on the western waters was the City of New Orleans, built at Pittsburgh by Robert Fulton's firm; the state of Louisiana had granted this firm a monoply on steamboat operations on the Mississippi River. This paddle wheeler descended the Ohio and Mississippi Rivers in 1811--traveling through the New Madrid Earthquake, and kept a regular schedule between New Orleans and Natchez for the next two and one-half years. Other steamers were put into service on the lower Mississippi during the next several years, with other companies challenging Fulton's monoply by building and operating river steamers. By 1818 it was clear that the courts would not prevent anyone from operating steamboats on the Mississippi, and the number of steamers on the river increased rapidly.

(8) Land settlement patterns in the northern portion of the study area were influenced by the Northwest Ordinance of 1785. Areas open to settlement were surveyed and subdivided into square sections and townships with this grid superimposed over existing settlements for reference purposes. This system and the desire of most Anglo-Americans to live on their own land, encouraged isolated farmsteads. With the river an essential transportation route, a linear settlement pattern developed along the river banks, as it had in the south. Different phases of development could be seen side by side in the study area in the nineteenth century--plantations, small independent farmsteads, hunting and trapping homesteads located in swampy regions. In addition, towns with diverse populations contributed to the variety of settlement

patterns. The new prosperity along the river was evidenced in the growth of ports for the rapidly growing river trade. Cotton, wheat from Illinois, other agricultural products, and slaves were the main southbound cargoes. Agricultural products came from the hinterland to New Orleans for export. Slaves came from the upper south where a surplus existed, and left the river vessels at many points along the route. Memphis, Natchez, Vicksburg, and New Orleans were the most important slave markets, but most river towns dealt in slaves for the surrounding agricultural areas. In addition to acting as marketplaces, river towns provided services and entertainment for the river men themselves. Natchez-under-the-Hill is the most famous example of the sections devoted to brothels, taverns, and gambling establishments about which every river town boasted.

(9) This prosperity was interrupted by the Civil War which raged along the Mississippi River from November 1861 until July 1863. Establishing bases at the extreme northern and southern ends of the lower valley by spring 1862, the Union army and navy joined in a series of operations during the next sixteen months which gave them control of the entire Mississippi Valley. The earliest theater of action was in Kentucky and Missouri. The Union army slowly extended itself down both sides of the Mississippi River from Cairo toward Columbus and in November tried, without success, to take Belmont. Three months later Confederate forces were forced to evacuate Columbus, and moved to defend Memphis and its important rail connection. In March and April 1862, the Union army and navy launched their campaign and captured New Madrid and Island Number Ten, the forward defenses. By June, Fort Pillow and Randolph had been evacuated by the Confederates. Memphis was outflanked by the new Federal position at Corinth, but the Confederates decided to make a stand. Memphis was attacked on 19 May and again on 22 May; that failing, a siege began with Memphis falling in June 1862. By 4 July 1863, the Confederate forces at Vicksburg surrendered and the Civil War on the Mississippi River ended.

(a) Prosperity did not immediately return after the Civl War. Commercial steamboats began to ply the river again, but for a decade, the cotton crops were smaller than before the war, and the slave trade had ended. Plantations in the bottomlands had lost their work forces, and it was a few years before the share-cropping system developed. Sharecroppers lived in isolated poorly constructed dwellings near the plots of land they worked.

(b) Railroad development in the 1870's and 1880's helped spur economic recovery by connecting most of the major river towns with metropolitan areas to the east and west. Many southern leaders urged that the south industrialize, resulting in increased interest in textile production and other manufacturing establishments in the large river towns during the 1880's. However, as the nineteenth century ended, the Lower Mississippi Valley economy had still not recovered the vigor of the antebellum period.

(10) Table 19 lists known archaeological and historical sites and known steamboat wreck events.

(11) From the time the United States purchased the Louisiana territory in 1803, there were two distinct spheres of culture in the project area. The more densely populated lower valley, with its large-scale commercial agriculture, French influences, and civilized lifestyles contrasted with the rest of the region, where a small and diffused population practiced a nearly subsistence-type agriculture. Differences between these two spheres extended to methods of land division, legal requirements, community organization, architectural styles, religious practices, speech patterns, and even eating habits. These basic differences are still evident in the varied cultures of the project area. In south Louisiana, French influences are manifest in street and community names, speech, culture, and cuisine. In this area, the Roman Catholic faith is predominant. Less distinctive cultural groups are found in the region north of Baton Rouge, where Protestant faiths are predominant and names are mostly Anglo-Saxon. In the Mississippi delta, the life styles of blacks reflect conditions which developed during the era of plantation living.

(12) Flooding in the project area is primarily headwater flooding from the Mississippi River and is frequent, occurring almost annually due to spring flows fed by rainfall and snow melt in the upper regions. During major floods, the entire project area is inundated. The floods of 1913, 1927, 1950, and 1973, are four of the worst floods in this century in the study area. Most damage from these floods occurred in areas other than the project area. The project area is generally unprotected from flood damages with most existing flood control work within the project area intended for protection of the study area (see Figure 1). However, the project area is now largely protected from drastic channel changes as a result of floods. Average annual damages due to flooding in the project area probably range between \$5 to \$10 million. Structural

TABLE 19
KNOWN ARCHAEOLOGICAL AND HISTORICAL SITES
AND STEAMBOAT WRECK EVENTS

River Mile	Historical Sites	Steamboat Wrecks [1]	Archaeological Sites [2]
955-900	Belmont, Island No. 10, Fort Jefferson, Iron Banks, Columbus, Chalk Bluffs, Lake County Confederate Batteries	51	(23 Nm 27), (15 Fu 4)
900-800	New Madrid, Tomato	22	(23 Nm 25),(23 Nm 205), (23 Nm 234),(40 Lk 7), (40 Dy 2), (40 La 7), (40 La 11), (40 La 18), (40 La 20), (40 La 25), (40 La 31), (40 La 32), (40 La 34), (40 La 36), (40 La 37), (40 La 39), (40 La 40), (40 La 33), (3 Ms 23), (3 Ms 53)
800-700	Plum Point, Fort Pillow, Fulton, Randolph, Fort Harris, Fort Wright, Memphis, Steamboat Landing, Fort Pickering, and Confederate Naval Yard, Hopefield	81	(40 La 2), (40 La 4), (40 La 6), (40 La 12), (40 La 17),(40 La 20), (40 La 26), (40 La 38) (40 Tp 1), (40 Tp 12), (40 Tp 13), (40 Tp 14), (40 Tp 15), (40 Tp 16), (40 Tp 26), (40 Tp 34), (40 Tp 35), (40 Tp 36), (40 Sy 9), (40 Sy 10), (40 Sy 12), (40 Sy 27), (40 Sy 28), (40 Sy 75), (40 Sy 205), (40 Sy 284), (40 Sy 285), (3 Ms 3), (3 Ms 4), (3 Ms 17), (3 Ms 18), (3 Ms 60), (3 Ms 61), (3 Ms 64) (3 Ms 68), (3 Ms 69), (3 Ms 70), (3 Ms 71), (3 Ms 72), (3 Ms 73), (3 Ct 3), (3 Ct 7), (3 Ct 9), (22 Ds 50), (22 Tu 503), (22 Tu 504)

TABLE 19 (cont)
KNOWN ARCHAEOLOGICAL AND HISTORICAL SITES
AND STEAMBOAT WRECK EVENTS

River Mile	Historical Sites	Steamboat Wrecks [1]	Archaeological Sites [2]
700-600	Utica, Helena	30	(3 Le 51), (3 Ph 8), (3 Ph 20), (3 Ph 21), (3 De 19), (3 De 21), (22 Co 605), (22 Co 655)
600-500	Montgomery Point, Mhoon, Austin, Delta, Friar's Point, Port Royal, Sunflower Landing, Pushmataha Landing, Rosedale, Center Point, Longwood, Bunch's Bend	41	((3 De 28), (3 De 31), (3 De 32), (3 De 33), (3 De 34), (3 Ch 43-20613), (22 Bo 512-17L5), (22 Bo 566-18L6), (22 Bo 587-18L7), (22 Bo-18L2), (22 Ws 503-18L2) (22 1s 522 (23M6)
500-400	Vicksburg, Warrenton, Palmyra, Grand Gulf, Stack Island, Winter Quarters	33	(22 1s520), (221s-522-23M6), (22 Wr 521-22 L 5), (22 Wr-23 M 4), (22 Wr-24 L 16), (16 Ec 6-21L3), (16 Ec 22 L 4), (16 Ec 22 L 6), (16 Te - 29 L 8),
400-300	Bruinsberg, Rodney, Natchez Hutchins Landing, Fort Adams	42	(22 Cb 509), (22 Je 504), (22 Ad 516), (22 Wk 505), (22 Wk 510), (22 Wk 511- 28 J 3), (22 Wk 513), (22 Wk 514), (22 Wk 515), (22 Wk 516)
300-255	Bayou Sara, Port Hudson [3]	20	None known

TABLE 19
KNOWN ARCHAEOLOGICAL AND HISTORICAL SITES
AND STEAMBOAT WRECK EVENTS

River Mile	Historical Sites	Steamboat Wrecks 1	Archaeological Sites 2
255-200	Fort Bute Plaquemine Lock 3	31	(16 Ebr 24) (16 Wbr-1-31L6)
200-100	Bayou Goula, White Castle, Legaard	47	(13 Lv 11-32 L 1),
100-10	Fort St. Leon, Fort St. Phillip,3 Fort Jackson 3	173	(16 Pl 12-24 Q 7)

1 Steamboat wrecks are a compilation of known accidents, not precise sites. Some of these sites may be located during project construction and may be salvageable.

2 Numbers are standard reference numbers of known sites.

3 National Register of Historic Places.

improvements within the project area have consisted of revetments, dikes, levees, and floodwalls; additional channel improvement is provided by construction dredging. Pumping stations are presently at some areas with serious drainage problems behind the mainstem levees. In the remainder of the study area outside the project area, vast portions of productive forestland, farmland and developed urban lands are protected from flood damages by the extensive levee and channel improvement system. Flood problems in the study area are due mainly to flooding on tributaries, some backwater flooding from the mainstem, and interior drainage problems in levee protected areas. In general, except for interior drainage problems which are sometimes very difficult to correct, land uses in the Lower Mississippi Valley are well adjusted to the flood hazard to which they are exposed. Urban and other developments by and large avoid areas subject to backwater and tributary flooding.

b. Aesthetics. Aesthetics may be considered as the appreciation of things of beauty. It is obviously an intensely personal and individual reaction, and what is aesthetically pleasing to one person may not be to another. While a nature lover may prefer the raw wilderness, a farmer will appreciate the view of a field of ripening crops, and an engineer might be ecstatic over the graceful arches of a river bridge.

(1) The Mississippi River, the largest river in the United States, offers a wide range of conditions aesthetically attractive to people of varied tastes. The river is the most visually outstanding aspect of the project area landscape. Large bodies of water serve as an important element of visual composition because of their horizontal extent, color, and texture. The Mississippi River's sinuosity provides the additional visual characteristic of surprise. Inactive parts of the river, such as oxbows, fulfill a similar role. The natural and cultural land uses within the project area complement the river by their contrasting geometry, color, and texture, or are aesthetically significant in their own right, as with the bottomland hardwood forests. The relatively natural land uses, such as bottomland hardwood forests, also provide habitat for many species of wildlife which can be considered aesthetically significant components of the landscape.

(2) The river has several scenic natural features along its course. A Chickasaw Bluff trail is planned by the State of Tennessee. This hiking trail from Reelfoot Lake to Memphis will provide a viewpoint from which to observe some of the most impressive scenery along the Mississippi River. Bluffs begin where the Obion and Forked Deer Rivers meet in Tennessee and provide the eastern boundary from there

to Memphis. Crowley's Ridge at Helena, Ark., below the mouth of the St. Francis River, briefly provides the western boundary of the project area. Proceeding south, there are Petit Gulf Hills, Ellis Cliffs, Tunica Bluff, Balls Bluff, and Mobile Ridge. Bluffs exist on the east side of the river from Vicksburg to Baton Rouge. There are beautiful overlooks and cliffs ending with Scott Bluffs at Southern University in Baton Rouge.

(3) The project area contains many man-made features which either contribute to or detract from the aesthetic quality of the project area. The river is constrained on the west bank by levees for almost the entire distance from Cairo to the Gulf. The east bank has considerably fewer miles of levee, with approximately 25 percent of the river bank leveed from Cairo to Memphis, almost all of the east bank leveed from Memphis to Vicksburg, and no levees from Vicksburg to Baton Rouge. Below Baton Rouge, approximately 90 percent of the east bank of the river is leveed. Other man-made features along the river include revetments constructed on both banks to protect the river channel. From Cairo to Fitler, Miss., more than 300 dikes have been built into the river, most several hundred feet long, but some as long as one mile. Almost all these dikes are under water at mid-bank stage; however, many are not only visible at lower river stages, but have greatly influenced the development of sand islands and bars as a result of the still water areas created by the dikes. Below Fitler, dike construction has been limited to only 17 dikes at 6 locations.

(4) Other major man-made features are the river-crossings for roadways, railroads, and overhead utilities. These are landmarks along their river stretches, and can be either aesthetically pleasing, or from some points of view, detrimental. The project area is relatively poor in architecturally outstanding man-made structures which can be considered aesthetically pleasing, since it is used primarily for flood control, protection of adjacent areas, and navigation. The man-made features which do exist in the project area are generally of a utilitarian nature.

(5) Although the river is vast, it is nearly featureless, and the observer often cannot get a true sense of its dimensions. A tow and barge provide a measure of scale for the scene and a reference point for the observer. Where wooded land has been cleared, the clearings provide edge definition of the natural wooded areas, and may serve to break up the visual monotony of continuous stretches of nearly identical woodlands. There is, of course, some point at which the presence of

man-made elements can overwhelm the natural landscape and produce a system which some observers may find aesthetically distressing, such as the industrialized corridor from Baton Rouge to New Orleans.

(6) The levees provide visual access to the project area and adjoining lands where visibility is limited by the nearly level terrain. Bridges perform a similar function for the river and batture. In addition, bridges and large flood control structures may have an aesthetic value to some observers as engineering works.

(7) Other man-made features which contribute to the aesthetic experience of the project area are archaeological and historical sites. Although not always visually impressive in themselves, once understood, these places can provide an appreciation of the past, thus imbuing the physical scene with cultural ambience. Thus, while not a physically dominating feature of the landscape, historical and archaeological sites aid the observer in his perception of the project area by enhancing the likelihood of using imagination to view the scene as it must have seemed to prehistoric and historical people who participated in the development of the study area.

c. Population. There are approximately 9,000 people living in the project area (defined as the area between the levees), as estimated from 1973 flood evacuation information from the Memphis, Vicksburg, and New Orleans Districts of the Corps of Engineers. Most of these people live in the northern portion of the project area.

(1) The project area includes parts of 49 counties which border the Mississippi River between Cairo, Ill., and Venice, La., and the three counties bordering the Arkansas River below Pine Bluff. In 1970, the total population of these counties was 3,156,735, an increase of 7.7 percent since 1960. This increase is only slightly below the 8.1 percent of the surrounding six states, which had a total population of 19,599,559 in 1970. The general study area increase is somewhat misleading, however, in that most of the gains occurred in the urbanized areas in and around Memphis, Baton Rouge, and New Orleans. Almost without exception, counties bordering the river from Cairo to Baton Rouge showed significant population decreases, ranging as much as 30.8 percent in the Missouri Bootheel Region.

(2) Most counties of the project area have been losing population for several years. Counties in the upper portion of the project area have consistently lost population since 1940 with the exception of Shelby and Crittendon Counties, which contain the Memphis metropolitan

area. Counties in the middle portion of the river, between Memphis and Baton Rouge, have generally lost population over the past two decades except for Warren County, Miss., which includes the Vicksburg area and Jefferson County, Ark., which contains Pine Bluff. Nearly all counties in the lower region from Baton Rouge to the Gulf have grown continually for the past three decades.

(3) Migration may have significantly influenced these trends. Counties which encompass the project area showed an average outward migration rate of 2.7 percent between 1960 and 1970 as compared to the six state average of 3.7 percent. The river sections between Cairo and Memphis and Memphis to Baton Rouge had the highest population losses due to migration, 8.4 percent and 20 percent, respectively; in the area below Baton Rouge, population gained by 11 percent.

(4) The non-white population within the counties bordering the project area increased by 2.6 percent between 1960 and 1970, for a total 1970 population of 1,235,430, or 34 percent of the total population of counties bordering the project area. In comparison, non-whites in the six-state area increased 3.2 percent during the same period for a total 1970 population of 3,674,313, or 18 percent of the six state total population. Figures show a definite trend toward outward movement by non-whites; in 10 years, 16.5 percent of the study areas's non-white population emigrated versus 6 percent for the surrounding six states. This trend was most evident in the middle portion between Memphis and Baton Rouge, which lost 30.6 percent of the total non-white population due to emigration. Nevertheless, in 17 counties in this area, more than 50 percent of the population was black.

(5) All major river cities within the study area decreased in population over the past decade except for Memphis and Baton Rouge, which increased 25.3 percent and 8.9 percent, respectively (averages were calculated for population within the city limits). Population gains in Memphis were due in large part to inward migration (11.5 percent of population) while natural increase in Baton Rouge offset population losses due to outward migration (7.5 percent).

(6) The project area counties show similarity to national trends toward urbanization with 76.4 percent of the population classified as urban in 1970. Urbanization has proceeded at a pace comparable to that of the surrounding six states; however, the rural population has decreased more than three times as much as the six state rural average (15.9 percent versus 5 percent) over the past decade. Only one section, Memphis to Baton Rouge, is still predominantly rural (53 percent), and

both the upper and middle sections show significant rural population decreases and urban increases. The lower portion of the valley below Baton Rouge showed some rural population gains between 1960 and 1970 (9.1 percent); however, the urban population increased almost twice as much during the same period (16.9 percent) for a total 1970 urban population percentage of 87.7 percent, the highest in the study area.

(7) Population concentrations in the lower portion of the study area are also evident in density figures which indicate an average density of 319 per square mile area in the 4,534 square miles included in the Baton Rouge to Venice section (figures based on county land areas). This figure is significantly higher than the study area average of 120 per square mile in a total area of 23,522 square miles and more than five times as high as the six state average of 66 per square mile. The Memphis to Baton Rouge section has the lowest density in the study area, with an average of 42 per square mile.

d. Land Use. Approximately 2,297,000 acres lie within the project area, over 1,885,000 acres of land, and almost 412,000 acres of water bodies, including the river. These land uses are summarized in Table 20. As shown, almost two of every 10 acres are covered by water throughout the year. All but a small part is covered by water at some time during most years due to flooding.

(1) Forestland, consisting of woodlands and timber plantations, is the dominant use, and comprises almost one-half (47 percent) the land in the project area. Forests, which once covered nearly all the project area and large parts of the study area, have undergone large losses, particulary within the last 25 years. Forest clearing for agriculture was heaviest in the northern part of the project area (Mississippi County, Mo.) where there was a decline from 79 percent forest in 1950 to 9 percent in 1969. This is reflected, in part, in the present distribution of forest, which is more abundant between Memphis and Vicksburg, ranging from 60 to 75 percent of the project area land. North of Memphis, forests comprise only 15 to 30 percent of the land; south of Vicksburg, 35 to 45 percent.

(2) Cropland is the second most important land use in the project area, occupying 3 of each 10 acres of land (29.7 percent). Despite flooding in the project area and subsequent periodic losses, it is usually profitable to plant and harvest soybeans and cotton, depending on prevailing agricultural economic conditions. Cropland use patterns run counter to forests, ranging from 50 to 55 percent north of Memphis; between Memphis and Vicksburg, cropland constitutes 5 to 15 percent of the land; this use accounts for 15 to 45 percent of the land use south of Vicksburg.

TABLE 20
LAND USE PROJECT AREA

	Water Bodies Ac.	Woodland Ac.	Timber Plantation Ac.	Grassland Ac.	Cropland Ac.	Urban Ac.	Other Ac.	Total Ac.
	412,000	877,000	23,500	311,000	560,000	9,500	105,000	2,297,000
	(18%)	(38%)	(1%)	(14%)	(24%)	(0.4%)	(4.6%)	(100%)
Percentage of land area		47%	1.2%	16%	29.7%	0.5%	5.6%	

Note: All acreages measured at average low water plane (ALWP).

Water bodies include the channel of the Mississippi River; its slackwaters and chutes, lakes (including borrow pits filled with water year round) and tributary streams.

Woodland includes early successional, late successional, mixed bottomland hardwood, and swamp forest (see biological section for description).

Grassland includes levee grass, pasture, and unmanaged grassland.

Urban is estimated.

Other includes sand bars and borrow pits intermittently water-filled.

SOURCE: RETA (5)

(3) Grassland, including levee grass, pasture and unmanaged grassland, is a constant 15 to 20 percent of the land area from Cairo to Baton Rouge. Between Baton Rouge and Venice, the average is near 40 percent. For the project area as a whole, grassland constitutes 16 percent of the land use.

(4) Urban land uses, such as transportation/communications/utilities, industry, homes, etc., constitute a very small (0.5 percent) fraction of the project area's land. Urban land uses are most heavily concentrated in the Baton Rouge-New Orleans corridor, which accounts for approximately one-half of the project area's urban usage.

(5) The other categories include intermittently water-filled borrow pits, sand bars, islands, or other areas which lack permanent vegetative cover.

(6) About 90,000 acres, or 4 percent of the land total of the project area, is in public ownership, with the remainder in private ownership.

e. Transportation. The Mississippi River is a major transportation artery in the United States; in 1972, almost 438 million short tons of cargo were transported on the river between Cairo and Venice (including 146.6 million short tons of oceangoing cargo). Vessel traffic has increased 100 percent over the past decade, with a total of 85 billion (85,000,000,000) ton-miles transported in 1972 through the project area.

(1) Petroleum and foodstuffs are the major categories of cargo in the project area; in 1972, 38 percent of the total commodity tonnage (168 million tons) were petroleum and coal products and approximately 31 percent were foodstuffs, such as grains. Metals and minerals (17 percent) and chemicals (10 percent) make up the other dominant types of cargo. River transport is significantly less expensive than other modes of transportation capable of bulk commodity service. On a ton-mile basis, rail service is about five times as costly, with trucking more than 20 times the cost. Other factors, such as time, packaging, unit value, and origin-destination influence the choice of mode. But as a means of distributing bulk materials, river transport is extremely competitive.

(2) Major port cities in the study area include Memphis, Helena, Greenville, Lake Providence, Vicksburg, Natchez, Baton Rouge, and New Orleans. These ports handled 198.1 million tons of cargo in 1972.

New Orleans handled the largest volume (125.6 million tons), followed by Baton Rouge (52.9 million tons), Memphis (10 million tons), Vicksburg (2.6 million tons), Helena (2.7 million tons), Greenville (2.3 million tons), and Natchez (0.9 million tons). Lake Providence handled the lowest volume (0.4 million tons).

(3) The study area contains several major highway and railroad arteries. Interstates 10, 20 and 40 provide direct east-west highway facilities which link up with both coasts. Major north-south arteries include Interstate 55 and U. S. 61 on the east side of the river and U. S. 65 on the west side. These highways provide direct routes between St. Louis, Chicago, or Des Moines and New Orleans. The Missouri Pacific Railroad provides direct rail service to St. Louis, Kansas City, Little Rock, Omaha, Dallas, and El Paso on the west side of the river. On the east side, the Illinois Central Railroad offers direct service from Chicago to New Orleans and from Shreveport, La., to Meridian, Miss., through Vicksburg. Connections can be made at intermediate points on these lines to almost every major railroad in the country. Highway and rail arteries cross the river at 15 points between Cairo and the Gulf; in the Cairo to Memphis section there are two interstate highway crossings (I-55 and I-40), one U. S. highway bridge, and two railroad bridges. From Memphis to Baton Rouge, there are three U. S. highway bridges, one interstate (I-20), and one railroad/highway bridge. From Baton Rouge to the Gulf, there is one state highway bridge, two railroad/highway bridges, and one interstate highway bridge (I-10).

f. Economics. Most economic activity in the project area is based on agriculture and forestry. Industrial and commercial activities are limited primarily to adjunct facilities associated with enterprises within the study area but outside the project area where flood protection is available. Most economic activity in the study area consists of manufacturing and services within the major metropolitan areas of New Orleans, Baton Rouge, and Memphis. These activities economically dominate the study area.

(1) Agricultural statistics for the project area may be estimated from land use in the project area and trends in counties adjoining the project area. As detailed in paragraph 2.08d, Land Uses, 560,000 acres of cropland are in the project area. Assuming 373,000 acres (two-thirds from data on surrounding counties) in soybeans with an average yield of 23 bushels/acre at an average price of $4 bushel, gross revenue from soybean production is estimated at

$34.3 million per year. Assuming the remainder of the cropland, 187,000 acres, in cotton yielding 580 lbs/acre/year at an average price of $0.30/lb, gross revenue from cotton production is estimated at $32.5 million per year. There are 310,000 acres of grassland of all types in the project area. Assuming a yield of 250 lbs. beef/acre/year times an average price of $0.30/lb, gross revenue from cattle grazing is estimated at $23.2 million per year. Thus, gross agricultural revenue in the project area is $90 million per year.

(2) The project area contains 773,000 acres of woodland (excluding the early successional woodland which has little economic value) and 23,500 acres of timber plantations or a total of 796,500 acres of timber. Almost all this acreage is hardwoods, the major forest type, with such species as oak, gum, cypress, cottonwood, sycamore, and maple. Woodlands can be expected to yield a net annual return of $10 to $15/acre based on 1970 conditions. Timber plantations will yield about $20/acre/year. Thus, net revenue from woodlands is $7.0 to $12.0 million/year; and timber plantations at about $0.5 million/year. The total net revenue from forests would be $7.5 to $12.5 million/year.

(3) Mineral extraction in the project area is limited primarily to dredging or excavation of sand and gravel, although petroleum natural gas production and shell dredging is more important in the Louisiana portion of the project area. The mineral extraction in 1970 in the study area is conservatively valued at $1.8 billion due almost entirely to fossil fuel production. Mineral extraction in the current project area would be similarly dominated by fossil fuels, with sand and gravel production totaling perhaps $10 million annually, primarily from the metropolitan areas.

(4) Commercial fishing in the project area (exclusive of Missouri) in 1970 amounted to 7.2 million pounds valued at $1.3 million. Important species are buffalo fish, catfish, bullhead, crayfish, and mussels.

(5) Trapping is not considered a significant economic activity within the project area.

g. National Priorities. The project area plays an important role in the national energy situation. Barges are far more effective per ton-mile than rail, pipeline, truck, or aircraft. The 85 billion ton-miles of cargo handled on the lower Mississippi River in 1972 would require a total of 303 million gallons of fuel if transported by barge, 454 million gallons of fuel if carried by rail over the same distance, and 1,465 million gallons of fuel if transported by truck. About 38 percent of the cargo handled on the lower Mississippi River consists of coal and petroleum products. A large portion of the crude oil production in the United States is centered in Louisiana and the Gulf Coast is a major area of petroleum refining. Distribution of these products is easily handled by river transportation along the lower Mississippi River and its tributaries at lower costs than by other means.

The lower Mississippi River is not suitable for hydro-electric power generation but does play a role in power production as a source of cooling waters for nearby steam-electric generating plants. The Mississippi River supplies cooling water for 67 percent of the study area's major (25 megawatts or larger) steam-electric generation plants. Total 1970 withdrawals of cooling water by these plants exceeded one trillion gallons. Consumptive losses (evaporation) amounted to less than one percent in 1970; the remainder is returned to the river to assimilate residual waste heat after cooling. The river also plays a major role in the transportation of coal and petroleum, fuels that can be utilized in power generation. The use of the project area's waterborne transportation capacity is also important for national defense. The project area contributes to national defense readiness by allowing easy movement of defense materials and defense production commodities in a cost-effective and energy-conserving manner. The flood protection feature of the project area also allows the agricultural production of the study area to contribute to the national defense posture.

3. RELATIONSHIP OF THE PROPOSED PROJECT TO LAND USE PLANS

Land use within the project area is affected by frequent flooding and construction of the Mississippi River levee and channel improvements. Land use plans within this area should consider the basic uses of this area for navigation and flood control. At the present time, no known conflict with these purposes exists for Federal, State, or local governmental land use plans within the project area.

4. ENVIRONMENTAL IMPACTS OF THE PROPOSED ACTION

4.01. Impacts of the Proposed Action on Physical Features.

a. Impact on the River. Constriction and alignment of the river by channel stabilization devices may change the nature of the water surface area of the mainstem river. A maximum of 10,000 acres of river surface water would become low-lying inundated areas and river backwater.

The proposed project would not affect the river system drainage area or flows in that the size or shape of upstream drainage basins or the climatological characteristics of these drainage basins would not be affected. However, within the project area, where levees are close to the riverbanks, river stages may undergo a larger range of fluctuation in some localities during flood periods. This larger range of fluctuation would result from a more efficient channel and from the absence of levee breaks which allow the floodwaters to spread out landside of the levees.

b. Impacts on Other Water Bodies.

(1) Several project features may result in increased areal extent and scour of low-lying inundated areas. This increase would be due to natural fill of lakes and borrow pits due to floodwaters within the levees and to limitation of the river meander process by channel stabilization devices. In addition, constriction of the river may result in a land gain resulting from filling of standing water pools.

(2) Major lakes would be affected only by the lack of development of new oxbow lakes due to controlled alignment of the channel. The natural process of sedimentation and scour during flood stages would continue. However, smaller lakes and borrow pits may tend to fill with sediment and vegetative material. Hence, the maximum areal increase of low-lying inundated areas would be equal to the areal extent of existing borrow pits and small lakes and the projected areal extent of new borrow pits required to bring the levees up to grade. On this basis, the maximum increase of areal extent of low-lying inundated areas would be approximately 58,000 acres. Past experience indicates that the majority of these small lakes and borrow pits will not fill in during the life of the project features.

(3) Borrow pits in the project area constitute the majority of lakes less than 20 acres in size. The areal extent of these minor lakes in the project area is approximately 40,000 acres. The immediate impact of the project would be to increase borrow pit acreage by 10,000 to 20,000 acres. However, natural fill processes and eutrophication may eventually tend to change borrow pits to low-lying inundated areas. As previously mentioned, fill-in of these borrow pits is not expected to occur during the 100-year life of the project features.

(4) The majority of the project features would not inhibit the flow of tributaries to the Mississippi River nor affect the drainage area of the tributaries. Hence, the project would have no impact on the character of the tributaries.

(5) The project features are not expected to have an impact on harbors in the project area. Those harbors which may experience increased shoaling would undergo periodic maintenance dredging. The project may indirectly affect harbors through increased port and harbor facilities as a result of improved navigation.

(6) During times of normal or low flow, project features would not affect drainage into water bodies landside of the levees since the river is lower than these water bodies. During flood stages, those water bodies landside of the levees would receive water from the river through local elevation of groundwater levels.

c. Impacts on Water and Air Quality.

(1) The project would affect water quality primarily during the construction activities necessary to implement and maintain the project. Sediment carried by surface runoff results from construction activities when protective vegetative cover is stripped from existing levees and borrow areas. This effect would be temporary. Vegetative cover would be replaced and maintained on the levees, and natural growth in the borrow areas would resume at the cessation of construction activities.

(2) Dikes and foreshore protection placement are temporary activities and have a relatively low impact on water quality. Surface preparation which dislodges sediment is required and placement of rock material would disturb bottom sediment, but the disturbance would be of a temporary and localized nature. Revetment placement requires extensive bank preparation, including bank stripping and grading. Surface runoff from the construction site carrying sediment would contribute large sediment loads to the river. As with levee construction, sediment disturbance would normalize after completion of revetment construction. Over the long term, the construction of revetment works would reduce sediment load by eliminating erosion and caving of banks.

(3) Floodways are used only during extreme floods and it is doubtful that water quality of the Mississippi River would be significantly affected under these conditions. Floodway operations generally would not degrade water quality in the project area since their purpose would be to divert water from the area. However, water diverted to the Birds Point-New Madrid Floodway would be channelled back into the Mississippi River downstream of Cairo. The two major floodways are discussed in paragraph 2.

(4) Pump stations, though they may conceivably introduce substances into the river, would have a small impact on the river water quality due to their low volume of flow (less than 1,000 c.f.s.) relative to that of the mainstem during flood stages. It should also be noted that the substances which might be introducted to the mainstem by the pumping stations would be eventually introduced by natural drainage systems if the pump stations did not exist.

(5) Dredging for channel navigation, harbor maintenance and construction, and spoil of dredge materials back into the stream have the most significant impact on water quality due to the large quantities of material involved. Because of the extent of impact and the availability of records concerning the effect of dredging on water quality, dredging operations can be used to quantify the maximum effect of implementation and maintenance of the project features on water quality. Table 21 presents water quality analyses during dredging operations for several locations on the mainstem river. These analyses indicate that water quality degradation is minor when compared to the ambient water quality. Dredging for harbor maintenance and construction may introduce dredge spoil to land and/or water that exceeds Environmental Protection Agency criteria for nitrogen. Since this can cause local impacts in terms of water quality, care must be taken in such dredging and subsequent spoil disposal.

(6) Since drainage is toward the mainstem river, water quality would be affected only between the area of construction activity and the river. Hence, no impact on the water quality of the study area other than that inside the project area will result from the project, except where a lake exists landside of the levee where the levee is being raised.

(7) It should be noted that concentrations of floodwaters within a narrower and deeper channel may be degraded by altering the following elements:

TABLE 21
WATER QUALITY DATA DURING DREDGE OPERATIONS

Sample Point	Mid-Channel Above (1)	Directly Above (1)	100 Feet Below (1)	300 Feet Below (1)
Parameter				
Suspended Solids (mg/l)	172	120	152	132
Dissolved Solids (mg/l)	258	272	254	359
Volatile Solids (mg/l)	122	122	102	100
Settleable Solids (ml/l)	-	-	-	-
Turbidity (ju)	175	175	180	180
Dissolved Oxygen (mg/l)	7.0	7.5	8.0	8.5
Temperature (^{o}C)	25	25	25.1	25
B.O.D. (mg/l)	5.7	1.3	4.0	3.8
C.O.D. (mg/l)	-	-	6.2	8.4
Nitrogen (mg/l)	-	0	-	-
Phosphorus (mg/l)	0.2	0.35	0.4	0.1
pH	6.0	6.5	6.8	6.0
Conductance (ohms/cm)	450	450	450	440

(1) Location - Bordeaux Bar; Mi. - 682.2; Date of Sampling - 6-27-72
Dredge - Burgess; Sample No. - 16; Depth of water above ALWP* - 13.3

	(2)	(2)	(2)	(2)
Suspended Solids (mg/l)	36	12	12	12
Dissolved Solids (mg/l)	350	326	353	222
Volatile Solids (mg/l)	196	152	170	206
Settleable Solids (ml/l)	0.3	-	0.6	0.4
Turbidity (ju)	70	83	68	60
Dissolved Oxygen (mg/l)	8.5	8.3	8.5	8.6
Temperature (^{o}C)	24	24	25	25
B.O.D. (mg/l)	-	-	-	-
C.O.D. (mg/l)	-	-	-	-
Nitrogen (mg/l)	-	-	-	-
Phosphorus (mg/l)	0.05	0.3	0.2	0.2
pH	6.3	6.5	6.0	6.2
Conductance (ohms/cm)	460	441	450	440

(2) Location - Ludlow Bar; Mi. - 621.0; Date of Sampling - 9-12-72
Dredge - Ockerson; Sample No. - 17; Depth of water above ALWP* - 7.3

TABLE 21 (Cont)
WATER QUALITY DATA DURING DREDGE OPERATIONS

Sample Point	Mid-Channel Above (3)	Directly Above (3)	100 Feet Below (3)	300 Feet Below (3)
Suspended Solids (mg/l)	90	84	95	92
Dissolved Solids (mg/l)	141	135	148	145
Volatile Solids (mg/l)	56	52	58	61
Settleable Solids (ml/l)	0.5	0.5	0.6	0.5
Turbidity (ju)	86	92	95	87
Dissolved Oxygen (mg/l)	8.0	7.5	8.0	7.0
Temperature (^{o}C)	28	26	27	-
B.O.D. (mg/l)	-	-	-	-
C.O.D. (mg/l)	-	-	-	-
Nitrogen (mg/l)	-	-	-	-
Phosphorus (mg/l)	-	-	-	-
pH	7.0	7.0	6.5	7.5
Conductance (ohms/cm)	410	420	430	400

(3) Location - Jack Ferguson; Mi. 614.0; Date of Sampling - 9-1-72
Dredge - Ockerson; Sample No. - 18; Depth of water above ALWP* - 8.8

	(4)	(4)	(4)	(4)
Suspended Solids (mg/l)	92	86	102	96
Dissolved Solids (mg/l)	232	220	243	237
Volatile Solids (mg/l)	171	165	243	181
Settleable Solids (mg/l)	0.5	0.5	0.5	-
Turbidity (ju)	65	63	72	68
Dissolved Oxygen (mg/l)	8.0	8.0	8.5	8.0
Temperature (^{o}C)	24	24.5	24	24.5
B.O.D. (mg/l)	-	-	-	-
C.O.D. (mg/l)	-	-	-	-
Nitrogen (mg/l)	-	-	-	-
Phosphorus	-	-	-	-
pH	6.5	6.8	7.0	7.3
Conductance (ohms/cm)	435	430	435	430

(4) Location: Ruby; Mi. 902.0; Date of Sampling: 9-21-72
Dredge: Potter; Sample No. - 1;Depth of Water Above ALWP* - 12.4

TABLE 21 (Cont)
WATER QUALITY DATA DURING DREDGE OPERATIONS

Sample Point	Mid-Channel Above (5)	Directly Above (5)	100 Feet Below (5)	300 Feet Below (5)
Suspended Solids (mg/l)	108	36	196	32
Dissolved Solids (mg/l)	257	286	289	286
Volatile Solids (mg/l)	107	105	113	119
Settleable Solids (ml/l)	-	-	-	-
Turbidity (ju)	140	180	240	220
Dissolved Oxygen (mg/l)	8.5	8.0	8.0	7.5
Temperature (°C)	24	24	23	23.5
B.O.D. (mg/l)	-	-	-	-
C.O.D. (mg/l)	11	12	15	11
Nitrogen (mg/l)	-	-	-	-
Phosphorus (mg/l)	0.2	0.4	0.4	0.4
pH	6.5	6.0	5.5	5.5
Conductance (ohms/cm)	440	430	450	460

(5) Location: Kentucky Point, Mi. 887.0; Date of Sampling - 6-23-74
Dredge - Potter; Sample - 3; Depth of Water Above ALWP* - 13.1.

* Average Low Water Plane

a The broad flood plain environment contains trees, shrubs, vegetation, and organisms which in their growth, absorb and utilize nutrients and minerals from runoff.

b Water velocity decreases on a flood plain result in sedimentation. Also, water trapped in flood plain pools seeps into the ground, is filtered or evaporated, and is returned in the hydrological cycle in a purer form. However, note that channelization would tend to decrease the amount of sediment available.

c Pockets and pools in the flood plain and shallow water areas afford ideal conditions for photosynthetic reduction of stream impurities and the production of oxygen.

d Shallow water areas contain a multitude of aquatic organisms which help in the natural purification process. Reduction of shallow areas could therefore reduce stream purification capabilities.

e By concentrating water in a straightened, deeper channel, the friction afforded by a shallow, vegetated, meandering channel is greatly reduced and stream velocities are increased, thereby increasing the erosive qualities of the stream as well as its silt-carrying capacity. Silt deposition could therefore increase downstream in these reaches where velocities are reduced below settling velocities and where conditions are suitable for sedimentation. However, as noted previously, the amount of silt available would tend to be decreased as a result of the proposed project.

(8) The project features may influence local temperatures and precipitation by affecting the amount of exposed water surface in the area. However, the areal change would not be sufficient in either the project or study area to alter basic area climatology.

(9) Activities related to upgrading the levees, installing channel stabilization devices and floodgate construction would have no direct effect on air quality, except during the construction phase. Because construction would take place over a period of years at various locations along the river, the overall impact on air quality would be negligible.

d. Impacts on Man-made Structures.

(1) Levees would be directly affected by the project since they would be upgraded to the revised 1973 project flowline. To accomplish

this goal, 30,000 to 45,000 acres of additional land would be disturbed in the project area by construction activities. Bank failures which occur during flood emergencies may require levee setbacks. These setbacks are constructed during flood emergencies or during rehabilitation phases and are funded by emergency funds. Bank failures and subsequent levee setbacks would be reduced with the completion of all MR&T features, particularly the additional revetments.

Setbacks, other than emergency setbacks, are undertaken subsequent to the discovery of unstable levee situations. Impacts related to setback activities can vary considerably, depending on the location of the setback and adjacent land uses. Land requirements may include croplands, woodlands or even residential areas. Loss of lands for setback construction may represent an irretrievable loss of resources. Relocation of public utilities, residences, and businesses are sometimes required for such setbacks. Correction of potentially dangerous levee situations, while sometimes imposing hardships on affected persons, also provides necessary margins of safety to these same individuals plus many more living in the area.

Relatively narrow battures exist in the reaches of the Mississippi River below New Orleans which do not allow for riverside expansions of levees. Any increases in levee widths, as well as setbacks, necessitate land requirements on the protected side of the levee. Because of the protection afforded to these lands, the values are usually much higher and environmental and socio-economic impacts are more adverse than if these lands were located on the river side. The degree of impacts are closely allied to the land uses of the affected area. Land uses adjacent to the levees south of New Orleans include residential areas, pasturelands, and citrus orchards.

(2) Retention of a properly aligned channel by channel stabilization techniques will decrease sediment contribution generated by the natural meander processes of the river, which would subsequently reduce maintenance dredging requirements. New construction dredging along the navigable channel would also decrease due to a properly aligned channel; however, increased river traffic would be expected to indirectly result in new construction dredging for additional port facilities. At present, approximately 75 million cubic yards are dredged annually.

(3) The placement of additional dikes, levees and foreshore protection to retain a natural alignment of the river would increase the existing number of systems. A total of 574 dikes in 165 locations would

be added to the system. The linear extent of expansion of revetments and foreshore protection is 325 miles at 154 locations and 74 miles at 52 locations, respectively.

(4) Harbor-related impacts in the project area would occur as a direct result of channel stabilization techniques used to constrict the channel and maintain a permanent alignment. As dike and revetment systems are implemented, the river adjusts downstream. In some cases, downstream adjustment would include increased sediment deposition in harbor areas. However, as mentioned previously, harbors are expected to be kept open through maintenance dredging.

(5) Indirect impacts of the project on harbor areas may be to increase the size and number of harbors with access to the mainstem river. This would result from an increase in river commerce which may, in part, be due to improved river navigation.

(6) No adverse impact on man-made structures such as bridges, wharfs, ferry crossings, pipelines and other mineral installations, power and communication lines, etc., is expected in the study area other than those already discussed within the project area. Generally these will be relocated or protected when in between the levees, and upgrading the levees would directly benefit man-made structures land-side of the levees by protecting acreage from flood damage.

4.02. Impacts of the Proposed Action on Biological Communities.

a. General.

(1) The primary impact of man's activity on plants and animals is the encouragement, creation or destruction of habitats. Biota of specific types are found in certain habitats, and in most cases, they cannot live and complete their life cycles when these habitats are altered or disturbed. The proposed project would cause significant changes in terrestrial and aquatic resources available to plant and animal species in the project area.

(2) A two-step approach was used to determine impacts of the project on biota; first, to quantify the change expected in the extent of basic habitats; and second, to qualitatively assess the impact of that change in habitat on the biota of the area. These qualitative impacts on biota are expressed as: minor, significant, and strong, in order of increasing impact. The basic habitats that can be defined in the project area are the same as described in the present environmental

setting. Changes in habitat as a result of the project are quantified in Table 22. The anticipated impacts of this habitat change on terrestrial vertebrates are summarized in Table 23; the impact on aquatic vertebrates is shown in Table 24. Additional secondary impacts that may indirectly result from the implementation of the proposed project features are more difficult to assess. In many instances, the indirect impacts are caused by a number of factors, of which the proposed features are only part. Therefore, indirect impacts in this assessment are given only minor consideration.

(3) Focusing primarily on the proportions of various habitats affected by the project has some inherent deficiencies as far as relating biological impacts. These include: (1) the effect upon the habitat within the project area may not have the same relative importance as the effect on the region of which the project area is a part; (2) the effect of changing the vegetation habitat type is not strictly proportional in its effect on the faunal elements; and (3) there is a dimension of time, as well as space, and the various habitats cannot be weighed equally in this respect. These ideas are discussed below:

(a) The project area contains some of the best and most extensive bottomland hardwoods and swamp forest remaining in the Mississippi River Valley. In the northern stretch, it may contain virtually all the significant woodland that remains in a given county. The tremendous deer kills previously shown in the counties bordering the project in Mississippi and northern Louisiana are possible because of the productivity of the bottomland woods. In a regional context, this habitat is more important than it might appear on the basis of habitat acreages within the project area.

(b) To persist through time, all species of organisms must maintain healthy populations, and the gene pools of these populations must retain sufficient genetic variability to allow the species to adapt to changing environments. Only remnants of original mixed bottomland hardwoods and swamp forests remain today and many of them are relatively isolated from other such habitats, existing in effect as islands. Recent experimental and theoretical work on island ecology has demonstrated that extinction rates of species on islands are inversely related to island area (24). This means that in some cases, decreases in habitat area may not just affect a concomitant decrease in the population size of a particular species in that habitat, but may increase the possibility that the population will suffer a local

TABLE 22
IMPACT OF PROPOSED PROJECT ON BASIC HABITAT
(As Acres ALWP and Percent Change)

River Reach	Main River (>5 ft.depth)	Main River (< 5 ft.depth)	Chutes	Slack-water	Lakes	Borrow* Pits	Early Successional Woodland	Late Successional Woodland	Mixed Bottomland Hardwood	Swamp Forest	Edge and Transition	Other*
Cairo-Memphis	-500 (-1%)	-100 (-1%)	-200 (-3%)	-3,300 (-35%)	0 (0%)	+200 (+16%)	-1,800 (-14%)	-600 (-1%)	-400 (-1%)	0 (0%)	+3,200 (+4%)	+3,400 (+1%)
Memphis-Baton Rouge	-7,100 (-5%)	-900 (-5%)	-3,700 (-36%)	-1,400 (-11%)	0 (0%)	+11,200 (+119%)	-6,400 (-9%)	-13,800 (-5%)	-4,400 (-1%)	-200 (-2%)	+7,700 (+4%)	+18,000 (+5%)
Baton Rouge-Venice	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	-1,700 (-9%)	-600 (-8%)	-600 (-10%)	0 (+0%)	+2,300 (-21%)	+600 ((+2%)
Overall	-7,600 (-3%)	-1,000 (-3%)	-3,900 (-23%)	-4,700 (-22%)	0 (0%)	+11,400 (+108%)	-9,900 (-9%)	-15,000 (-4%)	-5,400 (-1%)	-200 (-2%)	+13,200 (+5%)	+22,000 (+3%)

* Only Borrow pits generally filled with water year-round, others classified with edge and transition.

** Includes levees, cropland, plantations and exposed sandbars.

Source: Planimetry of projected changes by Ryckman/Edgerley/Tomlinson and Associates, Inc. (5)

TABLE 23
IMPACT OF PROJECT ON SELECTED VERTEBRATE SPECIES AND GROUPS WITHIN THE PROJECT AREA.

Group	Early Successional			Late Successional			Mixed Bottomland Hardwood			Swamp Forest			Edge & Transitional			Mainstem			Slackwater			Borrow Pits Lakes		
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
GAME																								
Swamp rabbit	-	-	-	-	(-)	-	-	-	-	NA	-	NA	+	+	+									
Cottontail rabbit	-	-	-	-	(-)	-	-	-	-				(+)	(+)	+									
Squirrels				-	-	-	-	(-)	(-)	NA	-	NA												
Deer	(-)	(-)	*	-	(-)	*	(-)	(-)	*	NA	-	NA	+	(+)	*									
Geese																			-	-	NA	+	+	NA
Mallard (Dabblers)							-	-	-	NA	-	NA							(-)	(-)	NA	(+)	(+)	NA
Wood duck				-	(-)	(-)	-	(-)	-s	NA	-	NA							(-)	(-)	NA	(+)	(+)	NA
Diving ducks																-	-	-	(-)	(-)	NA	(+)	(+)	NA
Turkey				-	(-)	-	-	(-)																
Bobwhite quail	-	-	*	-	-	*	-	-	*				(+)	(+)	*									
Rails, gallinules, coots, snipe																			(-)	(-)	NA	(+)	(+)	NA
Woodcock				-	(-)	-	-	(-)	-				+	+	+									
Mourning dove	(-)	(-)	-	-	-	-							(+)	(+)	+									
FURBEARERS																								
Opossum	-	-	-	-	(-)	-	-	(-)	-				(+)	(+)	+									
Beaver	(-)	(-)	-							NA	-	NA							(-)	(-)	NA	(+)	(+)	NA
Nutria muskrat	-	-	+							NA	-	NA							(-)	(-)	NA	(+)	(+)	NA
Bobcat cougar				-	(-)	*	-	(-)	*	NA	-	NA	+	+	*									
Fox-raccoon	(-)	(-)	-	-	(-)	-	-	(-)	-	NA	-	NA	(+)	(+)	+									
Skunks	-	-	-	-	(-)	-	-	(-)	-	NA	-	NA	(+)	(+)	+									
Weasel				-	(-)	-	(-)	(-)	-	NA	-	NA	(+)	(+)	+									
Mink-otter	-	-	-							NA	-	NA							-s	(-)	NA	(+)	(+)	NA
Coyote				-	(-)	-	-	(-)	-	NA	-	NA	(+)	+										
NON-GAME																								
Mammals-																								
Moist lowland	(-)	(-)	-	-	(-)	-	-	-	-	NA	-	NA												
Woodland				-	(-)		-	(-)	-															
Edge-transitional	-	-	-	-	-	-	-						(+)	(+)	+									
Bats					-			-																
BIRDS																								
Omnivores	(-)	(-)	-	-	(-)	-	-	(_)	-	NA	-	NA	(+)	(+)	(+)									
Top carnivores				-	(-)	-	-	(-)	-s	NA	-	NA												
Aquatic foragers				-	-	-	-	(-)	-s	NA	-	NA							(-)	(-)	NA	(+)	(+)	NA
Insectivores	(-)	(-)	-	-	(-)	-	-	(-)	(-)	NA	-	NA	(+)	(+)	(+)									
Aerial insectivores							-	-	-										(-)	(-)	NA	(+)	(+)	NA
Herbivores	(-)	(-)	-	-	(-)	-	-	(-)	-	NA	-	NA	(+)	+s	+									
AMPHIBIANS																								
Aquatic										NA	-	NA							(-)	(-)	NA	(+)	(+)	NA
Terrestrial	(-)	(-)	-	-	(-)	-	-	(-)	-	NA	-	NA	(+)	+	+				(-)	(-)	NA	(+)	(+)	NA
REPTILES																								
Aquatic	-	-	-							NA	-	NA				-	-		(-)	(-)	NA	(+)	(+)	NA
Terrestrial	-	(-)	-	-	(-)	-	-	(-)	-	NA	-	NA	(+)	(+)	+									
Alligator											(-)	NA								-	NA			

* Species is scarce in project area, large effect on habitat in project area should not significantly affect population in the region.
\- + minor
(-)(+) significant
-s, +s strong
NA Not applicable - habitat does not significantly occur in this region of project area.
A - Cairo to Memphis (955-735)
B - Memphis to Baton Rouge (735-255)
C - Baton Rouge to Venice (255 - 10)

TABLE 24

IMPACT OF THE PROJECT ON FISHES WITHIN THE PROJECT AREA

	Main River			Chute			Slackwater *			Borrow Pits**		
	A	B	C	A	B	C	A	B	C	A	B	C
Paddlefish	-	-	-	-	(-)	NA	-s	(-)	NA	+	+	NA
Sturgeon	-	-	-	-	(-)	NA	-s	(-)	NA	+	+	NA
Buffalo fish	-	-	-	-	(-)	NA	-s	(-)	NA	(+)	+s	NA
Walleye	-	-	-	-	(-)	NA	-s	(-)	NA	+	+	NA
Sauger	-	-	-	-	(-)	NA	-s	(-)	NA	+	+	NA
Catfish	-	-	-	-	(-)	NA	-s	(-)	NA	(+)	+s	NA
Drum	-	-	-	-	(-)	NA	-s	(-)	NA	(+)	+s	NA
Carpsucker	-	-	-	-	(-)	NA	-s	(-)	NA	(+)	+s	NA
Carp	-	-	-	-	(-)	NA	-s	(-)	NA	(+)	+s	NA
Bowfin	-	-	-	-	(-)	NA	-s	(-)	NA	(+)	+s	NA
Shad	-	-	-	-	(-)	NA	-s	(-)	NA	(+)	+s	NA
Minnows	-	-	-	-	(-)	NA	-s	(-)	NA	(+)	+s	NA
Sunfish	-	-	-	-	(-)	NA	-s	(-)	NA	(+)	+s	NA
Bass	-	-	-	-	(-)	NA	-s	(-)	NA	(+)	+s	NA
Crappie	-	-	-	-	(-)	NA	-s	(-)	NA	(+)	+s	NA

* Chutes and slackwaters as defined to not exist to any degree within the Baton Rouge-Venice section of the river. However, back-eddies do occur and they are similar to slackwaters as defined as habitat.

** Borrow pits are drained for mosquito control within the Baton Rouge-Venice section of the river.

- \- + minor
- (-) (+) significant
- -s, +s strong
- NA Not applicable - habitat does not significantly occur in this region of project area.
- A Cairo to Memphis (955-735)
- B Memphis to Baton Rouge (735-255)
- C Baton Rouge to Venice (255 - 10)

extinction. For example, a particular tract of woodland may have sufficient resources to support a population of seven pairs of Cooper's hawks. This may represent a minimally healthy population size for this species. If, however, a 20 percent reduction in the size of this woodland occurred as the result of this or some other project, the Cooper's hawk might suffer a reduction in population size to five pairs. This might be an insufficient population size to remain viable, and the final result might be the local extirpation of the Cooper's hawk from such an area.

(c) Through time, the river in the course of its meanderings adds land and takes land away. New sand bars may be vegetated by willows in 2 to 4 years. Table 25 presents Shelford's (25) schedule of community development in the flood plain in Kentucky and southeastern Missouri. It can be seen that the development of the bottomland hardwoods requires much more time than the initial colonization of early successional elements. Some transitional lands will require decades to develop even the aspect of a forest. The typical bottomland associations with a full complement of floral species probably require centuries rather than decades for development. In fact, the latter stages of the succession are no longer possible in the project area because they require terraces which permit the growth of species such as tulip tree, white oak, and several hickories. The existing levee systems hold the community development well below the subclimax forest level along the river. Thus, the impact of projected destruction or alteration is more enduring on some habitats than on others. Schedule of community development may be significantly shortened in lower reaches of the river due to increased length of growing season compared to the Kentucky/Missouri experience, but data to support that is lacking at present.

b. Terrestrial Communities.

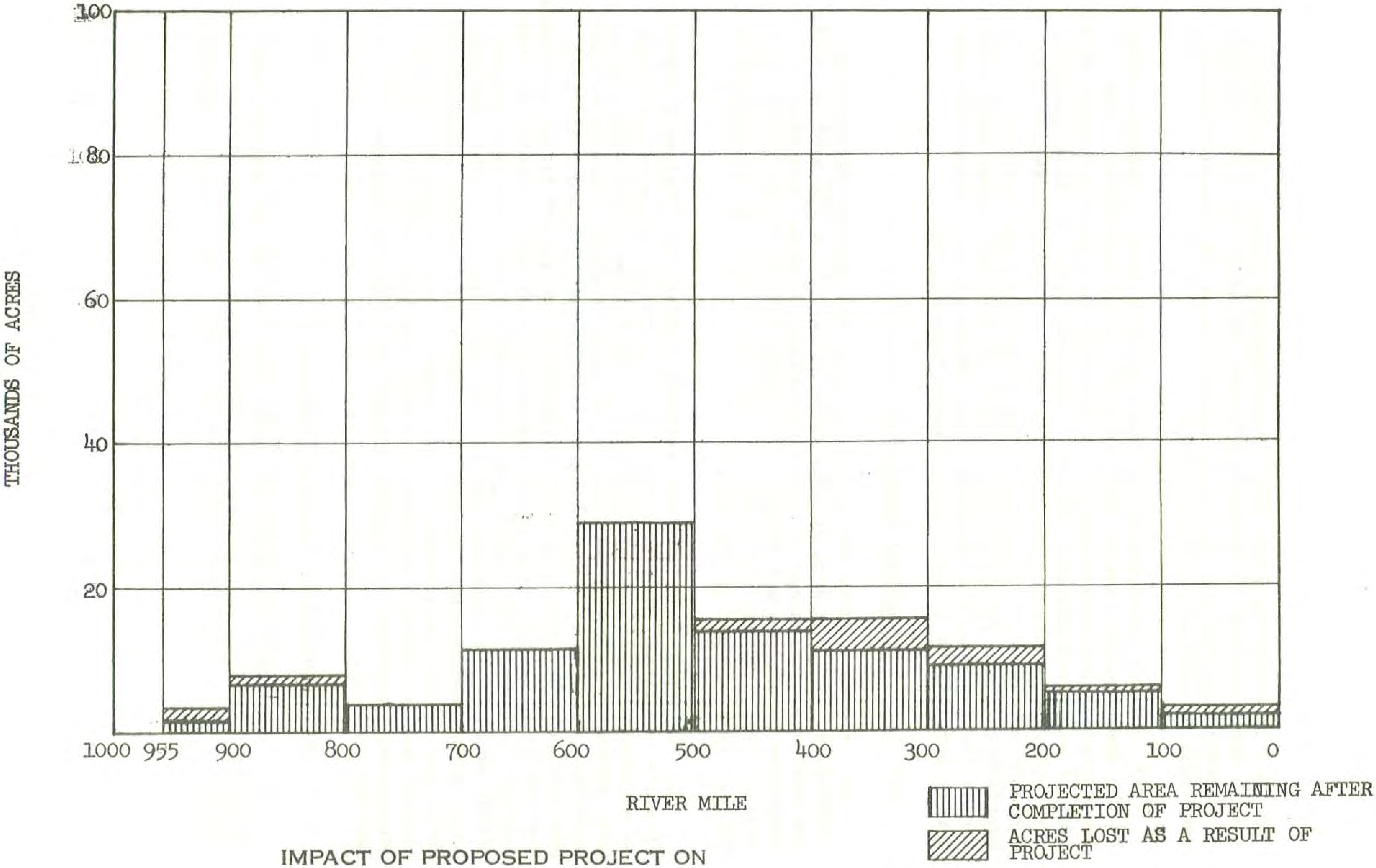
(1) Early Successional Community.

(a) The impact of the proposed project on early successional habitat would probably be limited to two reaches of the river. Between river miles 955 - 900 and 500 - 200, there are significant negative impacts (see Figure 6). The estimated loss of early successional habitat (primarily sand bar and black willow) within the project area is 9.4 percent, but the section from mile 500 - 200 will lose about 17 percent of its early successional communities.

TABLE 25
SCHEDULE OF COMMUNITY DEVELOPMENT

Successional Stage	Years in Period	Description of Areas and Processes	Years to recover: Added	Years to recover: Total
Virgin cottonwood-willow	35	Building of sand bar to 5 ft. above M.L.W.; April-May; water level suitable for sand bar willow	2-4	2-4
		Growth of sand bar willow. Deposition of 10-20 ft. of sand for seeding of cottonwood and willow. Elimination of total submergence of willows	11-13	13-15
		Growth of cottonwood-willow through equal growth period of the two	19-21	34-36
Older cottonwood-willow	51	Area assumed ready for cottonwood-willow at beginning. Less 21 gives 30 years of (a) elimination of willow dominance, (b) development of maple-box elder under cottonwood, (c) entrance of hackberry and gum	28-30	64-66
Hackberry-gum	82	Less 65 years; 17 years eliminates cottonwood dominance; beginning of hackberry, elm, and gum dominance	16-18	80-84
Early oak-hickory	116 & 134	175 years for entrance of early oaks and hickories. Subordination of hackberries and gums. Entrance of intermediate oaks and hickories	175-180	250-360
Old oak-hickory	No Data	First phase; elimination of early oaks and hickories	80-100	340-360
Western mesophytic forest (_sensu_ Braun)		Entrance of some remaining tulip-oak forest species	150-170	600-620

Source: Shelford (25)



IMPACT OF PROPOSED PROJECT ON
EARLY SUCCESSIONAL HABITAT
FIGURE 6

FIGURE 6

(b) It should be noted that these habitats develop in comparatively short periods of time and may show increases in total acreage if waterflow conditions are stabilized to allow the colonization of sand bars by willows on local levels.

(c) Animals particularly affected by this loss of habitat would be the semi-aquatic mammals such as mink, otter and beaver. Some insectivorous and omnivorous birds also will be negatively affected by loss of early successional habitat. However, most of these species are typical of disturbed habitats, so that the negative impact will probably not extend beyond the period of project construction. Reptiles that are predominantly aquatic utilize land areas near water bodies for reproductive purposes. The impact on this group (predominantly turtles) is judged to be a minor negative one.

(2) Late Successional Community.

(a) Figure 7 shows the impact on late successional habitats by river mile, with the area between river miles 500 to 200 most affected. The estimated percentage of late successional habitat disturbed or destroyed by the project would be 4 percent of the total within the project area. Within the mile 500 - 200 river section, the estimated acreage is 8 percent of the total.

(b) This impact on late successional habitat is considered significantly negative. This late successional habitat requires a minimum of perhaps 50 years for establishment. The willow, cottonwood, sycamore community is potential habitat for most woodland forms (i.e. deer, squirrels, mice, many birds, skinks, tree frogs) that occur in those woodland habitats with sufficient understory and ground litter available. The status of larger, less common mammals (black bear, coyote, Florida panther) is relatively unknown in the project area. The late successional woodland is potential habitat for these species. This habitat could also provide sites for breeding colonies of herons, particularly where more mature woodlands are less common. Distrubance or destruction of such a colony would have a strong negative impact on heron populations, probably way out of proportion to the percentage of habitat affected.

(3) Mixed Bottomland Hardwood Community.

(a) The mixed bottomland hardwood community is the most diverse terrestrial habitat type within the project area in terms of tree species. Again, the river reach from mile 500 - 200 will be impacted

IMPACT OF PROPOSED PROJECT ON LATE SUCCESSIONAL HABITAT
FIGURE 7

FIGURE 7

much more than other river sections (see Figure 8). An estimated 4 percent of this habitat will be lost in this river section, and due to biological desirability of mixed bottomland hardwood habitat, this negative impact is considered significant.

(b) A variety of faunal elements including game species such as deer, squirrels, wood duck, and turkey will be adversely affected by the habitat loss. The fauna occurring in this community are similar to late successional communities in many ways.

(4) Swamp Forest Community.

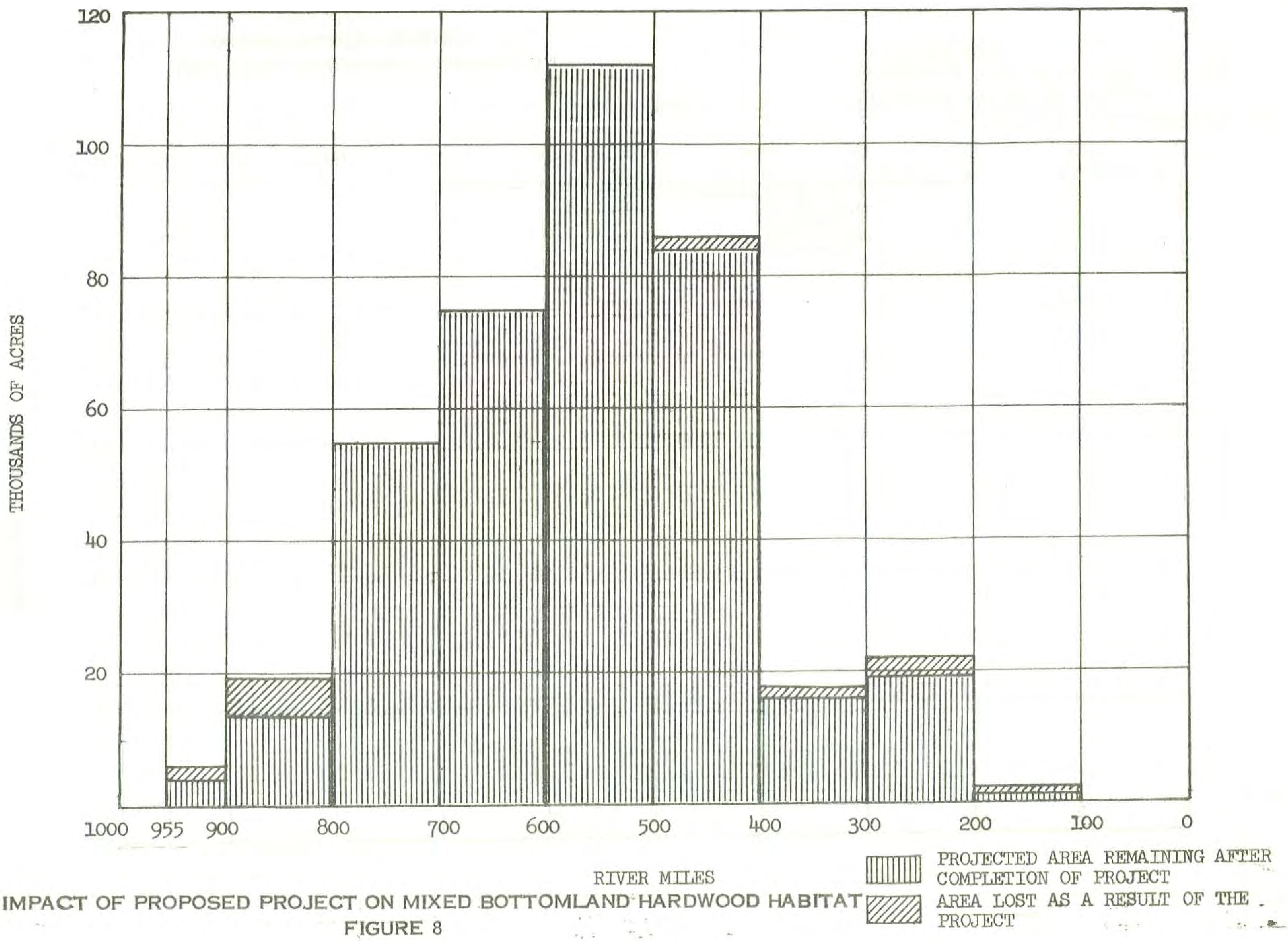
(a) The impact on swamp forest within the project area is limited to the area between river miles 400 and 300. (See Figure 9.) Within the region, 200 acres would be disturbed or destroyed, representing about 2 percent of the 10,900 acres of swamp forest within that reach of the river. This is considered a moderate negative impact due to the scarcity of this habitat in the project area.

(b) Swamp forest is made up primarily of cypress and tupelogum. This plant association is limited to North America and is one of the preferred habitats of the American alligator. The swamp forest has a rich herpetofauna which would be affected to the extent that the habitat would be destroyed.

(c) The swamp forest is also the preferred location for nesting by herons, egrets, and ibises, although some may also be found in mixed bottomland hardwoods and late successional woodland. The nesting sites are small, high density, mixed species colonies which may be used year after year. Generally, the impact of the proposed project on this group of aquatic foragers is judged to be negative but minor. However, this could become a strong negative if an active, traditional colonial nesting site is destroyed or disturbed by the project.

(5) Edge and Transitional Communities.

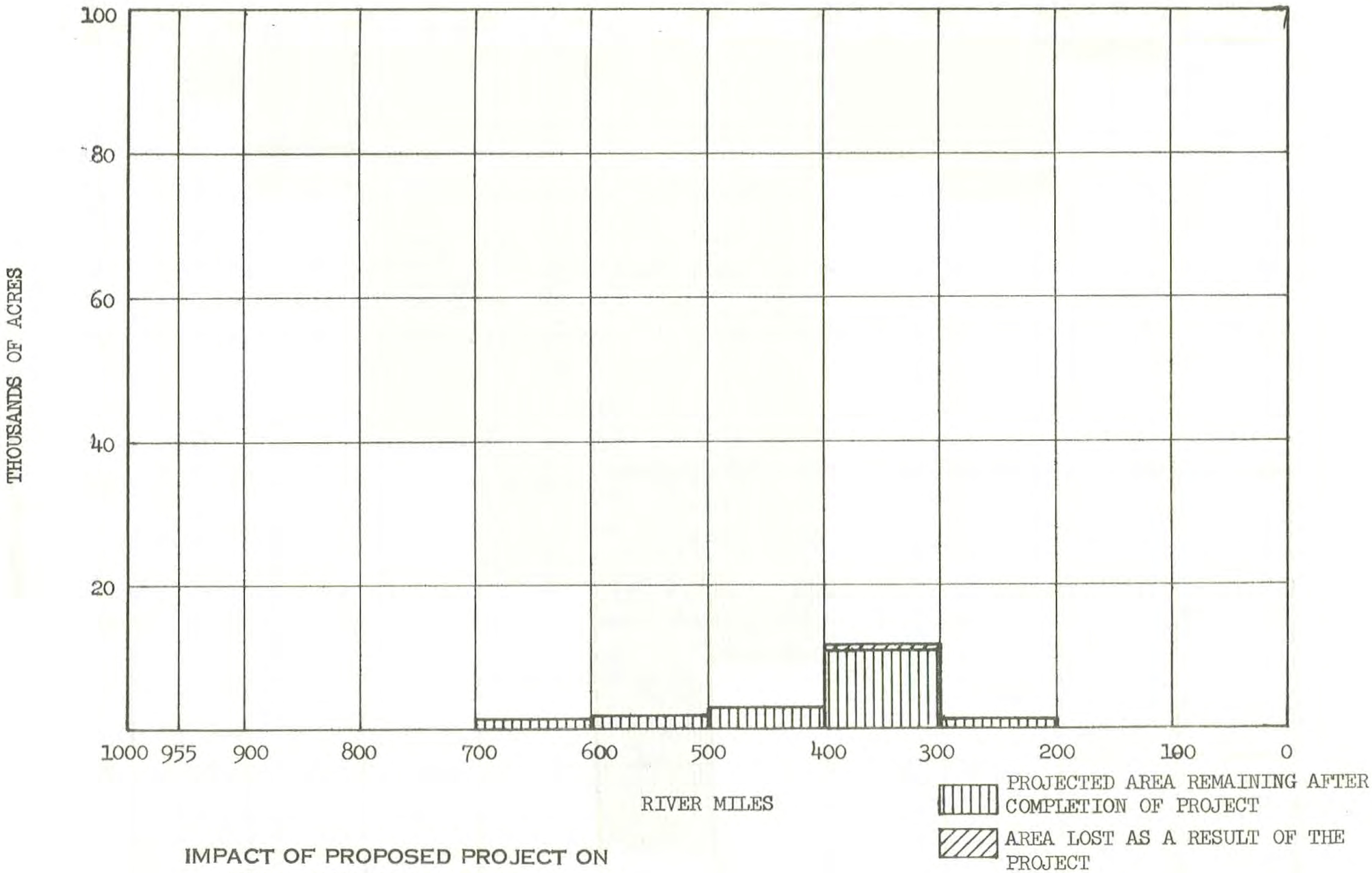
(a) The transitional areas and edge habitat should be positively impacted because of disturbance during levee construction (i.e. construction of roads). Again, the areas affected to a great extent would be the far northern portion of the study area and the river section from mile 500 - 200 (see Figure 10). The additional edge and transitional habitat will occur on or adjacent to newly constructed areas.



IMPACT OF PROPOSED PROJECT ON MIXED BOTTOMLAND HARDWOOD HABITAT

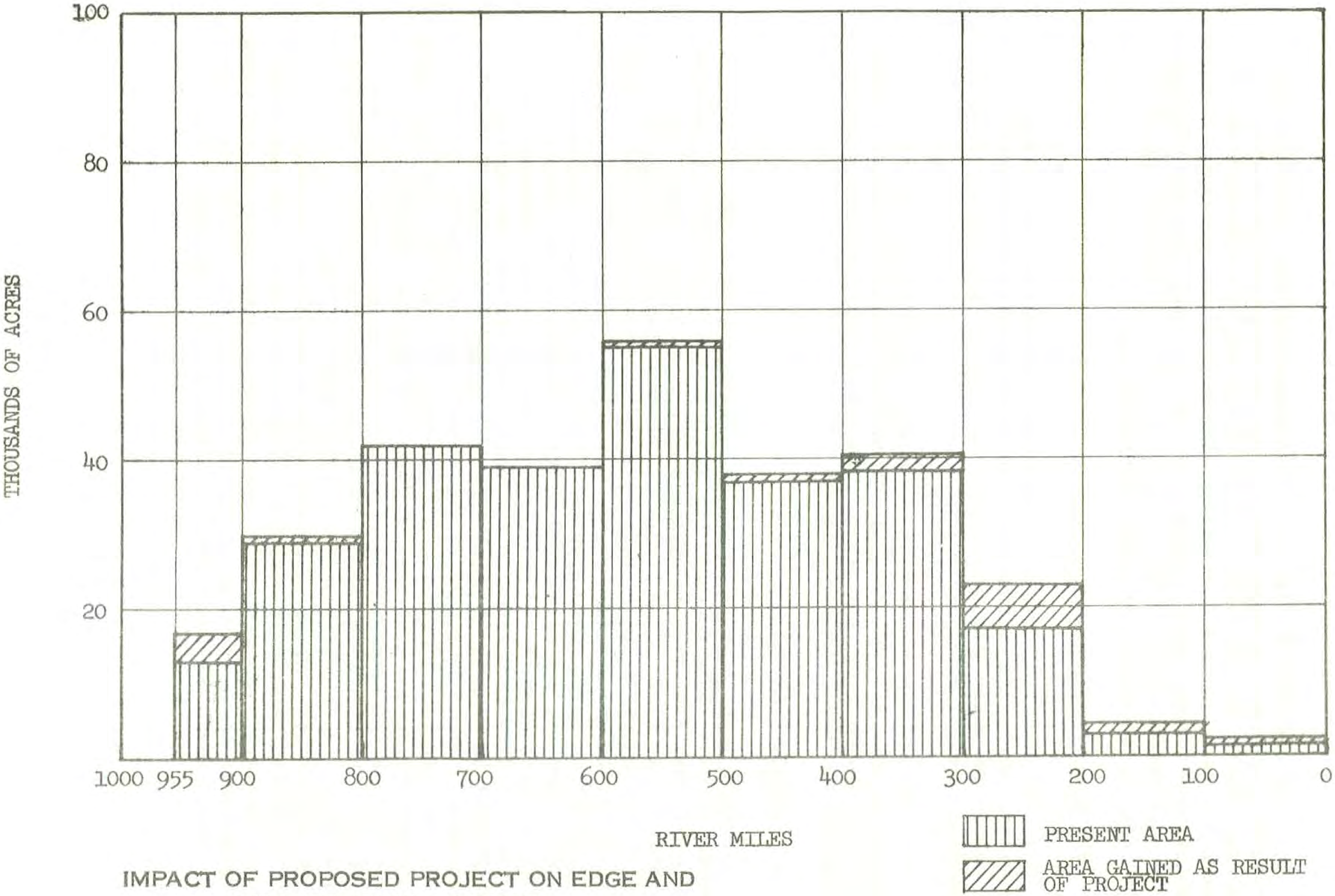
FIGURE 8

FIGURE 8



IMPACT OF PROPOSED PROJECT ON
SWAMP FOREST HABITAT
FIGURE 9

FIGURE 9



IMPACT OF PROPOSED PROJECT ON EDGE AND TRANSITIONAL HABITAT
FIGURE 10

FIGURE 10

(b) The addition of edge and transitional habitat represents an estimated 5 percent increase overall, and an estimated 10 percent increase within the 500 - 200 limits. This would provide additional browse for deer and increased habitat for both plants and animals that characterize transitional communities. The mourning dove and bobwhite quail, non-aerial insectivorous birds, and avian herbivores and omnivores will also probably be affected positively.

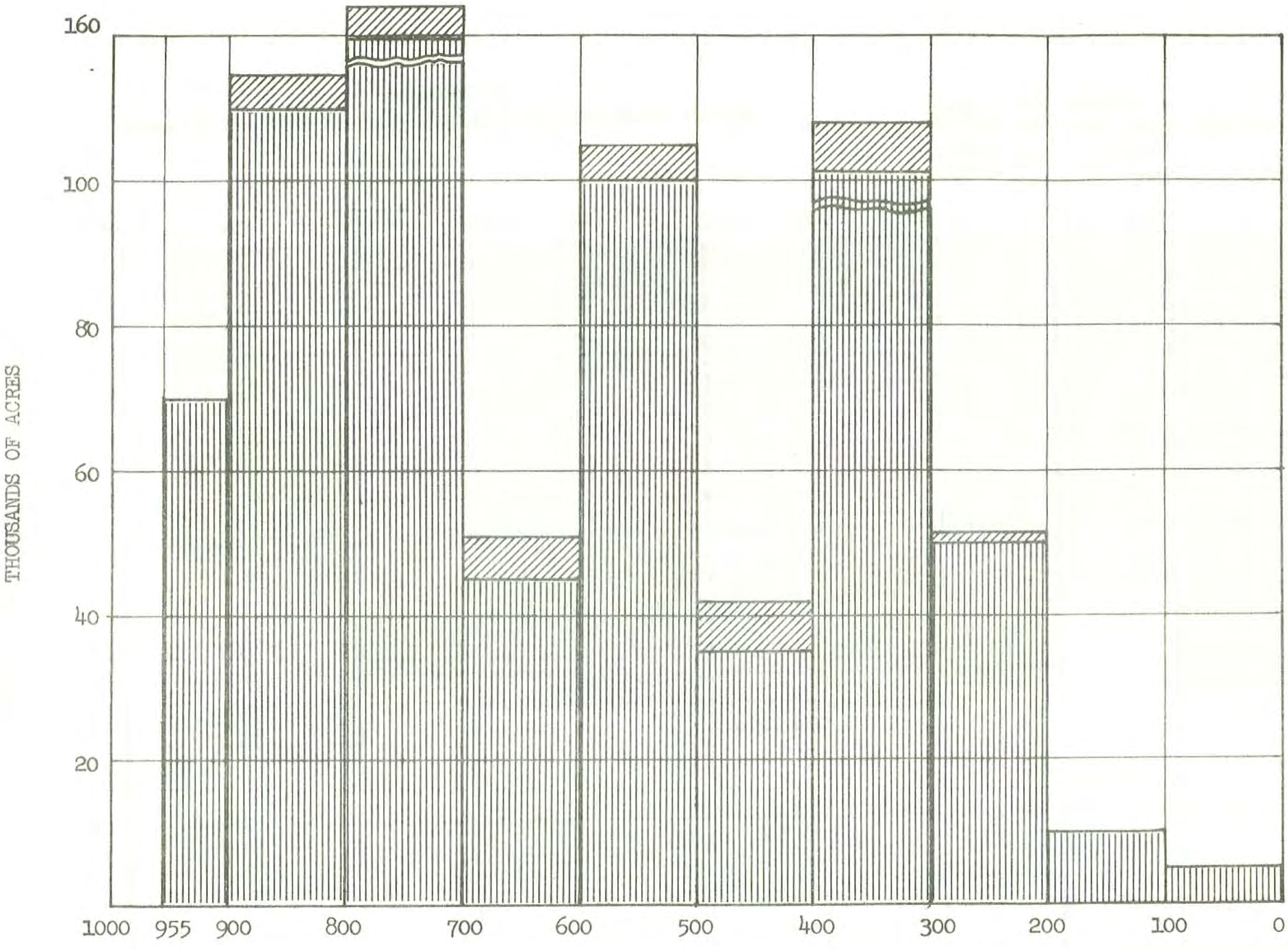
(6) Other Terrestrial Communities.

(a) The impact on cropland, sand bars, plantations and managed grasslands (including levees) would be fairly evenly distributed throughout the study area (see Figure 11), and in all river reaches considered a minor positive impact.

(b) The few impacts in terms of native species would be the creation of more suitable habitat for mammals such as the eastern mole, armadillo, meadow mice, and several species of grassland sparrows by increasing the areal extent of levees.

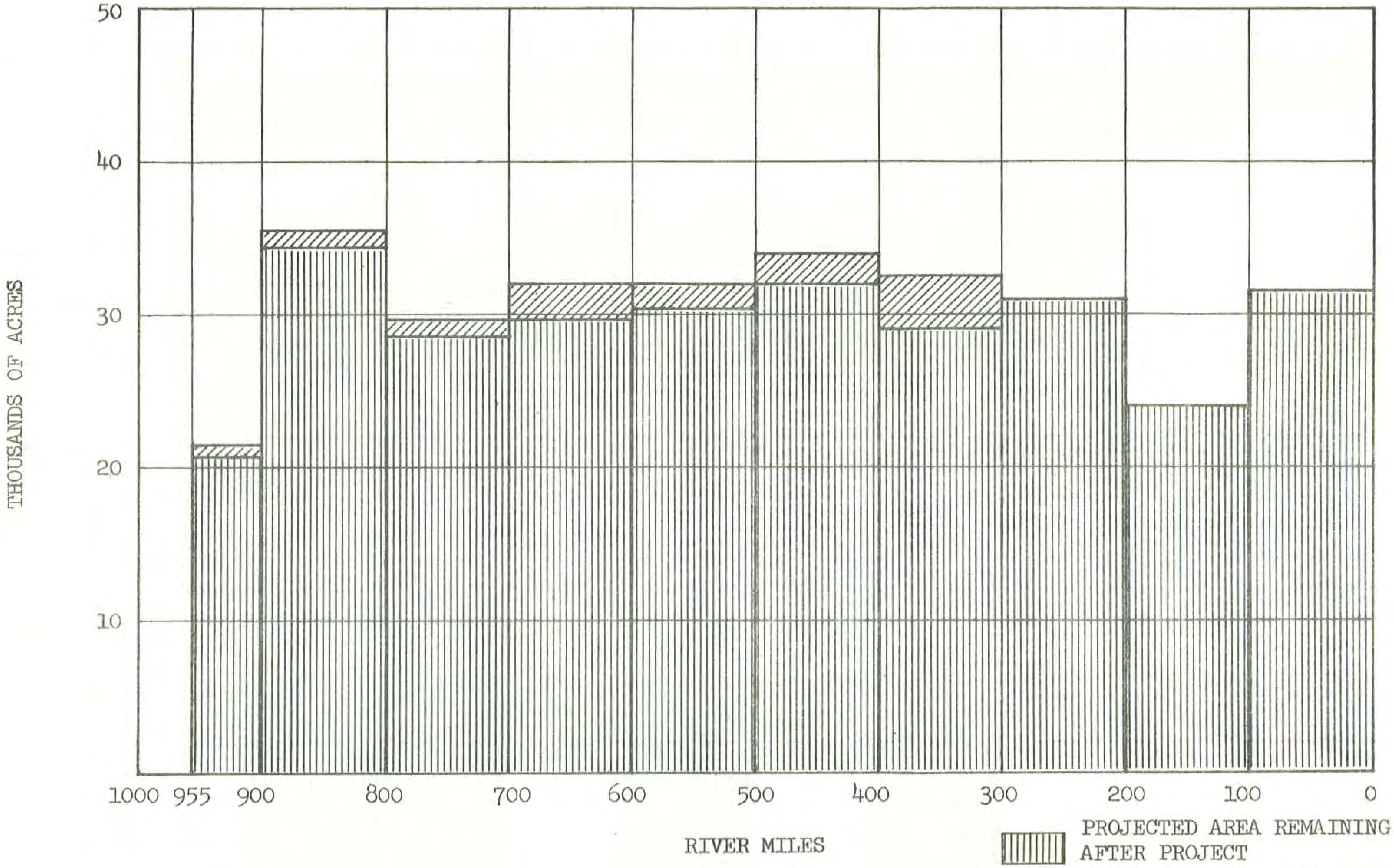
c. Aquatic Communities.

(1) Main River Aquatic Community. Dikes and revetments in the proposed project would decrease the width of the main river at selected points, causing the river to create a deeper channel at these points to accommodate its flow. This constriction would decrease the surface area of the main river by 3 percent, with the loss concentrated between river miles 300 and 700 (see Figure 12). This change would have little or no effect on large river species of fish, planktonic elements, floating elements, and pelagic elements. Because of the dynamic nature of the bottom of the main channel due to moving sediments and changes from flow variations in the river, the benthos that may be present must be capable of adapting to a constantly evolving environment. Thus the impact of the river's scouring action on the benthos is judged to be minor. The construction of dikes and especially revetments may have a more serious impact on benthos, particularly on groups such as the burrowing mayflies and caddisflies, which use the riverbank. The burrowing mayflies require erosion-resistant substrata such as clay. Caddisflies prefer a solid substrate such as rock to become attached to. Their lifestyle makes it difficult to sample these creatures by dredges and other traditional means. The construction of revetments and dikes will make the bank unavailable to burrowing mayflies where these features are installed. However, dikes and revetments create ideal substrate for attachment by the caddisfly. Thus



IMPACT OF PROPOSED PROJECT ON
"OTHER" HABITAT
FIGURE 11

FIGURE 11



IMPACT OF THE PROPOSED PROJECT ON MAIN RIVER
FIGURE 12

FIGURE 12

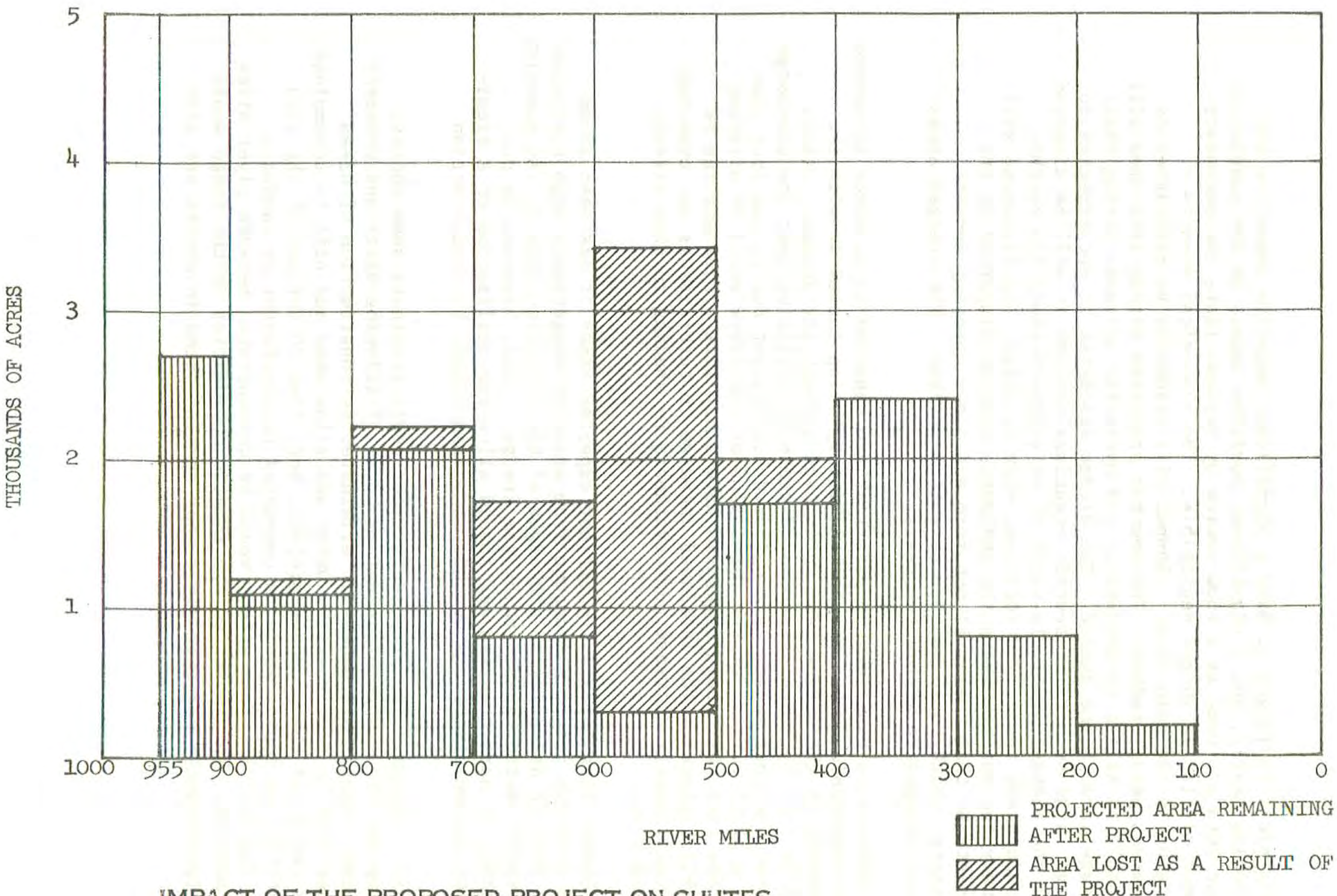
the project is judged to have a significant negative impact on the burrowing mayfly, but a significant positive impact on the caddisfly. Since both are used as a food source by various fish, the secondary impact on fish is judged negligible. The biological impacts of dredging in the main river channel will primarily be restricted to the areas being dredged. The benthic organisms within this area will probably be killed by mechanical and hydraulic stresses during their passage through the dredge. The dredge discharge is not expected to damage large numbers of benthic organisms because it will be directed into the deepest available water or on sandbars where few benthic organisms are found. In addition, when in water, the discharge will be near the surface where the sediments will be dispersed by the currents so that they will not form mud flows (gravity density currents) which could smother benthic organisms. The dredged areas should repopulate within two years.

Effects on planktonic populations are expected to be minor in nature. Some planktonic organisms will be lost by being sucked in with the sediments at the dredge head and passed through the dredge. Others will be lost by being entrapped by sediment particles near the discharge. However, neither impact is considered significant due to the fact that only a small portion of the total flow of the river would be affected and the fact that these organisms have short life cycles and can be quickly replaced. The localized increase in turbidity is not expected to significantly decrease photosynthesis by shading in this already turbid river.

Direct fish mortalities are not expected since it has been shown that fish can detect and escape from areas of dangerously high turbidity. Fish will be attracted to the edges of the discharge area by the quantity of organic matter suspended by the dredge. This, however, is not expected to harm the fish and should allow the utilization of a significant percentage of the benthic organisms killed by dredge action.

(2) Chutes. The proposed project would eliminate some chutes, making the river more efficient in terms of allowing water and commerce to pass. Chutes are generally eliminated by construction of dikes across them to slow the flow water and allow sand and silt to accumulate. As a result of the proposed project, more than 20 percent of the area identified as chutes would be converted to slackwater or sandbars (see Figure 13). This effect would be concentrated between river miles 500 and 700. The impact on the aquatic communities in the chute would be significantly negative since many species found in chutes are also

FIGURE 13



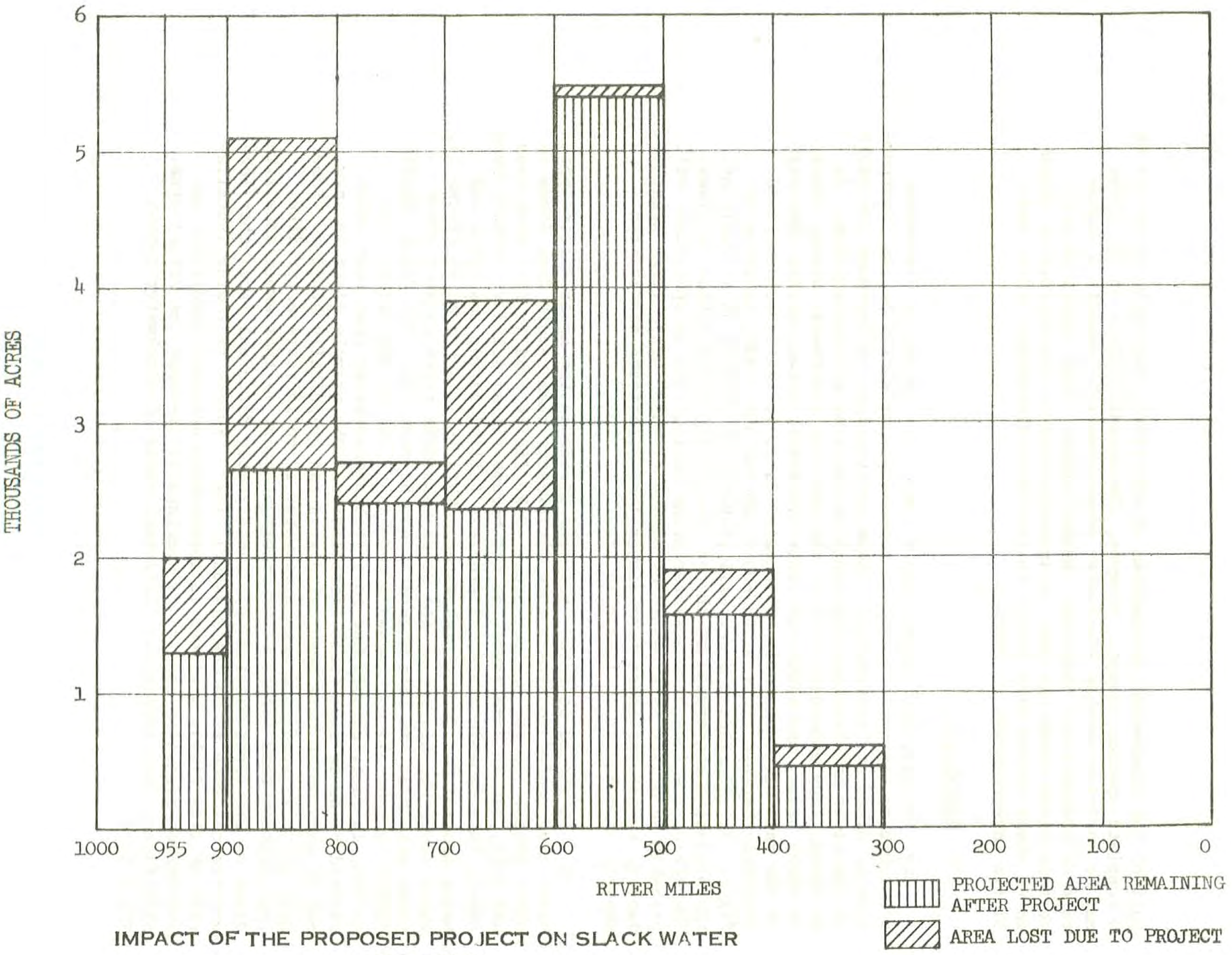
IMPACT OF THE PROPOSED PROJECT ON CHUTES
FIGURE 13

part of the slackwater communities of the river, and there would not be a complete species change. However, the overall effect on the river may be positive because slackwater areas generally exhibit a higher rate of productivity than open channel areas. This result is not certain since there has been no investigation of the biology of slackwater areas around dike fields in the lower Mississippi River and little investigation of chutes.

(3) Slackwater.

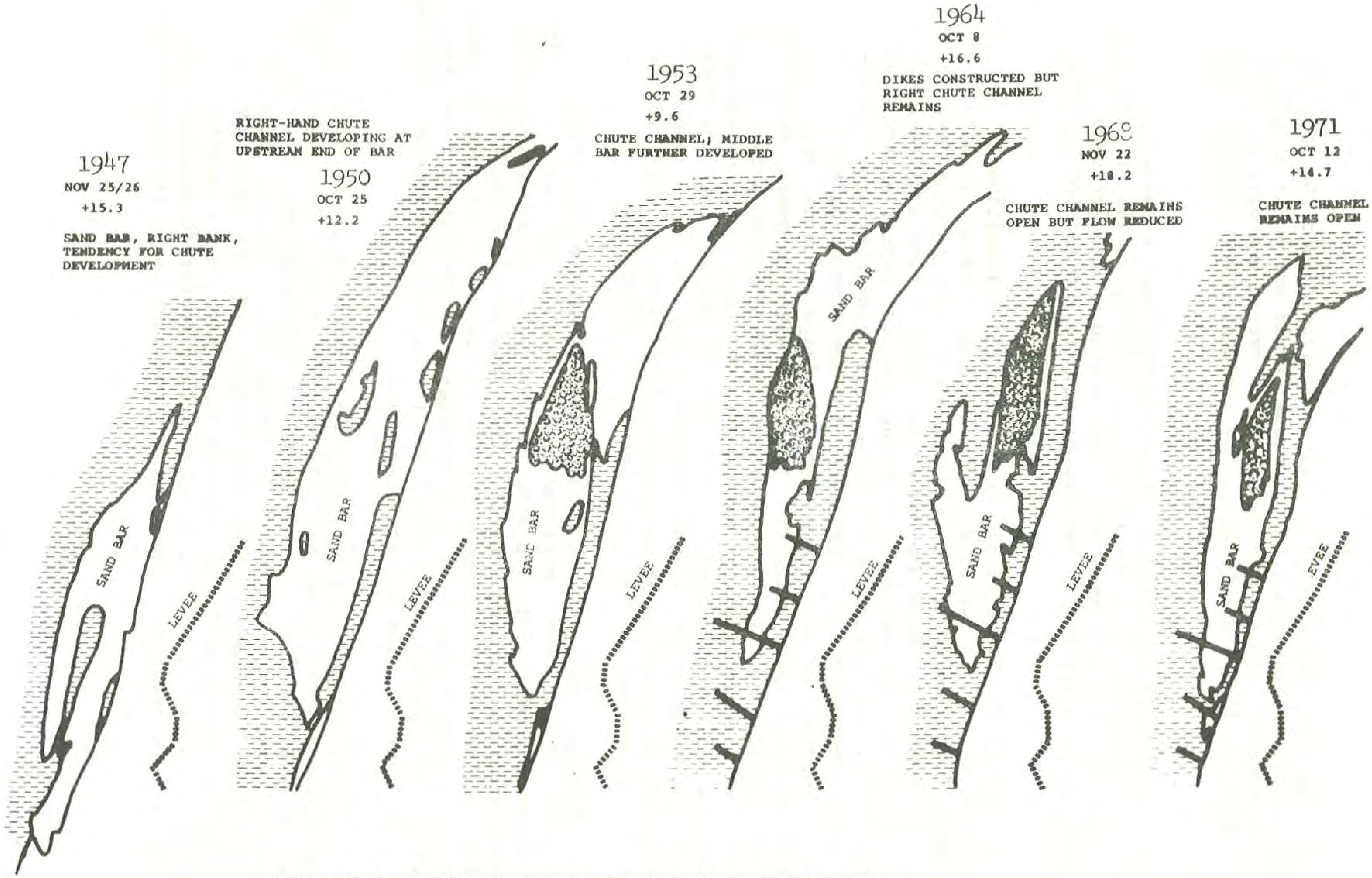
(a) The proposed project would reduce the amount of slackwater available to appropriate aquatic communities primarily by the construction of dikes and revetments. These act together to decrease the width of the river and increase its depth in the area of construction. In so doing, they generally fill in the existing slackwater areas, except as noted below, and scour out other slackwater areas, making them part of the main river channel. Slackwater is projected to be destroyed primarily between river miles 600 - 700 and 800 - 900, as shown on Figure 14. Slackwater areas will probably be created as a result of the projected conversion of chutes through the installation of dikes. Therefore, the loss of slackwater areas during fill in operations will probably be offset as a result of diking chutes. Overall, no negative impact, except for short term disruption of habitats and related aquatic communities is likely to occur.

(b) It should be noted that dike fields in the Lower Mississippi River have tended to retain more slackwaters than result from dikes in other areas. In the project areas, dike fields tend to fill with sand and silt, but in some cases, do not become filled solidly; rather, they remain in a dynamic state, alternately filling during low water and being scoured out during high water. This is illustrated on Figure 15, which shows the history of the Seven Oaks dike field located above river mile 523. In this figure it can be seen that dike field installation in 1864 had not caused a permanent loss of slackwater area. It had, in fact, established more stable slackwater than that which existed prior to dike field installation. The example given is only one of many which have been calculated and graphically studied. Some have actually producted more slackwater 12 to 15 years after dike installation than before. The important point is that experience with dikes on the lower Mississippi is distinctly different from other local experiences such as on the Missouri River. Events following installation of dike fields are seen to approximate original conditions and subsequent highwater conditions continually re-shape the entire area. Significant (but physically different) areas of slackwater remain 7 years later.



IMPACT OF THE PROPOSED PROJECT ON SLACK WATER
FIGURE 14

FIGURE 14



FATE OF SLACKWATER AREAS FOLLOWING INSTALLATION
OF DIKE STRUCTURES - SEVEN OAKS
FIGURE 15

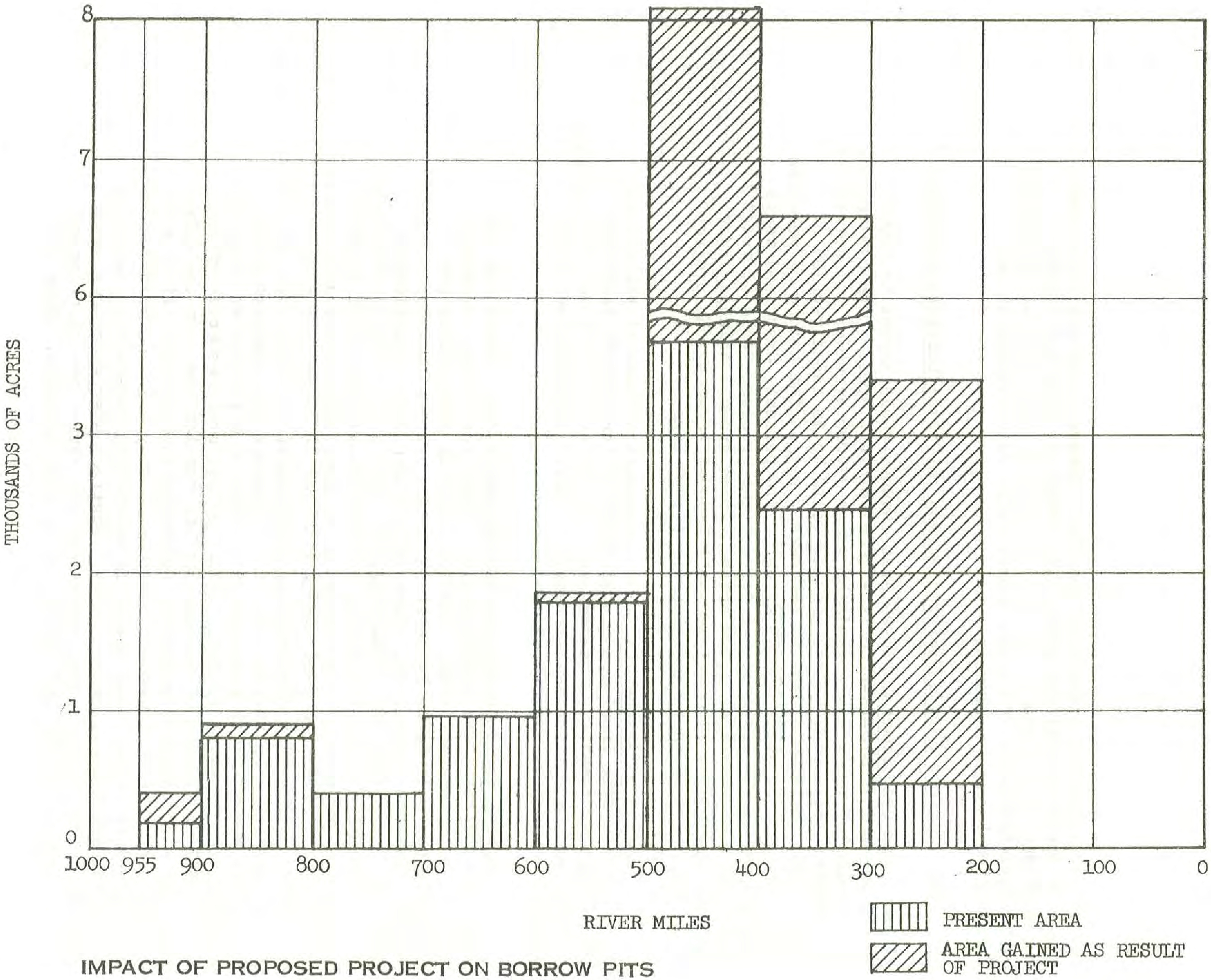
(c) Thus the impact of dike fields associated with the proposed project on slackwater areas, while strong, would not be as strong as could be expected from experience on other rivers, and may, in fact, have a positive impact on the extent of slackwater for selected local areas.

(4) Borrow Pits and Lakes. It is expected that a substantial number of borrow pits will be created in providing a fill to raise the levees and fill in old borrow pits where needed. This activity is projected to be concentrated between river mile 200 and 500 as shown in Figure 16.

The impacts of this activity on the aquatic communities in the borrow pits will be in two steps. The first is a major disruption of the communities as some of the existing borrow pits in this area are pumped dry and filled with new borrow to create a firm substrata for levee extension. The second is a strong positive impact as the newly created borrow pits are populated by aquatic organisms through overflow of the main river or other means. The development of borrow pit areas is dependent on soil types, local drainage patterns, etc. Rehabilitation of these areas will take from weeks to years, depending on local conditions. The net impact on borrow pit communities is judged to be a strong positive one in the long term since the extent of borrow pits will be increased by more than 100 percent over the whole project area. The impact of the proposed project on lakes in the project area is judged to be negligible since these features are not a part of the project in any but a peripheral sense.

d. Vectors. The proposed project will eliminate approximately 4,700 acres of slackwater areas and create about 11,400 acres of borrow pits or small ponds. This increase in quiet water areas will probably increase mosquito breeding habitat. This increase is expected to increase the vector populations, but the direct effect of this increase on the frequency of vector related diseases is difficult to ascertain. The effect will probably be minimal due to the control programs conducted along the river by state and local agencies.

e. Threatened and Endangered Species. The proposed construction and maintenance features are not expected to further endanger critical habitat of any species identified as endangered or threatened and occurring in the project area (refer to Tables 15 through 18). However, detailed distributional information within the project area for those species discussed in Section 2.07j is, for the large part, not presently available. A review of these species, their preferred habitats and general biology revealed no apparent adverse impacts on the populations



IMPACT OF PROPOSED PROJECT ON BORROW PITS
FIGURE 16

FIGURE 16

of any threatened or endangered species. However, the estimated reductions in specific habitats previously detailed, will put further restrictions on the use of the project area by some species associated with these habitats. Projects impacts will be monitored as more information becomes available.

4.03. Impacts of the Proposed Action on Social/Cultural Elements.

a. Land Use Impacts. Total area changes would amount to about 50,000 acres or 2.1 percent of the total project area. Land use changes as a result of the project would be about 32,000 acres or 1.7 percent of the project area land. These changes would be in the direction of forest land to levee grassland and borrow pits. The amount of woodland would decrease by about 30,500 acres or 3.4 percent. Grassland would increase by 19,000 acres or 6.1 percent and cropland would decrease by less than 0.5 percent or 2,500 acres. Urban areas, including boat harbors, and timber plantations would be unaffected by the project, while sand bars would be increased by 17,000 acres.

b. Impacts on Aesthetics. The construction phase of the project would involve some localized disturbances of the natural landscape. If the project is completed, the natural and culturally-influenced landscapes would provide greater visual diversity. River training devices may constitute a negative aesthetic impact.

c. Impacts on Historical/Archaeological Sites. There are 736 reported historical and archaeological sites (including steamboat wrecks) in the project area. The locations of these sites are generally not well known in relation to the precise location of the project features; therefore, these impacts can only be estimated. While 736 historical and archaeological sites are in the project area, it is likely that only a fraction of these known sites will actually be adversely affected. Destruction of a historical or archaeological site could occur if the area became a source of borrow, or cleared for levee or berm site preparation, emplacement of revetments and dikes, or the site for construction of cutoff trenches and drainage wells. To prevent damage of this nature, all Corps of Engineers actions are now evaluated in terms of their effect on cultural resources within the overall provisions of the appropriate regulations. On the other hand, the site could be preserved (although inaccessible) if it were sealed under a berm, levee, or revetment. Many of the archaeological and historical impacts may result in uncovering heretofore unreported historical and archaeological sites. Contract specifications would require contractors to cease operations and advise the contracting officer immediately if any historical or archaeological sites are discovered. In addition to identified sites, an unknown number of undiscovered sites may be affected by the proposed action. It is almost certain that the number of undiscovered sites in the project area is greater than those sites reported to date. Many other sites of historical, architectural, or archaeological significance located outside the project area will be preserved by completion of the proposed project by virtue of its flood protection capabilities.

d. Impacts on Transportation. The impact of the project on transportation would be to protect the capacity of the river to continue to move increasing numbers of ton-miles of cargo.

e. Impacts on Economic Growth and Development. Significant impacts on the project area's economy would be limited to potential revenues from agriculture and forestry. With the implementation of the project, the project area would experience a net loss of 2,500 acres of row crop land. Assuming 1,700 acres in soybeans (two-thirds) with an average annual yield of 23 bushels/acre times an average price of $4/bushel, gross revenue loss from the project's impact is estimated at $160,000 per year. Assuming 800 acres (one-third) in cotton yielding 580 lbs/acre/year times an average price of $0.30/lb, gross revenue loss from the project would be $140,000. Against these losses there would be a gain of 19,000 acres of grassland of all types in the project area. Assuming an average yield of 250 lbs. beef/acre/year, times an average yield of $0.30/lb, gross revenue gained due to the project is estimated at $1,425,000 per year. Therefore, the net impact of the project on gross agricultural revenue in the project area would be an increase of $1,125,000 per year, an increase of 1.25 percent over the existing estimated revenue.

The project would reduce harvestable timber woodland by 20,000 acres, resulting in a net annual loss of $200,000 to $430,000 per year The adverse effects on fish and wildlife use have been quantified and are included in the project economic analysis, summarized in the economic addendum.

f. Impacts on National Priorities. The impact of the project on national priorities is to protect the capacity of the river to continue to move bulk commodities with less energy used than by other modes and to allow the study area to continue to contribute to the national productive capacity.

g. Impacts on Population Characteristics. The project is not expected to affect existing population distribution and general trends, or to have a significant impact on social and cultural patterns within the project area.

h. Impacts on Study Area. The project will allow continued use and development of the study area outside the project area by improved flood protection. The impact is thus one of not acting to slow this trend, but rather allowing the area to respond to development pressures much as it is presently responding.

The major impact would be through improved river transportation and increased utilization of port facilities. This will, in turn, allow the development of harbors and other river facilities with the associated industrial and commercial development around these facilities.

5. ANY ADVERSE ENVIRONMENTAL EFFECTS WHICH CANNOT BE AVOIDED SHOULD THE PROPOSAL BE IMPLEMENTED

5.01. Adverse Effects on Physical Features.

a. Water Bodies.

(1) Realignment of the navigation channel and construction activities would affect the character of lakes, borrow pits and low-lying inundated areas. Maintenance of a permanent navigation channel would restrict the meander process of the river, thus limiting the natural development of oxbow lakes. Under natural conditions, existing lakes in the project area may tend to fill with sediment and vegetation and eventually become low-lying inundated areas. However, historical navigation charts indicate that the majority of water bodies will not fill in during the life of the project features.

(2) Levee construction activities would create additional borrow pits because of the fill requirement for bringing present levees up to grade. The initial effect would be to increase the areal extent of borrow pits from 10,000 to 20,000 acres. Eventually, existing and newly created borrow pits may tend to fill with sediment and vegetation and become low-lying inundated lands though past records indicate that this will not occur. The maximum areal extent of transition from borrow pits to low-lying inundated land equals existing borrow pits and the projected area of borrow pits developed as a result of the project. This area ranges from 51,000 to 58,000 acres.

(3) The realignment of the river would also reduce the surface area of the mainstem river by a maximum of 10,000 acres. This acreage, through processes of natural fill, may tend to become low-lying inundated areas.

(4) Although there would be a change in the character of present water bodies, there is no way to assess which of these changes are adverse or beneficial.

b. Water Quality.

(1) Water quality would be affected during the construction phase of project implementation. However, these effects would be local in nature and of relatively short duration. Construction activities would affect water quality because they introduce increased sediment loads into the water. This increased load is a result of agitation of bottom sediment by dredging, direct introduction of sediment into the stream due to dredge spoiling and indirect introduction due to surface runoff around construction sites. Increased sediment loads due to project activities would be local and of minor significance relative to the natural sediment load of the river.

(2) Dredging and dredge material disposal would have the greatest adverse impact on water quality relative to other construction activities due to the volume of sediment reintrained into the water. An analysis of water quality during dredge operations indicates that the impact on water quality is not significant when compared to ambient conditions. Other sources, considered less detrimental to water quality, include spills and prop wash from river traffic.

c. ManMade Structures. Stabilization of the channel would affect some existing stabilization features such as dikes and revetments; these may be displaced or become inoperative. However, in total, there would be an increase in the number of dikes, revetments, and foreshore protection in the project area. Upgrading the levees should not have a significant impact on structures within the project area as there are relatively few structures in the area of levee enlargement and areas from which fill will be obtained; however, the levees would protect structures outside the project area from flood damages.

5.02. Adverse Effects on Biological Elements.

a. Terrestrial Communities. The adverse impact of the proposed action has been addressed in terms of habitat loss and by qualitative assessment of these expected losses to the wildlife associated with each defined habitat type. Early successional communities are expected to be reduced by 9,900 acres, or about 9 percent of the total in the area. Organisms associated with early successional communities will probably be affected proportionately.

Late successional and mixed bottomland hardwoods are expected to be reduced by 4 percent (14,000 acres) and 1 percent (5,400 acres), respectively. Wildlife associated with these terrestrial habitats are expected to be adversely impacted proportionate to their use of these habitats (c.f. Table 23). The proposed physical modifications will reduce the swamp forest communities by 2 percent (200 acres) and likewise will probably reduce the populations of the organisms associated with this habitat by a similar proportion. The relationship of the reduction of animal populations to habitat loss is discussed in Section 4.02 (b).

b. Aquatic Communities. Adverse impacts of the proposed action on the main river, greater than a 5-foot depth and less than a 5-foot depth, are expected to be losses of 3 percent (7,600 surface acres) and 3 percent (1,000 surface acres), respectively. Aquatic populations associated with these habitats are expected to withstand reductions proportionate to the habitat loss. A reduction of 23 percent (3,900 surface acres) of the chutes that occur within the study area will likewise adversely impact the biotic communities associated with these areas (c.f. Table 24 for impacts on specific fish species).

The anticipated reduction of slackwater areas by 22 percent (4,700 acres) is expected to adversely impact aquatic communities and populations of other water related species (i.e. waterfowl, shore birds, amphibians, semi-aquatic mammals) proportionate to habitat losses. However, other slackwater will be gained from diked chute areas. A discussion of habitat reduction and concomitant losses to animal populations is discussed in Section 4.02 (b).

The overall project impact on aquatic habitat from Cairo, Illinois, to Venice, Louisiana, includes a 23 percent reduction of chute areas, which will largely become slackwater areas, and a 22 percent reduction of existing slackwater areas. An estimated 36 percent of chute areas from Memphis to Baton Rouge and 35 percent of slackwater areas from Cairo to Memphis will be adversely affected by the project.

5.03. Adverse Effects on Social/Cultural Elements.

a. Adverse Effects on Land Use. The project would adversely affect the amount of woodland and cropland. Cropland would decrease by 2,500 acres while there would be a loss of 30,500 acres of woodland as a result of the project. The loss of woodlands is discussed more fully in the biological section.

b. Adverse Effects on Aesthetics. The construction phase of the project would have an adverse effect on natural aesthetic elements by stripping vegetation and excavating borrow, thereby exposing areas of bare sediment. The river training devices may represent an adverse aesthetic impact.

c. Adverse Effects on Historical/Archaeological Sites. The destruction of any site would constitute an adverse impact. After investigation by an appropriate expert, the site may be physically disturbed without a loss of historical or archaeological data. However, the recovered archaeological data cannot fully substitute for the sites *per se*.

d. Economics. Due to the loss of cropland and timberland, the project would result in a loss of gross revenue from these sources. The loss of cropland would result in an estimated $300,000 loss per year, and the loss of timberland would result in a $200,000 to $430,000 loss per year. The adverse effects on fish and wildlife use have been estimated and are included in the project economic analysis, summarized in the economic addendum.

6. ALTERNATIVES TO THE PROPOSED ACTION

Each plan considered has been evaluated on its estimated potential to provide a reasonable level of flood control and navigational utility. The plans run the gamut from doing nothing to undertakings which would vastly alter the physical and economic aspects of the region. The various alternatives to the proposed project that were considered include:

1. No action.

2. Alternative maintenance measures.

3. Maintenance of existing project efficiency.

4. Storage of excess floodwaters in reservoirs.

5. Dredging to increase the hydraulic capacity of the river.

6. Additional cutoffs to increase the hydraulic capacity of the river.

7. Diverting flood flows.

8. Widening existing floodways.

9. Alternative construction and maintenance methods.

This section presents and discusses each of these alternatives with regard to its impact upon the project area. These impacts are summarized in Table 26.

6.01. No Action.

a. Definition of Action. The no-action alternative to the Mississippi River and Tributaries project would involve the cessation of all construction or maintenance activities designated to maintain or improve the main channel, the levees, and river stabilization devices.

b. Physical Parameters and Impacts. Physical changes that could be expected to occur from this alternative include formation of new oxbow lakes, integration of some borrow pits and inundated lands into the main channel while other areas fill in and undergo successional revegetation, and the displacement/neutralization of project features such as revetments, dikes, retards, and foreshore protection works. Eventually the meandering river channel would breach the levees, thus subjecting man-made structures outside the levees to flood damage at almost any flood stage.

c. Biological Parameters and Impacts. The result of cessation of construction and maintenance on the project would be destruction of the integrity of the present system and reversion of the river to its natural state of meandering over large parts of the study area with subsequent frequent flooding. In this situation, the project area becomes equivalent to the study area from the standpoint of impacts.

(1) The no-action alternative would largely reverse present trends towards clearing of land within the study area. Because of the greatly increased flood hazard, it would be likely that urban and

TABLE 26
IMPACT TRADEOFFS PROJECTED FOR ALTERNATIVES

Impact Category	ALTERNATIVE: Recommended Plan	No Action	Maintenance of Existing Efficiency	Storage of Excess Floodwater in Reservoirs	Dredging to Increase Hydraulic Capacity	Additional Cutoffs to Increase Hydraulic Capacity	Diverting Flood Flows	Widening Existing Floodways	Alternative Maintenance Measures	Alternative Const. and Maintenance Measures
River flowline	+s	-s	0	+	+	+	(+)	(+)	(-)	-
Other water bodies	+s	+	0	-s	0	(-)	(-)	-	+	0
Water quality	-	0	-	(-)	-s	-	-	-s	+	-
Climatology	0	0	0	-	0	0	0	-	-	0
Geology	0	-	0	(-)	-	-	0	(-)	0	0
Levees	+s	-s	0	+	0	0	(+)	+s	(-)	0
Channel improvements	+s	-s	+	+	+s	-	(+)	-	(-)	(+)
Harbors	+	-	+	+	+	0	0	0	(-)	-
Floodways	0	-	0	+	0	0	+s	0	-	0
Pumping stations	+	-	0	+	0	0	0	0	0	0
Reservoirs	0	-	0	+s	0	0	0	0	0	0
Cutoffs	0	+	0	-	0	+s	0	-	+	0
Early Successional habitat	-s	+s	+	(-)	-s	-s	-	-	+	+
Late Successional habitat	-	(+)	+	(-)	(-)	-s	-	(-)	+	+
Mixed bottomland hardwood	-	(+)	+	(-)	-	(-)	-	(-)	+	+
Swamp forest	(-)	(+)	-	(-)	-	-	-	-	+	+
Edge & transitional	+	-	+	(-)	(-)	-	(+)	+s	+	+
Other communities	-	(-)	+	(-)	(-)	+s	(+)	(-)	-	-
Main Channel > 5 ft. deep	+	-	+	0	+s	+s	0	(-)	-	-
Main Channel < 5 ft. deep	-	(+)	+	-	+s	+s	0	(-)	-	+
Chutes	-s	+	-	-	-	+	0	+	+	0
Slackwater	-s	(+)	0	0	-	(-)	0	(+)	0	0
Lakes	0	(+)	0	+s	0	(-)	(-)	(-)	0	0
Borrow pits filled year round	+s	(+)	+	0	(-)	(-)	+s	+s	-	0
Borrow pits filled intermittently	+s	(+)	+	0	(-)	(-)	+s	+s	-	0
Population growth	+	(-)	-	(-)	0	0	(-)	-	-	-
Land use - agricultural	(+)	-s	-	-s	+	-	(+)	(-)	-	-
Surface transportation	(+)	-s	-	(-)	+	0	-s	(-)	-	-
Land use - commercial	(+)	-s	-	-s	(+)	-	(-)	(-)	-	-
Land use-residential/ service	(+)	(-)	-	(-)	+	-	-	-	-	-
Economic growth	+s	-s	-	(-)	+	+	-	-	-	-
National defense	+	-	-	-	+	+	+	-	-	-
Historical-Archaeological	-	-	0	-s	-	(-)	(-)	-s	0	-
Settlement patterns	+	(-)	-	(-)	0	0	(-)	(-)	-	-

Legend

-	+	Minor
(-)	(+)	Moderate
-s	+s	Strong
0		No impact projected

agricultural uses (other than timber harvesting and timber plantations, and some grazing) would be untenable. The net result would be that natural successional trends could be re-established in major portions of the study area.

(2) The natural successional trend may be generalized as cropland or managed grassland to unmanaged grassland and bushes and then through various successional stages to a mixed bottomland hardwood association or swamp forest association.

(3) The time period for change is dependent upon the stage of succession at the time of implementation of the no-action alternative. The transition from cropland to grassland could be accomplished in a season; the transition through early and late successional stages to mixed bottomland hardwood association may take upwards of 200 years.

(4) As these habitat changes occur, the impact on terrestrial plants would be a gradual increase in forest species and a drastic decrease in cultivated species and natural grasses. The impact on terrestrial animals would be a drastic decrease in domesticated animals and a gradual increase in species utilizing the various habitats. At the steady state, although constantly changing as the river changes, the total proportions of the various habitat types remains constant, with the mixed bottomland hardwood forest association predominant. The impact of the no-action alternative on aquatic plants would be to increase their extent as the number of lakes increases in new oxbows and in previously drained depressions. There would be a comparable increase in aquatic animals.

d. Social and Economic Parameters and Impacts.

(1) Under the no-action alternative, large parts of the study area would be subject to frequent flooding. The degree of flood hazard would exceed that for the years preceding project initiation for the following reasons: higher population, greater investment, development of extensive areas under the assumption of flood protection, and greater economic integration of the study area. Under this alternative, the Mississippi River would be free to meander across large parts of the study area, causing widespread bank erosion and changing land use patterns. This alternative would impact significantly on land use, aesthetics, archaeological and historical sites, transportation, economic growth and development, national priorities, and population.

(2) Land use patterns would drastically change as a result of the no-action alternative. The amount of land in transition from water-filled to that covered by vegetation would increase greatly as the river changed from a stable to a constantly shifting channel. Commercial lands, including transportation/communications/utilities, industrial, services, and residential areas would be subject to severe flood hazard and much of this land would be difficult or impossible to protect without recourse to a system of levees, revetments, dikes and foreshore protection for the whole river. Although many of these urban and built-up places were founded under conditions of such flood hazard, it is doubtful that they could survive under this competitive disadvantage vis-a-vis other parts of the nation. While the tremendous investment in the cities of Baton Rouge and New Orleans might induce non-Federal interests to undertake the extremely problematical engineering and economic task of navigation maintenance and flood protection, such added costs would place an insuperable obstacle to continued growth and development of these areas. Smaller urban areas in the study area would probably be under even more stringent limitations and could be expected to decrease drastically.

(3) Agricultural land uses in the study area for crops would diminish to relatively low levels comparable to that now existing in the project area with a concomitant increase in natural vegetation. Agricultural losses due to flooding would be high and market access would be severely diminished due to loss of the navigable channel and flood-related deterioration of the road networks. Similar but less severe restraints would face agricultural land use for grassland grazing but such use would probably undergo a great increase.

(4) Woodlands and timber plantations in the study area would show agricultural increase as the level of agriculture actively dropped in response to the flood hazard. Together these forest land uses would probably approach proportions in the study area similar to those in the project area. Wetlands would increase throughout the study area as a result of flooding. Recreational land use potential in the study area would increase but access would decrease. Public ownership of land would grow at the expense of private ownership as flood losses caused land to be forfeited for taxes.

(5) The aesthetic impact of the no-action alternative would be to increase the visual diversity and contrast in the study area as the proportion of cropland decreased and grassland and woodland increased. Visual access, however, would decline. Relics of previous land uses,

abandoned due to flood, would be aesthetically distressing in most cases (although some might be viewed as "ruins" and aesthetically pleasing). The flooding of the study area would probably be mainly viewed as displeasing by most observers.

(6) Some archaeological and historical sites would undergo partial or complete destruction due to flooding and erosion, although other sites would be insulated from the effects of construction activities.

(7) Waterborne commerce on the Mississippi River would be reduced to a minute percentage of present activity by the no-action alternative. Pipelines, utility wires, dock and terminal facilities, rail lines, airports, and roads would all be difficult or impossible to maintain in the study area due to flooding and diminished local revenues and support facilities. The freight rail industry would capture a large share of the bulk commodity traffic presently carried by barge.

(8) The character of economic growth and development would completely change if the no-action alternative was implemented. Manufacturing and services would decline in conjunction with urban areas. Row crops would be replaced by increased grazing, lumbering, and trapping. Overall gross economic activity would drastically decline to a small fraction of existing conditions.

(9) The capacity of the study area to contribute to the attainment of national objectives would be decreased by the no-action alternative. Use of the Mississippi River for energy-efficient transportation would be largely lost. Alternative transport modes, with less energy efficiency, would have to be sought. Loss of navigational capacity would also impact the national defense posture as would the loss of much of the study area's productive capacity for foodstuffs and fibers.

(10) Population patterns would be changed by out-migration due to the no-action alternative. In parts of the study area, the urban population could be expected to relocate. Given regional preferences, those urban areas affected by this outmigration would be other southern cities. Minorities in both the migrating population and the host metropolitan areas may suffer social and economic disadvantages in job competition. The rural population may experience a lower proportional outmigration.

6.02. Alternative Maintenance Measures.

a. Definition of Alternative. Alternative maintenance measures include the suspension of all repairs and/or dredging with its attendant spoil deposition, as well as other selective minor options such as levee maintenance by grazing, spraying, or mowing. The impact of the actions would have essentially the same effect as the no-action alternative. The time elapsed from cessation of maintenance to project failure would tend to be longer than if the no-action mode were implemented. Likewise, the selection of only one of the above sub-alternatives, suspension of maintenance or suspension of dredging, at best would only tend to stave off the ultimate result of project failure for a longer time period. The end result would be a return of the unchecked meandering process. Use of other minor variations for maintenance procedures would tend to continue the existing project conditions to varying degrees. Eventually a severe flood would overtop existing levees and lead to project failure as pointed out in the discussion of the maintenance of the existing project efficiency alternative.

b. Physical Parameters and Impacts.

(1) If the meandering process of the river is allowed to progress, oxbow lakes would continue to develop. Borrow pits and many existing lakes would continue to fill and scour or become integrated into the main or secondary channels. Low-lying inundated lands would continue to fill and scour or may also be integrated into the main or secondary channels. Confluences with tributary streams will also tend to migrate.

(2) The ceasing of dredge operations would have an immediate effect on the mainstem channel. Due to deposition of sediments, the bottom contour would be continually changing. The most drastic effect would be that river navigation would be adversely affected due to sedimentation of crossings. The flood-carrying capacity of the river would also be reduced.

(3) Geologic elements, especially geomorphological features resulting from sedimentation and erosion processes will continue to develop and to degrade naturally despite implementation of major repairs.

(4) The absence of dredging operations would affect the rate of development of some geomorphological features. In particular, sand bars in crossings areas would develop more completely and would remain for longer periods of time without dredging.

(5) Land disposal would have a profound effect on the geological elements in the area where the disposal takes place. The impact will include soils, geomorphic features, and rates of sediment action and erosion.

(6) The make-up of the soils in the area where disposal takes place would change. Dredged materials consist of sandy and coarse materials; whereas, materials normally deposited by floods consist of silt and clay materials. River overbank spoiling would change the ratio of sandy materials relative to silts and clays in local areas.

(7) The greatest impact of no repairs on the project will affect man-made structures in the project area. If the river is allowed to meander, those man-made structures within the levees will be affected almost immediately. Revetments, dikes, foreshore protection, etc., will be either displaced or rendered inoperative. Private and commercial development will also be affected in direct proportion to the shift in the river channel. Eventually the river channel will breach the levees and man-made structures landside of the levees will be subjected to flood damage.

(8) The lack of dredging operations would allow for the shoaling of harbors and would render inoperative many of the channel stabilization devices. Once a significant number of channelization devices were destroyed or made inoperative, the channel alignment could not be held and the channel would assume its natural meander process. Hence, man-made structures on both sides of the levees would be subject to flood damage and to displacement by the river.

(9) It is not expected that overbank disposal would be permitted in an area where the dredged materials would affect operative man-made structures or structures of a historical or archaeological value. However, structures not in these categories could be covered or partially covered with sediment.

c. Biological Parameters and Impacts.

(1) Biological implications of present dredging operations in the mainstem have not been thoroughly catalogued. Some studies available indicate that discernible effects of dredging are limited to

the immediate locality of the work. Land disposal of dredged material has several potentially desirable features in addition to inherent problems. The obvious beneficial aspects are reduction of silt and suspended toxins (pesticides, herbicides, heavy metals) which will be reintroduced to the river. On the detrimental side is the transfer of silt and the potentially dangerous materials to the land dredged material site.

(2) Levee maintenance might include the following: mowing, herbicide use, burning, or grazing. These measures serve two purposes generally: utilization of the grass produced on levees as livestock feed and prevention of the establishment of ligneous growth on the levee. Preventing trees and shrubs is necessary to maintain the structural integrity of the levee.

(3) Use of herbicides on mainline levees is generally performed by independent levee districts. The herbicides presently used have low toxicity to man and other animal species tested. Most are not permanent and may degrade within a year or less of application.

(4) Two measures which might hold promise in overall levee maintenance schemes are periodic burning and a different selection of grass mixture. Both methods should be tried experimentally before any long range plans are adopted. Establishment of typical prairie grasses may result in benefits derived by affording more typical summer forage and possessing a growth pattern which would reduce tree seed germination.

d. Social and Economic Parameters and Impacts.

(1) The impacts of the alternate maintenance measures would be similar to those of the no-action alternative, but would occur over an indefinite period of time and use changes from row crops and urban land uses to woodland, decline in overall economic activity, and population loss would be drastic but more gradual. Presumably, these changes would be less difficult to accommodate than a sudden drastic impact. On the other hand, a gradual decline into a chronically depressed condition may not elicit national support in the same manner that might be expected upon massive widespread losses.

(2) Migration out of the study area would accelerate should project maintenance activities be suspended.

(3) Historical and archaeological sites would be subjected to increased water damage but decreased human disturbance.

6.03. Maintenance of Existing Project Efficiency.

a. Definition of Alternative. The alternative to maintain existing project efficiency differs from the recommended plan only in that levees would not be raised and new levees would not be constructed.

b. Physical Parameters and Impacts.

(1) Water bodies of the study area would continue to develop naturally, to fill in and become vegetated outside the levees and to become continuous with the river in the project area. The processes would continue to be subject to man's interference. Geological features will remain relatively unchanged.

(2) Continuation of present project efficiency could allow project features to hold the river at its present status for many years. While the status quo is maintained, the present man-made structures landside of the levees would remain protected with additional facilities being constructed. This alternative, however, does not recognize the requirement for an integrated framework of mutually supporting structures necessary to provide the protection considered feasible in engineering and economc respects. If the recommended plan is not carried to completion and the levees are not raised, then the project would fail due to the levees being overtopped and breached. This is not to say that any recommended plan can absolutely guarantee complete protection; the capability of natural forces to overcome any man-made project is recognized. What is certain is that the present efficiency is not sufficient to cope with some future and inevitable flood which is within man's ability to contain. Thus, present and future structures within the study area would experience certain major flood damage under the maintaining present efficiency alternatives.

c. Biological Parameters and Impacts. Flood damages under this alternative would tend to discourage clearing of timbered areas and associated agricultural, commercial, and industrial uses. Accordingly, fish and wildlife habitat would become somewhat more plentiful and its diversity and quality would also increase. Food chains would depart from a linear (grazing) aspect to the web like; increasing specialization will occur, and life cycles would become more complex.

d. Social and Economic Parameters and Impacts.

(1) The status quo alternative would ultimately result in the abandonment of some lands presently used for agricultural, commercial, industrial, and residential modes. This transition would adversely affect regional economic activity with a fraction of the loss being recouped through different land uses.

(2) In those areas where a natural succession process is established, the visitor could enjoy a heightened natural aesthetic appeal. In the event of project failure, a serious flood could certainly reduce the aesthetical appearance of the affected area.

(3) Historical-archaeological resources will suffer increasingly from natural elements, less from human activities.

(4) Population might ultimately dwindle in the study area, with the remaining individuals more concentrated in remaining/developing viable communities.

(5) An additional result of the maintaining existing project efficiency alternative would be the constraining of methods of river transportation to those which can be used under present river conditions. The increasing necessity of transporting a larger volume of goods at a reduced rate of energy consumption favors barge transports. The adherence to this project alternative, however, would remove the option of river modification to improve river traffic capability.

6.04. Storage of Excess of Floodwaters in Reservoirs.

a. Definition of Alternative. Consideration was given to lowering the flow line by providing additional reservoirs with a combined storage capacity sufficient to reduce stages as necessary to conform to the computed (26) project design flood flow line. Lowering the discharge to stay within this project design flow line would require 27 million acre-feet of flood control storage. For one combination of storms, a total of 69 reservoirs would be required to provide the required storage. Fifty-six of these could be headwater reservoirs in the Ohio, Upper Mississippi, and Missouri River Basins. One could be a mainstem reservoir about 7 miles upstream of Cape Girardeau, Missouri. Twelve could be headwater reservoirs on tributaries to the mainstem between Cairo, Illinois, and Arkansas City, Arkansas (see Fig. 17). These dozen reservoirs would aid the flood situation but not be fully effective, as major floods on the lower Mississippi traditionally are produced in the Ohio River Basin. Order-of-magnitude estimates indicate these reservoirs would cost about $4.5 billion. To allow for other combinations of storms which could produce the project design flood, many more reservoirs would be required at a considerably greater cost. The required acre-feet of storage in the many reservoirs that must be provided would have to be allocated exclusively for flood control benefits in the Lower Mississippi River Valley. The operation and maintenance of this large number of reservoirs to achieve the desired reduction in the flow line would be extremely complicated and expensive.

b. Physical Parameters and Impacts.

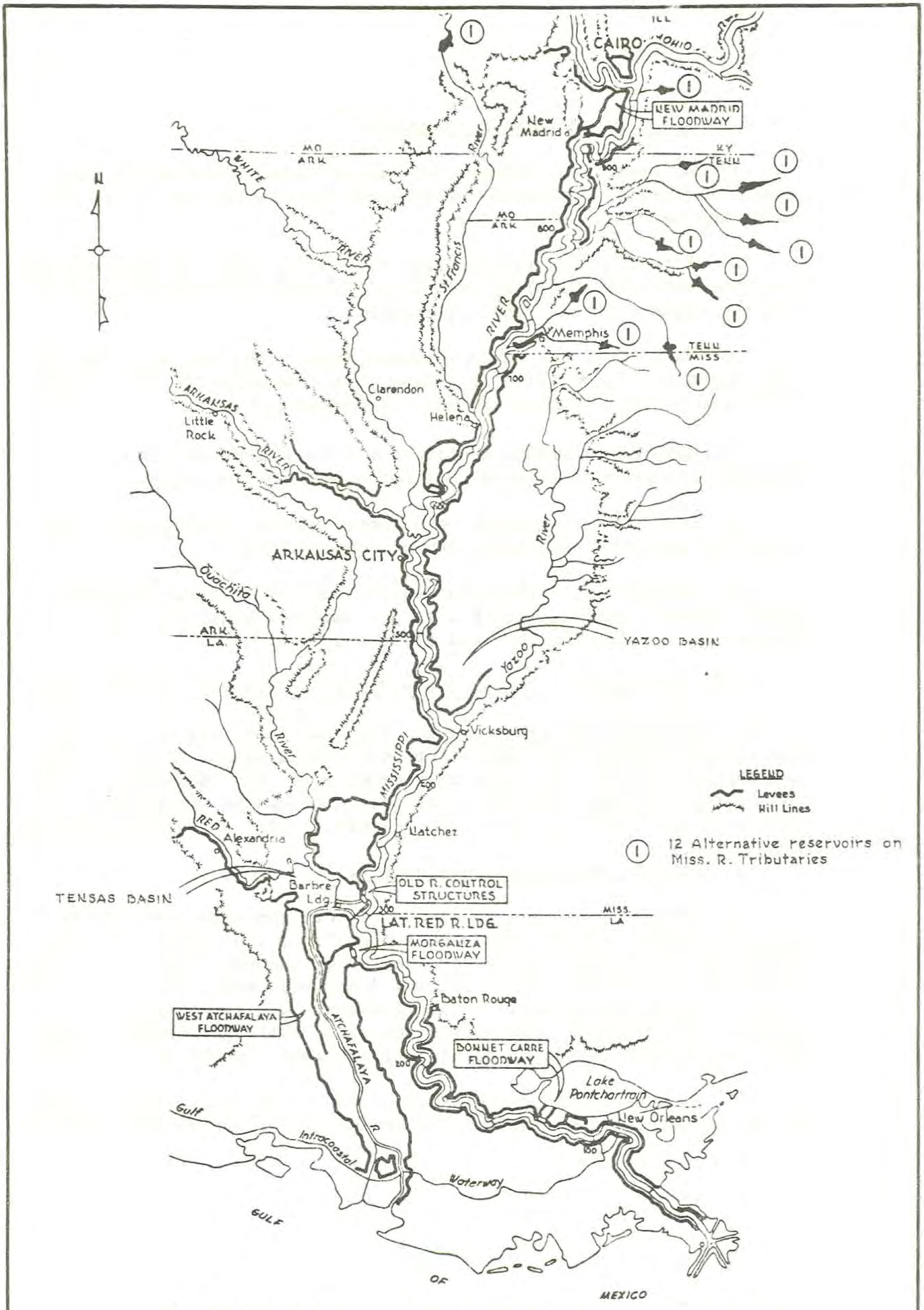
(1) The effect on water bodies is one of the most significant connected with this particular alternative. The creation of 69 new reservoirs would markedly alter the appearance and character of the region.

(2) Unique geomorphological features within the area flooded by each reservoir would be subject to inundation and deterioration.

(3) Project structures would be increased in number manyfold and distributed over a greater geographical area. As discussed above, the system would be extremely complicated and expensive. Man-made structures outside the leveed area would be subject to replacement by one of the many reservoirs.

c. Biological Parameters and Impacts. Biological implications of this alternative are enormous. The habitat destroyed as a requirement to construct a minimum of 69 reservoirs would be very large. Certain of these losses, such as aquatic habitat, would be replaced following construction and the quality of the aquatic resource would be changed from pre-reservoir conditions. Each would, of course, represent a tradeoff of lake-situation replacing a free-flowing stream-situation.

Terrestrial habitat destruction would be immense. Certain wildlife forms now utilizing terrestrial habitats might become isolated to the point of extirpation by the reduction and severance of preferred habitats.



ALTERNATIVE SOLUTIONS - RESERVOIRS

FIGURE 17

d. Social Parameters and Impacts.

(1) As specified, changes in land use under this alternative would be drastic. Intensive development would give way to surface water and necessary open lands.

(2) Potential for recreational facilities would be expanded and the aesthetically-appealing reservoir facility made available to a greater segment of the region populace.

(3) Historical and archaeological sites could be destroyed in vast numbers. Probability indicates that some affected sites would be listed on the National Register of Historical Places.

(4) Population redistribution would be significant, with the Federal Government obligated to finance most of the cost.

(5) Transportation would be affected by the severance of many roads and possibly the inundation of some airports.

(6) Usurpation of the land would favor one national priority, flood control; while damaging a second national objective, the production of adequate food and fiber supplies.

6.05. Dredging to Increase the Hydraulic Capacity of the River.

a. Definition of Alternative. The practicability of lowering the project design flood flow line on the Mississippi River by channel dredging beyond that presently embodied in the adopted plan was considered. The estimated cost of this alternative would be in excess of $3.5 billion, less cost of work for the Atchafalaya portion.

b. Physical Parameters and Impacts.

(1) This action would upset the pattern and magnitude of the bedload (coarse particle sediments) migration, thus making it more difficult to maintain an adequate navigable channel. Open water disposal of this material would depress dissolved oxygen levels of the river on a continuing basis. Land disposal may impact land use, health considerations, aesthetics and cost, although disposal sites which would have little or no significant impact would be selected.

(2) Because of the disturbance of the river equilibrium caused by the movement of the quantity of bedload this alternative requires,

many geological features of the project area would undergo deterioration and transition. Massive transport of bedload and the river's response to this would result in damages to some project features and increased maintenance requirements.

c. Biological Parameters and Impacts.

(1) Dredging on the scale required for this alternative would depress the dissolved oxygen content of the mainstem, thus adversely affecting the aquatic community. Physical disruption of the river bed would be substantially greater than the current project activity. Accordingly, greater adverse impacts would occur to benthic organisms. Those organisms within the channel enlargement alignment would be destroyed.

(2) Disposal site requirements would dictate some changes in land uses. A vast acreage of terrestrial wildlife habitat would be damaged and accompanied by losses in wildlife resources. Habitat disruption would also occur each time increased maintenance dredging would be necessary and revegetation of disposal sites would begin during the following growing season.

d. Social Parameters and Impacts. If overbank spoil areas are used, some agricultural lands would undoubtedly be required for the deposition of dredged materials. These agricultural lands would thereby be aesthetically displeasing and, at least temporarily, taken out of agricultural production. Known historical and archaeological sites could probably be avoided as deposition sites. Overbank disposal would render existing historical and archaeological sites less accessible.

Habitation patterns would be unaffected. As maintenance of the navigable channel would be made more difficult, the costs of river transportaion would rise, slowing economic growth.

6.06. Additional Cutoffs to Increase the Hydraulic Capacity of the River.

a. Definition of Alternative. Consideration has been given to river cutoffs as a means of lowering the river flow line. In the past, temporary success has been achieved in this manner, but the natural tendency of the river to establish its characteristic slope and meander pattern has resulted in greater maintenance requirements.

Investigations indicate 14 locations where successful cutoffs would shorten the river approximately 78 miles in the reach between Helena, Arkansas, and Baton Rouge, Louisiana. These locations are shown in Figure 18. Based on experiences with previous cutoffs, an allowance of 25 miles has been made for length required before alignment control could be achieved. The estimated cost of the cutoffs, including relocations and channel improvements, would be $1.4 billion.

b. Physical Parameters and Impacts. The cutoff alternative would incorporate lakes within cutoff alignment into the main river regime, thus substituting one aquatic condition for another. A meandering pattern different from the present would be established. This, along with cutoff construction, would remove or damage many existing project structures. In addition, geological features from the beginning point of construction and downstream will be subjected to an extended period of alteration. Man-made structures outside of the levees will be affected, depending upon specific cutoff alignmert.

c. Biological Parameters and Impacts. Due to the substitution of new oxbow lakes for river environment, the fishery resource would be the most economically significant change in water use. Transportation of goods would be enhanced by decreased river mileage and savings in required fuel expenditure could be expected. However, with the change in meandering characteristics, an increase in the level of maintenance necessary will be required.

No change in population or its distribution would be likely. Historical and archaeological sites would be in jeopardy depending upon specific cutoff alignment.

6.07. Diverting Flood Flows.

a. Definition of Alternative. An additional floodway to divert Mississippi River floodwaters and adequately lower the adjusted project design flood flow line was also considered. The diversion of flow would be required about the latitude of Arkansas City, Arkansas, to reduce stages in the affected reach. The floodway would be located in the Boeuf Basin, roughly following the Boeuf River, and emptying into the Ouachita River as shown in Figure 19. A control structure would be required with a floodway averaging 7.5 miles wide and 150 miles long with guide levees. Extensive relocations would be necessary because of the many highways, railroads, drainage canals, and utilities servicing this intensely developed rural area. This floodway was studied in great detail in the 1920's. The Flood

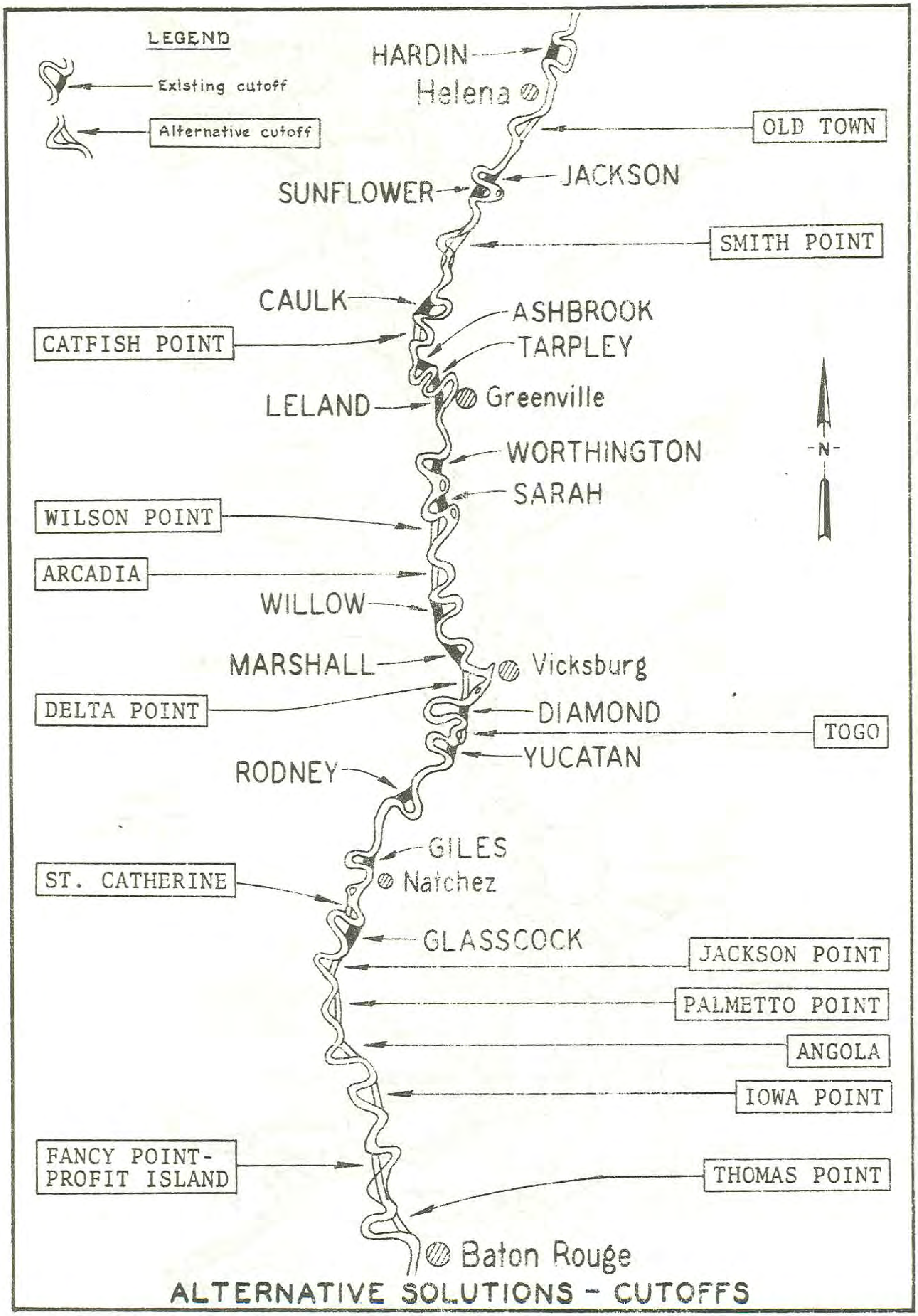
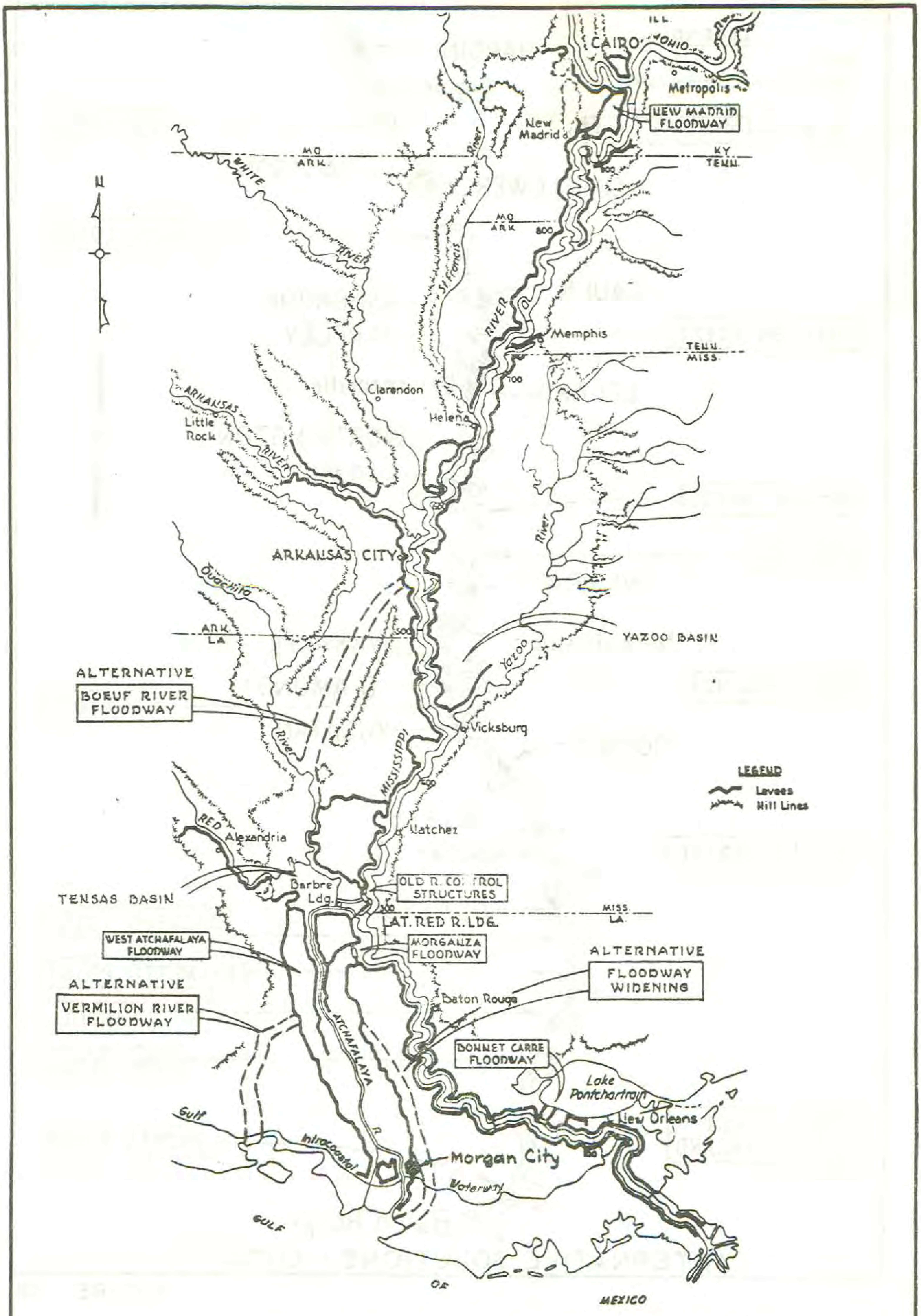

LEGEND
Existing cutoff
Alternative cutoff
HARDIN
Helena
OLD TOWN
JACKSON
SUNFLOWER
SMITH POINT
CAULK
ASHBROOK
CATFISH POINT
TARPLEY
LELAND
Greenville
WORTHINGTON
-N-
SARAH
WILSON POINT
ARCADIA
WILLOW
MARSHALL
Vicksburg
DELTA POINT
DIAMOND
TOGO
YUCATAN
RODNEY
GILES
Natchez
ST. CATHERINE
GLASSCOCK
JACKSON POINT
PALMETTO POINT
ANGOLA
IOWA POINT
FANCY POINT-
PROFIT ISLAND
THOMAS POINT
Baton Rouge
ALTERNATIVE SOLUTIONS - CUTOFFS

FIGURE 18



ALTERNATIVE SOLUTIONS - FLOODWAYS

FIGURE 19

Control Act of 18 August 1941 authorized abandonment of both the Boeuf Floodway and a substitute floodway authorized by the Flood Control Act of 15 June 1936. It is estimated that the Boeuf Floodway would cost in excess of $1 billion.

b. Physical Parameters and Impacts. Except during periods of floodway use and for construction of guide levees, no change would occur regarding water bodies. The same would be true of the floodway alternatives effect on geologic features. As pointed out in the preceding paragraph, structures within the floodway right-of-way would be subjected to damages from construction activities as well as flood operation. Physical damages during operations of the floodway would consist of scouring at some sites and deposition of sand and silt at other locations and damages occurring from inundation and/or the force exerted upon any structures by flood flows. Necessary steps to ameliorate these damages would be complex in scope, disruptive of normal area life styles, and expensive.

c. Biological Parameters and Impacts. Biological consequences of floodway construction will include destruction of many lakes, swampy areas, and timbered areas of various types through levee construction. While these work areas are of limited size, the result would be to sever habitat continuity and facilitate increasing development outside the floodway, especially when the area is completely inclosed by levees by virtue of connecting floodway levees to existing levees. Some wildlife within the floodway at the time of use would be displaced or destroyed. Ground dwellers such as rabbits would be among the most vulnerable. Also, ground nesting birds would have to renest after the waters recede. Floodway usage could benefit some species, e.g. crawfish and finfish, by increasing their habitat.

d. Social Parameters and Impacts. Land use would not be changed to any large extent by the alternative. Aesthetics and some outdoor recreation would be degraded by levee construction. However, levee construction could improve accessibility for some forms of recreation, especially by providing access to boat ramps.

Populations within the new floodway would progressively decline. Transportation would be affected by necessary relocation and improvement of roads and rail lines. Historical and archaeological sites could possibly be destroyed by floodway construction.

6.08. Widening Existing Floodways.

a. Definition of Alternative. Consideration was given to increasing the flood-carrying capacity of the Mississippi River by widening the leveed channel. This would require that the mainstem levees be set back from 2 to 6 miles throughout the affected reach from about Helena, Arkansas, to Baton Rouge, Louisiana. This would be much more expensive than raising the existing levees.

b. Physical Parameters and Impacts. Physical features within the affected reach (between the proposed new levees) would all be impacted by construction alignment and operation. Water bodies would be filled in some instances to maintain an economical levee alignment. New water bodies would be created to the extent that borrow pits were developed for necessary fill and subsequently filled with water. Floodway use would result in disturbance of established aquatic communities located in between the new levees.

Man-made structures would be in jeopardy by construction and by floodway use. At best the operation of the floodway would mean abandonment of these structures for a limited time; at the worst, the structures would be destroyed by the flood waters.

c. Biological Parameters and Impacts. Habitat would be diminished by new levee construction and associated maintenance activities. Remaining aquatic habitat will suffer from floodway operation but not to the extent that terrestrial habitat will be removed and/or reduced in carrying capacity.

d. Social Parameters and Impacts. A significant loss of agricultural production would occur and severance of farm units would be prevalent. Farm lands on the river side of the new levees could be farmed periodically; however, the agricultural lands required for levee construction would be removed from production for the life of the project. Aesthetics would be impacted and recreation affected to the extent of disturbance of water bodies and timbered areas. Historical and archaeological sites would be vulnerable to construction activities. Population would be expected to progressively decrease within the expanded area between the levees.

During times of high water, surface transportation would be interrupted over a larger area than with the recommended plan. At low water periods, river traffic would conversely be impeded more than with the recommended alternative.

6.09. Alternative Construction and Maintenance Methods.

a. Definition of Alternative. This alternative would involve placing in uncompleted reaches structural features other than those recommended by the authorized project. Various structural measures: reservoirs, floodways, and new, more widely separated levees have been treated in other alternative discussions. The remaining known, possible options are dikes, floodwalls, and foreshore protection.

By this rationale, floodwalls might be used as a substitute for levees. These floodwalls would be massive structures by necessity and their cost would greatly exceed that of the levee raising option. Foreshore protection would minimize erosive damage of floods to the levees. It has been found that dikes work only when placed in natural deposition areas. Accordingly, these structures would be of limited utility so far as providing flood protection through changes to the river flow pattern.

b. Physical Parameters and Impacts. Physical elements: water bodies, geological features or man-made structures would not be greatly affected by these structural measures other than in the specific alignment of floodwall construction.

c. Biological Parameters and Impacts. Aquatic communities would be disrupted by dike fields and foreshore protection while floodwalls would eliminate some terrestrial habitat. Another impact of floodwall construction, perhaps more serious than the habitat destruction within the zone of construction, is the severance of habitat extending from the river banks.

d. Social Parameters and Impacts. Social-cultural elements such as land use, recreation, aesthetics, historical and archaeological sites would all be adversely affected by construction of floodwalls. Dikes and foreshore protection measures would probably have little impact on these elements.

7. THE RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

7.01. Physical Elements.

a. Short-term uses include those immediate benefits derived from implementation of the project. Long-term effects include those environmental impacts as a result of the project.

b. The benefits to water bodies derived from the project would be immediate and include an increase in the total surface area of water bodies within the project area. This increased surface area would result from additional borrow pits to meet fill requirements for levee construction.

c. The long-term effect on water bodies would be a reduction in the amount of exposed surface area and a change in the character of the water bodies. Through placement of channel stabilization devices, the meander process and subsequent development of oxbow lakes would also be limited. These processes are long term and past records (historical navigation charts) indicate that the majority of these water bodies will not fill in during the 100-year life of the project features.

d. Water quality would not be directly benefited by this project, and detrimental effects of project implementation would not be significant. In fact, channel stabilization which would restrict the meander process would reduce the amount of bank recession. This, in turn, would decrease the amount of sediment introduced into the stream and the subsequent amount of maintenance dredging and bottom sediment agitation required. Construction activities necessary to implement the project would contribute to the sediment load carried into the mainstem; however, this effect would be short-term and restricted to a relatively small area downstream of construction activity.

e. There would be no impacts or benefits relative to the climatology resulting from the project; hence, an examination of short-term uses and long-term effects is not applicable.

f. Short-term benefits and long-term effects on geological elements include the effects on soils, geomorphology and rates of sedimentation and erosion.

g. Short-term geological benefits are primarily related to channel stabilization devices which retard or stop the rate of river meander. The benefits derived from these devices include reduced bank caving, reduced crossing deposition, and reduced opportunity for new river channels to be developed.

h. Long-term effects are also primarily an effect of channel alignment and restricted meander of the river. Development of geomorphological features, such as oxbows, point bars, and meander loops would decrease, and some present features would be eventually eliminated by erosion, sedimentation, and other natural processes. The soil character would also change since containment of flood waters by the levee system will prevent spreading of sediment load onto acreage landside of the levees.

i. Upgrading of the levees would not result in any short-term advantages or long-term effects on groundwater levels within the project area. Flood stages would still elevate groundwater levels above the ground surface, causing standing water landside of the levee for varying distances. This fluctuation of ground water levels would be temporary, although agricultural operations could be affected for a significant period of time.

j. Short-term benefits from upgrading levees include increased flood protection to areas landside of the levees. The effects of levee construction are both long and short-term. Short-term effects include the impact of levee construction on water quality, while long-term effects are primarily land use changes. The levee enlargement itself occupies additional land with further acreage required for new borrow.

k. On a short-term basis, dredging operations make the channel more navigable for river traffic. Long-term effects do not occur from this short-term, localized operation. Water quality as a result of this factor is temporarily degraded due to disruption of bottom sediments. However, increased sediment load and attendant increased concentrations of constituents is restricted to a relatively small area downstream of dredging operations.

l. Channel stabilization devices (dikes, revetments, foreshore protection) also aid navigation. In addition, by helping to maintain a natural alignment of the main channel, these devices contribute to control of the meander process and flood control. The effects of impact of the devices are short-term and occur during construction when bottom sediments are dislodged and/or bank sediments introduced into the water subsequently affecting water quality. However, this is a short-term effect limited to the construction period and restricted to a relatively small area downstream of construction.

m. Other effects of channel stabilization devices includes their influence on sedimentation and erosion and the resulting bottom configuration of the channel. This effect has no adverse impact on the physical features of this project.

7.02. <u>The Relationship Between Local Short-Term Uses of Man's Environment and the Maintenance and Enhancement of Long-Term Productivity for the Proposed Project</u>.

a. The immediate biological benefits derived from implementation of the project are the creation of open brush, grasslands, borrow pits, and the enhancement of the creatures that utilize these habitats. However, the inhabitants of the communities that will be sacrificed for construction will be adversely affected to the extent their habitat is lost.

b. The project will also create new habitat in the river by constructing dikes, revetments, and laying riprap. These modifications may create more diverse aquatic communities in a river environment of otherwise limited physical variability.

c. The long-term terrestrial biological effects are to gain edge-transitional and early successional habitats, and lose late successional and mixed bottomland hardwood. This would be followed by advancing successional changes toward a more mature forest stand as time goes by. Early successional stages in the vicinity of the borrow areas may proceed through herbaceous and early successional tree, vine, and shrub species at a much faster rate than the typical successional pattern observed at the river front due to the adjacent sources of seed stock and a more stable existing soil structure.

d. There will also be a gain in managed grasslands (levees) whose maintenance may negatively impact the surrounding habitats.

7.03. <u>Social/Cultural Elements</u>. There are no short-term effects of the project which would reduce the long-term social/cultural productivity of the project area.

8. ANY IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES WHICH WOULD BE INVOLVED IN THE PROPOSED ACTION SHOULD IT BE IMPLEMENTED

8.01. <u>Physical Elements</u>. Irreversible and irretrievable commitments would include those environmental resources irreversibly lost if the project were implemented.

a. Those water bodies affected include lakes, borrow pits, riverside channels, backwaters, and low-lying inundated areas. The project would limit the meander process and development of oxbow lakes. The number of borrow pits would increase due to fill requirements.

b. The impact of the project on water quality would be insignificant. After implementation of the project, there would be no effect on the water quality and no irreversible or irretrievable commitments.

c. Since the project would not have a significant impact on climatology, there would be no irreversible or irretrievable commitment of resources.

d. Irreversible and irretrievable commitments would be imposed on geomorphic features, soils and rates of sedimentation and erosion. By maintaining channel alignment and restricting the meander process, the rates of sedimentation and erosion as well as development of the attendant geomorphic features would be irreversibly retarded. By containing the floodwaters within the levees, the landside soil contribution of floods breaching the levees would be lost.

e. There would be no irreversible or irretrievable commitment imposed on groundwater levels which would continue to fluctuate principally according to river stages and precipitation. Flood stages would continue to elevate groundwater levels above the ground surface on the landside of the levees with attendant seepage, standing water, and potential damage to crops, roads, and man-made structures.

f. Irreversible and irretrievable commitments imposed on structures within the project area would be primarily those associated with construction and maintenance efforts. Massive requirements of manpower, equipment technology, and money would be necessary to implement the project features.

8.02. Biological Elements.

a. The primary terrestrial irreversible and irretrievable commitments associated with the project is the loss of significant portions of mixed bottomland hardwoods, swamp forest, and, to a lesser extent, the loss of late successional woodland. This is considered irreversible and irretrievable because of the large time scale (hundreds of years) associated with the replacement of these forests assuming they remain undisturbed while in transition.

b. The major aquatic irreversible and irretrievable commitments associated with the project are the loss of some slackwaters and chute as a result of channelization. These represent particularly productive portions of the river and would be lost or modified if the river training devices are maintained in their present form.

8.03. Social/Cultural Elements. The loss of row crop and forestry revenues from the project would be irretrievable, as would the loss of bottomland hardwood forest land. With the exception of levee grass (which must be artificially managed to prevent woody vegetation from breaching the integrity of the levee) and of riprapped areas of revetments above the water line (ALWP), all other land use changes caused by the project would be reversible within the design life of the project. The loss of archaeological and historical sites (from both direct project-related actions and from any secondary effects such as localized acceleration of bank erosion) would be both irreversible and irretrievable, although with proper preconstruction archaeological salvage work, part of the historical data may be preserved.

9. COORDINATION WITH OTHERS

9.01. Public Participation. Public meetings have been conducted almost continuously on a scheduled basis at major cities between Cairo and Venice since 1882. These meetings are open to public participation for any concerned citizen. Cities at which these meetings are held include Cairo, Memphis, Greenville, Vicksburg, Natchez, Baton Rouge, and New Orleans. Such meetings include discussion of any feature of the Mississippi River and Tributaries Project. In recent years, no major environmental issue concerning the levees and channel improvement on the Mississippi River between Cairo and Venice has been identified at these meetings.

9.02. Government Agencies. Following Congressional authorization for review of the MR&T Project in 1954, interested Federal, State, and local agencies were contacted for their comments on the overall project. The reports of governmental agencies that responded to the comprehensive review were included in House Document 308.

9.03. Coordination of the Draft Environmental Impact Statement. The draft EIS, covering the authorized Mississippi River and Tributaries, Mississippi River Levees and Channel Improvement Project, was provided to the following Federal, State, and local agencies or interests for their review and comment.

LETTERS OF COMMENT

SOIL CONSERVATION SERVICE, USDA (Illinois)
SOIL CONSERVATION SERVICE, USDA (Arkansas)
SOIL CONSERVATION SERVICE, USDA (Missouri)
SOIL CONSERVATION SERVICE, USDA (Jackson, Mississippi)
SOIL CONSERVATION SERVICE, USDA (Tennessee)
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY, DALLAS, TEXAS
UNITED STATES DEPARTMENT OF THE INTERIOR, OFFICE OF THE SECRETARY
(Southeast Region, Atlanta, Ga.)
(Supplemental Questions)
ADVISORY COUNCIL ON HISTORIC PRESERVATION (Washington, D. C.)
DEPARTMENT OF TRANSPORTATION, UNITED STATES COAST GUARD
FOREST SERVICE, USDA (Upper Darby, Pa.)
DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT (Region VII, St. Louis, Mo.)
DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT (Region IV, Knoxville, Tenn.)
DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT (Region IV, Jackson, Ms.)
DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT (Region VI, Dallas, Tex.)
DEPARTMENT OF HEALTH, EDUCATION AND WELFARE (Region VI, Kansas City, Mo.)
DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE (Region V, Chicago, Ill.)
DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE (DALLAS, TEXAS)
STATE OF ARKANSAS DEPARTMENT OF PLANNING (State Clearinghouse)
STATE OF ARKANSAS DEPARTMENT OF COMMERCE DIVISION OF SOIL AND WATER RESOURCES
STATE OF ARKANSAS, DEPARTMENT OF PLANNING (State Planning and Development Clearinghouse)
ARKANSAS ARCHAEOLOGICAL SURVEY
ARKANSAS STATE DEPARTMENT OF HEALTH
STATE OF ILLINOIS, DEPARTMENT OF CONSERVATION (Projects Task Force)
DEPARTMENT OF NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION
(Commonwealth of Kentucky)
KENTUCKY HERITAGE COMMISSION
STATE OF LOUISIANA, DEPARTMENT OF PUBLIC WORKS
STATE OF LOUISIANA, DEPARTMENT OF PUBLIC WORKS
STATE OF MISSISSIPPI, BOARD OF WATER COMMISSIONERS
MISSISSIPPI FORESTRY COMMISSION
STATE OF MISSOURI OFFICE OF ADMINISTRATION (State Clearinghouse)
MISSOURI DEPARTMENT OF CONSERVATION
MISSOURI STATE HIGHWAY COMMISSION
STATE OF TENNESSEE, OFFICE OF URBAN AND FEDERAL AFFAIRS
(State Clearinghouse)
TENNESSEE WILDLIFE RESOURCES AGENCY
BOOTHEEL REGIONAL PLANNING COMMISSION AND ECONOMIC DEVELOPMENT COUNCIL
CENTRAL ARKANSAS PLANNING AND DEVELOPMENT DISTRICT, INC.

NATCHEZ - ADAMS COUNTY PORT COMMISSION
ENVIRONMENTAL ACTION COUNCIL OF MEMPHIS, MEMPHIS, TENNESSEE
ENVIRONMENTAL DEFENSE FUND
(Letter addressed to Vicksburg Engineer District)
(Letter addressed to New Orleans District Engineer)
SIERRA CLUB, OZARK CHAPTER (Olivette, Missouri)
NORTHEAST MISSOURI STATE UNIVERSITY
(Missouri Chapter of the American Fisheries Society)
DAVID A. MARCELLO, ATTORNEY AT LAW
FOREST SERVICE, USDA (Southeastern Area, State and Private Forestry, Atlanta, Ga.)

Comments received on the draft statement and responses are summarized below. Copies of comments received are attached (Appendix F).

(1) SOIL CONSERVATION SERVICE, USDA (Illinois)

Comment: Page 110 (3) This paragraph indicates an expected increase in borrow pit acreage by 10,000 to 20,000 acres. Page 110 (1) states "natural growth in the borrow areas would resume at the cessation of construction activities." You may wish to consider planting adapted species for early cover and wildlife habitat.

Response: Specifications written for all construction activities are increasingly more rigid with regard to environmental rehabilitation measures. Accordingly a larger number of plant species are being selected for use due to their value to wildlife species and these plants are being used for a larger number of construction items.

Comment: Page 155 (4) indicates an interest in finding adapted grasses for overall levee maintenance. The Soil Conservation Service technical guide lists suggested seedings for such areas. Each Soil Conservation Service field office can make this information available on request.

Response: Technical information from the Soil Conservation Service will be utilized as each construction item is reviewed during the writing of specifications.

Comment: Sedimentation from spoil is recognized as a problem and revegetation is planned. No mention is made of erosion control during nonconstruction periods. This may require the use of temporary seedings in some cases.

Response: It is anticipated that construction work within any individual construction item will be completed with a minimum of interruptions. This would make the use of temporary seeding practices unnecessary in all but the most extraordinary of circumstances.

Comment: If you have questions relating to erosion control, vegetative seedings (temporary or permanent), woody plantings, borrow area development, soils, or any soil and after conservation practice, don't hesitate to get in touch with our district conservationist at the Soil Conservation Service field office or this office.

Response: The technical ability and cooperation provided by the Soil Conservation Service are appreciated.

Comment: We appreciate the opportunity to review and comment on this project.

Response: Acknowledged.

(2) SOIL CONSERVATION SERVICE, USDA (Arkansas)

Comment: The draft environmental impact statement "Mississippi River and Tributaries, Mississippi River Levees and Channel Improvement," overall is very good to excellent.

Response: Acknowledged.

Comment: Paragraph 5 omits adverse effects on biological communities.

Response: Paragraph in question has been added to statement.

Comment: Paragraph 6.05 omits biological parameters and impacts.

Response: The subsections of paragraph 6.05 were improperly numbered so that the biological parameters and impacts were included under 6.05c. The paragraph has been renumbered.

(3) SOIL CONSERVATION SERVICE, USDA (Kentucky)

Comment: We have reviewed the subject statement and have no comments to make regarding the project's effects upon the environment since the statement appears to adequately consider the conservation of land, water, and other related natural resources.

Response: Acknowledged.

(4) SOIL CONSERVATION SERVICE, USDA (Missouri)

Comment: We have reviewed the statement and believe that you have done an excellent job of preparing a thorough statement. We have no comments regarding the works of improvement in the State of Missouri.

Response: Acknowledged.

(5) SOIL CONSERVATION SERVICE, USDA (Jackson, Mississippi)

Comment: Your statement is well written and gives a good description of the project, the environmental resources in the project area and the impacts on these resources resulting from the project. The expected changes in land use are clearly documented. The project covers the main stem of the Mississippi River only and does not cover tributary streams; therefore, it will have no effect on Soil Conservation Service projects in Mississippi.

Response: Acknowledged.

Comment: A positive statement on page 4, paragraph 1.03, "Project Features," that this proposed action will not affect projects of other agencies would be helpful if this is, in fact, the case.

Response: We disagree. Section 9 (p 172) "Coordination with Others" lists those agencies from whom comments have been requested. Any effect on projects of other agencies will be reflected in the comments of the respective agencies in their view of responsibility.

(6) SOIL CONSERVATION SERVICE, USDA (Tennessee)

Comment: We have studied the subject draft environmental impact statement and offer these comments for your consideration:

Page 53, lines 16 and 17: Page 47, paragraph 3, line 1, states that the northern sector of the project is characterized by agriculture. We suggest that these acreages be displayed separately not grouped with sandbars, etc.

Response: The intent of this section is a discussion of terrestrial habitats rather than the economics of the land. Because of its low diversity and relative unimportance as a habitat, cropland was so grouped. In other sections agricultural land is discussed in more detail, such as Sections 2.08d and f.

Comment: Page 53, line 30: The Levin and Read citation is incomplete (see references).

Response: Citation should read (Wharton [6]). Correction has been made in text and bibliography.

Comment: Page 137, lines 4-7: The biology known of slackwater areas and chutes should have been included in the environmental setting.

Response: As stated on page 137, lines 4-7 ". . . there has been no investigation of the biology of slackwater areas . . ." The general estimates of comparative productivity of chutes and slackwater is based on relative productivity of shallow, slow moving waters and deeper, faster waters.

Comment: Pages 137 and 140: Trade off of slackwater areas for borrow pits is not equitable in distribution. Loss of slackwater is between river miles 600-700 and between 800-900. Areas of gain are primarily between river miles 200 and 500. This makes the loss of productive habitat even more adverse for those areas of loss.

Response: Generally, the impacts in Section 4.02 were written for the entire project area. The significant losses to local areas (i.e. loss of slackwater between river miles 600-700 and 800-900, p. 137) are addressed where appropriate. The inequities of local losses and gains can be readily compared using Figures 6 through 16.

Comment: We appreciate the opportunity to review and comment on this proposed project.

Response: Comment acknowledged.

(7) UNITED STATES ENVIRONMENTAL PROTECTION AGENCY, DALLAS, TEXAS

Comment: We have reviewed the Draft Environmental Impact Statement, Mississippi River and Tributaries (MR&T), Mississippi River Levees and Channel Improvement. The proposed project is designed to improve navigation and reduce flooding between Cairo, Illinois and Venice, Louisiana. Project features include dikes, revetments, levees, and maintenance and construction dredging of the mainstem and several harbors. The proposed project will affect portions of Arkansas, Illinois, Kentucky, Louisiana, Missouri, and Tennessee.

We have classified your Draft Environmental Impact Statement as Category 3, Inadequate. Our reason for categorizing the statement as Inadequate is based on the lack of sufficient information to assess adequately the total impact of project implementation on the Mississippi River Basin System. For example, we do not believe the draft statement provides enough information on the Atchafalaya segment of the MR&T project. The Atchafalaya Floodway (authorized as part of the MR&T and currently being studied by the New Orleans District) is designed to act as a diversion channel for Mississippi River floodwaters and is subject to frequent overbank flooding. Presently, one of the major concerns in the Atchafalaya Basin is the increased siltation rates and resultant land building. Siltation rates have been accelerated by the numerous river alterations that have occurred in the Mississippi River Basin. We believe the potential long-term effects of siltation in the Atchafalaya Basin are related to the various project actions in the MR&T system, and therefore, a consideration of all MR&T actions and their interrelationship to the integrity of the lower Mississippi River Basin is needed in the final statement. Without this information it is not possible to determine the full environmental effect of the proposed MR&T program. Therefore, we suggest that an environmental evaluation of the interrelated effects of the Atchafalaya Basin project and the remaining MR&T projects be included in the final statement. Also, the final statement should provide additional information on water quality, sediment analysis, secondary environmental impacts, dredge material placement, and alternatives.

Response: The Lower Mississippi River provides an outlet for drainage from over 41 percent of the nation. The Arkansas, Missouri, Ohio, and Upper Mississippi Rivers, and numerous lesser tributaries contribute to the flow of the main river. Any comprehensive environmental study of the Mississippi would encompass nearly half of the continental United States and is clearly beyond a practical undertaking. The Corps is preparing environmental impact statements on projects throughout the Lower Mississippi Valley, including a statement on the Atchafalaya Basin Floodway and related projects. Suspended sediment measurements on the Mississippi for the past 25 years have not shown an increase in suspended sediment discharge; therefore, it can be presumed that siltation rates have not been significantly modified by actions discussed in this EIS.

Comment: The statement (pg.112) mentions that EPA criteria for heavy metals and nitrogen may be exceeded during dredging operations. However, no information concerning existing water quality for the above parameters is given in the draft statement. Therefore, we would suggest that a water quality monitoring program be implemented at the dredge and disposal sites which would, at a minimum, record dissolved oxygen, total dissolved and suspended solids, total Kjeldahl nitrogen, and heavy metal concentrations, before, during and after dredging operations. Assurance that State water quality standards will not be exceeded during the dredging operations should be given in the statement. If concentrations of pollutants should reach levels harmful to the environment, we suggest that temporary suspension, reduction or other modifications of the operation is considered to insure that water quality will be maintained at acceptable levels.

We also suggest that the statement identify and discuss the municipal and industrial water supply intakes in the project area which could be adversely affected by the resuspension of pollutants during dredging operations. Mitagative measures which could be employed to minimize any adverse impacts upon these intakes should be described.

Response: The statement should discuss nitrogen only since information on heavy metals is not available. The appropriate change has been made to the statement. Responsibility for the maintenance of environmental quality during operations is assumed by each District and will be done in compliance with the applicable Water Quality standards.

Comment: The discussion of dredged material placement should include a project map depicting the proposed open water and land disposal sites. Also, we believe the statement should include a discussion of the criteria that will be used to determine the disposal sites. Because of the volume of dredged material involved (75 million cubic yards), the impacts associated with spoil placement could be severe if mitigative controls are not provided. The statement should specify the controls (such as ring levees) that will be used during channel enlargement to lessen the effects of dredging and spoil placement on marshland areas and water quality. We would also like to point out that EPA believes wetlands should be protected from adverse dredging and filling practices. It is our contention that the placement of dredged material on any ecologically productive wetland area could be considered as an adverse environmental impact.

To help in evaluating the potential environmental impacts of dredging and dredged material placement, the final statement should include information on the physical, chemical, and biological characteristics of the dredged material. We would suggest the analysis of the following elements:

A. Physical Quality: A general description of the composition of the dredged spoil material (i.e., sand, silty clay, sludge, etc.), settleability, and the source of the spoil material for various reaches of the project area should be included in the statement.

B. Biological Quality: The dredge spoil should be analyzed for bacterial quality and acute toxicity (48 hr. TL_{50}) to fish, algae or invertebrates.

C. Chemical Quality: Volatile solids, Chemical Oxygen Demand, Total Kjeldahl Nitrogen, heavy metals, and chlorinated hydrocarbons should be determined for the various reaches of the project area. Also, we would suggest that a water quality monitoring program be established to analyze heavy metals, total dissolved solids, total suspended solids, and dissolved oxygen concentrations of the supernatant effluents from manually operated ring levee discharge points. Concentrations of these elements in supernatant discharges should not exceed levels that would be harmful to the maintenance and propagation of aquatic life.

Additional information concerning the long-term effects of dredging and the placement of dredged material within the project area is needed in the final statement. For example, the statement should discuss the effect of annual operation and maintenance activities (Over a period of many years) on water quality and land disposal areas. In particular, the impacts of increased sedimentation on the Louisiana Delta and the Atchafalaya Floodway should be considered. Inclusion of this information in assessing the long-term environmental impacts associated with project implementation.

Response: The majority of all material dredged from the channel is considered to be unpolluted since it is predominantly composed of sand-sized particles (0.3-50 mm). This material is normally dredged during the low water season (i.e. summer and fall) at the channel crossings (see page A-3) and deposited within the river itself (occasionally on bars) but within 800 feet of the channel. Since the river averages approximately 4000-5000 feet wide at such crossings, the material is generally deposited in deep water a relatively long distance from the banks. The areas thus affected are the least productive from a biological standpoint and the impacts of this maintenance dredging are considered minor. In the past an average of 36 million cubic yards of material has been dredged during channel maintenance.

Dredging of harbors may well involve the removal of polluted materials particularly since harbors are usually underlain by sediments normally composed of fine particles to which pollutants are sorbed. The treatment of such sediments will require detailed pre-dredging sediment analysis and strict control of material disposal to prevent or minimize adverse impacts on surrounding habitats. All dredging and disposal of dredged material conducted as a portion of this project will be accomplished in full compliance with existing regulations. In recent years an average of approximately two million cubic yards of material have been dredged in connection with harbor improvement.

It should be noted that retention of the present channel alignment and completion of the authorized works described in section 1.05 (page 6) is expected to reduce annual dredging requirements because of a reduction in bank caving and the creation of a more efficient channel.

Comment: Relationship to Other Projects

Several projects related to the MR&T Project are considered briefly in the draft statement. However, we believe the statement could be strengthened by including a discussion of the major Federal projects located on the tributaries of the Mississippi River between Cairo, Illinois and Venice, Louisiana (e.g. Red River Project). The cumulative effects of these projects and their relationship to the MR&T program should be discussed in the final statement. This information is needed in order to determine the full impact of the MR&T project and related projects on the Lower Mississippi River and Tributaries System.

We also suggest that the future plans to enlarge the lower Mississippi Channel to accommodate deep draft vessels, between the ports of Baton Rouge and New Orleans, be discussed.

Response: Adjacent projects may have an adverse effect on the mainstream Mississippi River and vice versa. The cumulative environmental impacts of these projects on the Mississippi River and its tributaries have been considered during studies leading to the preparation of this statement. However, these related projects and their impacts are considered on an individual basis as is the decision on whether or not to follow through on the projects.

The deep draft project is considered a separate project apart from the Mississippi River and Tributaries Project and a separate EIS has been prepared (draft EIS filed with CEQ and notice published in the Federal Register 30 August 1974).

Comment: Secondary Impacts

According to CEQ guidelines (Federal Register, Aug. 1, 1973), an environmental statement should discuss secondary or indirect impacts as well as primary impacts. Although the statement predicts that the project's impact on river transportation would be "to protect the capacity of the river to continue to move increasing numbers of ton-miles of cargo," the statement does not fully consider the secondary effects associated with increased river commerce. We suggest that the final statement discuss the effects such increases in river travel could have on the environmental quality of the project area. For example, the need for new and larger harbors, future industrial growth and possible accelerated urban growth could generate potential adverse effects on land, air and water uses in the project area. Also, channelization of many of the tributaries to the Mississippi River is being carried out for flood control. These operations could tend to worsen flood conditions in the lower reaches of the Mississippi River. This could result in a continuous cycle of levee and channel improvement projects. We believe that the final statement would be strengthened by further discussing the secondary environmental impacts that could occur as a result of project implementation.

Response: We recognize that secondary and tertiary impacts will occur as a result of the proposed project, and some may have worldwide implications. These have been omitted in the text because of the magnitude of the project and the complex inter-relationships that exist between various aspects of the project and other areas of the national economy and environment.

Comment: Alternatives

The final statement should include a discussion of the feasibility of transporting present waterborne commodities by other transportation methods. For example, the final statement should evaluate and compare the environmental and economic impacts of various transportation alternatives, such as rail, truck, airline, or combinations of these transportation modes. The draft statement mentions that barge traffic is more efficient from an energy standpoint (BTU per ton mile), when compared to other modes of transportation. We believe the statement should also compare energy requirement for the operation and maintenance of the various systems. This would better depict the total energy requirements for any transportation system.

Response: For a discussion of energy efficiencies see pages 249-252.

Comment: We also believe that the final statement could include alternate mitigative measures which, if implemented, could lessen the environmental impacts associated with the deposition of 75 million cubic yards of dredged spoil annually. Such measures as land treatment for tributaries contributing heavy sediment loads to the mainstem; revegetation and/or stabilization of spoil piles to reduce the erosion process; and the possible commercial market for dredged material. We suggest that these alternatives be discussed in the final statement and considered in the operation and maintenance plan for the Mississippi River mainstem wherever feasible.

Response: See first response on page 181.

Comment: Due to the size of the project area, we believe that the final statement should be divided into and discussed in segments. By utilizing this approach, it would be possible to provide detailed information on the existing environmental setting in each segment; actions to be implemented in each segment; and environmental impacts anticipated in each segment. These segments could vary in size, depending on the type of habitat and the detail necessary to describe adequately the proposed action and its impacts. We would, however, emphasize that while a segmented approach would benefit the decision-maker in determining the project's impacts on each individual river section, it would still be necessary to discuss the overall or cumulative impact of project implementation on the total project area.

Response: In fact, the environmental assessment upon which the impact statement is based was done in segments. It was decided that conversion of the impact statement into segments would not increase the detail and quality of the data or conclusions. In addition, it was felt that the approach taken; that is, the project area as a whole with impact pinpointed wherever possible, would result in a more comprehensive statement.

Comment: Tables 23 and 24 (Pgs. 121 and 122) of the statement summarize the impacts of habitat change on terrestrial and aquatic vertebrates, respectively. However, no mention is made regarding the source or the method used to compile this summary. We believe the final statement would be strengthened by including this information.

Response: Each species was judged individually based on the importance of the various habitats in the life history of the species and on the amount of each habitat type affected by this action. The impact on the species was further considered within each of the three main regions so that the abundance of the species within the region and the abundance and percentage affected of the various habitat types could be considered.

Comment: Approximately 200 acres of swamp forest is scheduled to be destroyed during operation and maintenance activities. While this represents a small percentage of the total woodlands in the project area, we believe that the loss of these very productive areas should be discussed as a potential adverse environmental impact. Also, the discussion of chutes (pg. 135) and slackwater areas (pg 137) does not address adequately the importance of these very productive biological systems. The statement does note that a reduction in these areas would represent a negative environmental impact. However, the statement implies that offsetting factors (loss of chutes in one instance and increase in slackwater in another) could result in a net positive gain in selected local areas. We believe the final statement should include additional information to support this contention.

Response: The statement has been revised to increase the discussion of the value of swamp forest to both the aquatic and terrestrial communities. The determination that conversion of main channel borders or chutes to slackwater areas is a gain is based on the recognition that slackwater habitats are more productive biologically than are main channel border areas or chutes which are generally characterized by significant flow and high turbidity. In localized areas such a conversion would result in positive impacts; however, the overall loss of aquatic habitats for the entire project area is recognized to be a limited adverse impact.

Comment: We recognize that herbicide use on the mainline levees is generally performed by the independent levee districts. However, we suggest that the specific types of herbicies presently being applied or being considered for future use be listed in the final statement. Care should be taken to use EPA approved pesticides in the project area in accordance with their labelling instructions. Also, we would suggest that the impacts on air quality, associated with maintaining the mainline levees by burning, be discussed in the final statement.

Response: The maintenance of levees by local interests is monitored to insure it is in accordance with our standards. The U. S. Army Corps of Engineers does not, however, control the use of pesticides or the practice of controlled burning. Both actions are initiated and controlled by local authorities. It is the responsibility of these authorities to see that the applicable environmental regulations are met.

Comment: Chapter 4, "Environmental Impacts of the Proposed Action", and Chapter 5, "Adverse Environmental Effects" should acknowledge that, by concentrating waters in a narrower and deeper channel and narrowing the floodplain, natural floodplain efficiency may be lost and water quality could be degraded by altering the following elements:

a) The broad floodplain environment contains trees, shrubs, vegetation, and organisms which in their growth, absorb and utilize nutrients and minerals from runoff.

b) Water velocity decreases on a floodplain result in sedimentation. Also, water trapped in floodplain pools seeps into the ground, is filtered or evaporated, and is returned in the hydrological cycle in a purer form.

c) Pockets and pools in the floodplain and shallow water areas afford ideal conditions for photosynthetic reduction of stream impurities and the production of oxygen.

d) Shallow water areas contain a multitude of aquatic organisms which help in the natural purification process. Reduction of shallow areas could therefore reduce stream purification capabilities.

e) By concentrating water in a straightened, deeper channel, the friction afforded by a shallow, vegetated, meandering channel is greatly reduced and stream velocities are increased considerable, thereby increasing the erosive qualities of the stream as well as its silt-carrying capacity. Silt deposition could therefore increase downstream in these reaches where velocities are reduced below settling velocities and where conditions are suitable for sedimentation. This point should be discussed in the final statement.

Response: These comments are generally correct and the appropriate corrections to Chapter 4 of the Impact Statement have been made.

Comment: The proposed project requires that 450 miles of levee be raised in order to provide minimum freeboard above the 1973 flood flow line. However, the draft statement does not give the revised flow line nor does it denote the location of the levees to be raised. Inclusion of this information would strengthen the final statement.

Response: The existing and the revised 1973 flow lines were used to determine the areas where levees were below grade as well as the amount of borrow which would be required. The reach affected by the revision lies approximately between Helena, Arkansas (river mile 665) and Donaldsonville, Louisiana (mile 175). On the west bank, the levees are to be raised a maximum of 6 feet in the vicinity of Vicksburg, Mississippi, and gradually tapering to less than a foot at both Helena and Donaldsonville. On the east bank, minimal increases (i.e. less than 2 feet) are expected for two reaches: first, the area between Vicksburg and the latitude of the southern border of Arkansas, and second, the area from Baton Rouge to Donaldsonville.

Comment: Page 4(p) The final statement should discuss why significant reductions have occurred in the flood capacity of the river.

Response: See last response on page 223.

Comment: Page 4(c) The final statement should clarify whether the benefits of the mainstem include those attributed to tributary projects. For example, river training devices on the Missouri River could transpose flood waters to the Lower Mississippi Basin. Are those considered costs to flood control and benefits to navigation?

Response: The tributaries with the exception of the Arkansas River are not included in the scope of this study. However, in the computation of the benefit-cost ratio for the project, adjustments were made to account for costs and benefits attributable to the tributaries.

Comment: Page 7(c) (Revetments) Additional information specifying the amount of concrete and other materials in place and proposed on the Mississippi as a result of bank protection (cubic yards of concrete mattress, or square miles of concrete beneath the Mississippi River) should be given in the statement. Also, the effects of the mattress on the riverline ecosystem should be discussed.

Response: Composition and size of revetment sections are presented. Linear feet and/or miles of river training devices are provided in Table II. The biological effects are duscussed as impacts in Chapters 4 and 5 of the statement.

Comment: Page 44 Oyster mortality can be expressed as a quantitative loss. Therefore, dollars lost versus dollars gained for beds south of the areas of mortality could be stated. The area south of the area of mortality should be located on a project map.

Response: Impacts resulting from the operation of the Bonnet Carre Spillway would be different each time the spillway is utilized. Severity of impacts to the oyster fishery would be dependent upon the duration of the opening, total volume of water discharged, and the season of the year. The area of oyster mortality resulting from the 1950 operation was quite different from the 1973 operation. Expression of quantitative losses and gains would be most difficult to obtain and would reflect impacts only on a specific spillway operation and not necessarily be applicable to other operations.

Comment: Page 110(3) What is the life of the project?

Response: The economic life of the project is 100 years; addition to text has been made.

Comment: Page 117(2) Approximately 75 million cubic yards are dredged annually. According to the draft statement, this figure is not expected to significantly increase due to the proposed project. This statement seems to be inconsistent with the information presented in the B/C analysis in the attachment. Here, there is a reduction in dredging of $700,000. This point should be clarified in the final statement.

Response: The reduction is the result of the decreased amount of dredging anticipated due to channel alignment resulting in decreased sediment load.

Comment: Page 144 (2) Borrow pits increase from 10,000 to 20,000 acres initially. The maximum areal extent of transition from borrow pits to low-lying inundated land equals existing borrow pits and projected pits resulting from this project. Total area ranged from 51,000 to 58,000 acres. However, information on Page 110(2) and (3) appears to be inconsistent with this by stating that a maximum increase of low-lying inundated areas would be approximately 67,000 acres. The difference in 9,000 - 16,000 acres of this land transition should be accounted for in the statement.

Response: Page 110(2) has been corrected to read 58,000 acres.

Comment: Attachment The Benefit-Cost Analysis could be strengthened in order to independently evaluate the project on economic terms or balance the economic benefits against environmental and economic costs.

Footnote 1 states the ratio was derived from measuring total benefits against total costs. If the total project benefits are annual benefits, it should be reworded by inserting the word "annual". If the benefits are all annual benefits, a question is raised especially regarding the line "Increased Returns of Wooded land" (349,319,000). The statistics in the body of the EIS present the following information:

Page 48	Total Woodlands	876,000 acres
Page 147	Loss of Woodlands to Project	30,000 acres
Page 147	Loss of Timber Revenue	$300,000-450,000/year
Page 58	Plantations	23,600 acres
Page 108	Total Timberland including plantations excluding early successional woodland	796,000 acres of oaks, gum, cypress, cottonwood, sycamore and maple.
		Woodlands yield $10-15/acre
		Plantations yield $20/acre

Thus, total net revenue from forests would be $7.5-12.5 million/year. The question arises, how can benefits of almost $350 million be credited to the project when existing revenues and acreage will decrease $300,000-450,000/ year and 30,000 acres respectively? The economic analysis should list the assumptions used in computing the benefit/cost ratio including the discount rate and the life of the project.

Response: Comments noted and text so modified. The comparison made between "Increased Returns of Wooded Land" and statistics in the body of the EIS is not valid because the former includes woodlands inside and outside the project area, whereas the EIS statistics refer to only woodland inside the project area. An error was found on Table 22; 30,500 rather than 30,000 acres of woodlands will be lost due to project completion.

(8) UNITED STATES DEPARTMENT OF THE INTERIOR, OFFICE OF THE SECRETARY (Southeast Region, Atlanta, Georgia)

Comment: The draft statement does not involve any Indian trust lands that are under the jurisdiction of the Bureau of Indian Affairs; therefore, it will have no adverse impact on the Indian people.

Response: Acknowledged.

Comment: The statement is deficient in its treatment of the impact of the project on recreation. All recreation use areas to be affected by the project should be noted in Chapter 4.03. Several designated recreation use areas, funded under provisions of the Land and Water Conservation Fund Act of 1965 (Public Law 88578) amended, may be affected by construction of the project. Section 6(f) of the act requires prior approval by the Secretary of the Interior for conversion, to other than public outdoor recreation use, of lands acquired with assistance under provisions of the act. The State Liaison Office in each state should be contacted to determine if provisions of Section 6(f) of the act applies.

Response: Responsible state officials in each state were asked to review the draft EIS and to forward to the state A-95 Clearinghouse for dissemination to other agencies.

Comment: The environmental impact statement should include a discussion of the impact on recreation of the authorized Hickman-Tiptonville and Tiptonville-Obion levee extension. These project features lie in the vicinity of Reelfoot Lake and the Obion River-Forked Deer River areas of recreational interest.

Response: The extension of approximately 5 miles of levee between Hickman, Kentucky and Tiptonville, Tennessee, as shown on Map 1-8 (1), will not significantly affect area recreational opportunities. Recreational activity within this immediate (levee improvement) area is conducted primarily with and surrounding the Reelfoot Lake property (in 3 miles east). The Cates Casting Field [Map 1-11(1)] is located immediately southwest of the levee extension. Operated by the Corps of Engineers, it represents an industrial activity competing with any potential recreational pursuit in the environs of the levee extension. Between these factors: (1) more suitable areas to the east, (2) industrial competition, the recreational potential will suffer from the commitment of this stretch of levee work.

The Tiptonville-Obion Levee Extension, however, represents a different situation. Impacts anticipated as a result of this portion of the project are discussed on pages 14-16.

Comment: The impact of the project upon recreational boating and boat harbors should be addressed in the statement.

Response: Recreational boating opportunity is expected to be enhanced by project completion through the planned construction of

47 access sites within the project area. However, the construction of project features will negatively impact aesthetic aspects of this activity.

Comment: The statement indicates that bottom-land hardwoods, areas of prime recreation attraction, will be destroyed by project construction. Recreation benefits foregone as a result of this destruction should be discussed.

Response: The extent of bottom-land hardwood loss is shown in Figure 8.

Comment: Federal guidelines on cultural (historic, archaeological, and architectural) resource preservation require greater detail be furnished in environmental statements. Information contained in this statement is not sufficient to determine if full compliance has occurred.

Response: Please refer to response to the comments of the Advisory Council on Historic Preservation.

Comment: "We are enclosing a copy of a booklet entitled, "Preparation of Environmental Statements: Guidelines for Discussion of Cultural (Historic, Archaeological, Architectural) Resources." If the environmental statement prepared on the project reflects the considerations described in these guidelines, the final statement will be adequate insofar as cultural resources are concerned.

Response: Acknowledged.

Comment: Because most of the project is to extend or enlarge existing improvements, we assume that pipelines and other mineral installations already have been protected or relocated. We suggest the statement be expanded to address this point.

Response: Statement so expanded.

Comment: The statement is vague about the location of structural features that are planned and authorized, and we are unable to make a meaningful evaluation of the total effects that the project may have on fish and wildlife resources. Several alternatives to the proposed action which were presented in the statement appear to be more environmentally acceptable than the remaining project work planned. Specific beneficial and adverse impacts of the alternatives should be more fully discussed and benefit-cost ratios should be provided to allow a more meaningful and objective comparison of the alternatives.

Response: Information on the location of authorized project works planned for construction has been referenced or included in the final statement (see section 1.05, page 6; and second response, page 186). In our opinion the alternatives have been properly covered. However, if further information is desired, the Environmental Assessment of the Lower Mississippi River may be reviewed at the Vicksburg District office of the U. S. Army Corps of Engineers.

Comment: The threatened and endangered species lists should be revised according to the "United States List of Endangered Fauna," May 1974, published by the Fish and Wildlife Service, pursuant to the Endangered Species Act of 1973 (Public Law 93-205; 87 Stat. 884). The Endangered Species Act supplanted the Endangered Species Conservation Act of 1969, on December 20, 1973. The Office of Endangered Species and International Activities, Washington, D.C., should be contacted to obtain the current status of species which may occur in the project area. In addition, detailed impact evaluations should be provided for endangered species which may be affected directly or indirectly by the proposed project.

Response: The endangered species lists have been revised to reflect the current status of species listed thereon.

Comment: Also, the wetlands affected by the proposed project should be classified according to Fish and Wildlife Circular 39, "Wetlands of the United States," so as to better facilitate evaluations of project impacts on individual wetland types.

Response: The Fish and Wildlife classification of project wetlands has been incorporated into the final environmental statement in 2.07f(4).

Comment: The statement, "Slackwater areas of the river would be reduced in the upper reaches of the river," should be revised to indicate the effect that the overall project impact on aquatic habitat from Cairo, Illinois, to Venice, Louisiana, would include a 23 percent reduction of chute areas and a 22 percent reduction of slackwater areas. Greater losses would occur along specific sections of the project area, including 36 percent of the slackwater areas from Cairo, Illinois, to Memphis, Tennessee.

Response: Section 5.02 has been added and revised to state these impacts.

Comment: This section states that in evaluating project justification, the premise has been adopted that a balanced plan exists. However, project implementation will result in significant losses of aquatic and terrestrial habitat, including 22 percent of the slackwater areas and 23 percent of the chute areas along the Mississippi River from Cairo, Illinois, to Venice, La., and 30,000 acres of woodland, including 5,400 acres of bottom-land hardwoods and 200 acres of swamp forest. Furthermore, inadequate descriptions of the proposed mitigating measures consisting essentially of 11,400 acres of additional borrow areas and 13,200 acres of additional edge and transitional habitat renders meaningful evaluation of the mitigation items mentioned impossible. We believe the validity of the assumption that a balanced plan exists has not been demonstrated. It should also be noted that the Fish and Wildlife Service has not had previous opportunity to evaluate fish and wildlife aspects of this project.

Response: 1) The balanced plan discussed on page 4, paragraph 1.03d, refers to a balance between the benefits of "flood control and navigation benefits." The Section in question is meant to address only the physical engineering features of the project itself and following Sections (i.e. 2-8) are meant to define as well as possible the present setting and project the impacts of the construction and operation of these features on the present environment. Additions to paragraph 1.03d should further clarify the intended meaning of this statement.

2) With the present state-of-the-art of river training works, it is not possible to predict on a long-term basis just where work will be required and in what amounts. About the best we can do now is to estimate about five years in advance where either revetments or dikes will be needed and then adjust these locations in June or July of each year, based on what has occurred during the high water season just passed.

All meetings of the Mississippi River Commission are well publicized, including meetings dealing with the project elements. In addition, public meetings have been conducted on a scheduled basis at major cities between Cairo, Illinois, and Venice, Louisiana, since 1882. Such meetings include discussions of any feature of the Mississippi River and Tributaries Project. Each District is also available to discuss its portion of the MR&T river stabilization program with any interested persons.

Comment: Page 7, paragraph e The statement that, " . . . 574 additional dikes have been proposed for 175 locations," contradicts data in Table 1, page 18, which indicates that dikes would be required at 165 locations. Specific information relating to foreshore protection, revetments, levee improvements should be provided to facilitate impact evaluations on affected fish and wildlife resources.

Response: 1) EIS has been revised to show the total locations for diking to be 165. 2) Additional information relating to proposed project features is incorporated in the final EIS (see response at top of page 191).

Comment: Page 8, paragraph d This section indicates that the proposed works would include dredging to correct alignment and confine flow to selected channels. The amount and extent of dredging presently required and estimates of that which would be required for the initial work and maintenance of the proposed project would have a direct bearing on the short and long-term impacts of the proposed project and should be discussed in the final environmental impact statement.

Response: Sections 4.01, 4.02c (1), and 6.05 discuss the impacts of dredging and have been altered to further delineate and define these effects.

Comment: Page 18, paragraph 1.09 This section states that the benefit-cost ratio of the project is 17.1. An explanation should accompany this statement explaining what factors were and were not considered in arriving at this figure. If intangible environmental benefits or losses are associated with the proposed project, such factors should be discussed.

Response: The factors considered in the benefit-cost ratio were:
a) Crop flood damage prevented benefit
b) Non-crop flood damage prevented benefit
c) Cleared land increased returns benefit
d) Wooded land increased returns benefit
e) Navigation benefit
f) Recreation benefit
g) Reduction in dredging as a benefit
h) Redevelopment benefit
i) Miscellaneous flood control benefits
j) Estimated Federal construction cost
k) Estimated non-Federal construction cost
l) Fish and wildlife losses as a cost

See also last response on page 274. Details supporting the BCR are available in the Office of the President, Mississippi River Commission.

Comment: The scientific names for several plants and animals are not included in Section 2.07, "Biological Overview," or in Appendix C, "Biology." The scientific names should be included in the final environmental impact statement.

Response: Additions have been made in the Appendix to include the scientific names of those organisms referred to in Section 2.07.

Comment: Page 38, first complete paragraph 1) This section indicates that dredge material is spoiled in the Mississippi River, sufficiently near to operations to minimize costs and yet not interfere with the channel being dredged. This statement should be clarified to reveal what types of habitats along the river would be affected by dredge spoiling.

2) In general, dredging and spoil deposition in areas that are highly valuable as habitat for fish and wildlife should be avoided. The Fish and Wildlife Service and other appropriate Federal agencies and State conservation agencies should be consulted in the future selection of dredging and spoil deposition sites and other planning activities that may affect fish and wildlife.

Response: 1) Section 4.02c has been amended to include the effects of dredging on aquatic habitats. See also page 181, first response.

2) Comment noted.

Comment: Page 44, third paragraph This section states that "... discharge of Mississippi River water into the Lake Pontchartrain-Borgne-Mississippi Sound system by operation of the Bonnet Carre' Spillway influences short- and long-term benefits and detriments as did natural flooding many years ago." Such a direct parallel between Bonnet Carre Spillway operation and natural flooding of years past is inaccurate insofar as man's influences on the system have altered such factors as frequency of flooding, rate of flow, and water quality.

Response: The statement was simply intended to note that prior to gaining control of Mississippi River flood waters natural overflow of the River influenced short and long-term benefits and detriments. There was no intention of drawing a direct parallel between natural and controlled flooding related impacts.

Comment: Page 62, second paragraph The term "economically significant" should be more fully explained.

Response: An explanation has been added to Section 2.07d(5).

Comment: Page 97, Table 19 This list should carefully differentiate between sites listed on the National Register of Historic Places and those not listed.

Port Hudson and Plaquemine Lock are both listed on the National Register and should be designated as such. This section should be expanded to include steps taken to comply with Executive Order 11593 and the National Historic Preservation Act. The Advisory Council on Historic Preservation's "procedures for the Protection of Historic and Cultural Properties" (Federal Register, January 25, 1974), Section 800, outlines steps required for compliance.

There is no indication that the State Historic Preservation Officers for the States to be affected by the subject statement have been consulted as required in Section 800.4. Their response should be included in the final statement.

It is the constructing agency's responsibility to determine the presence or absence of cultural (historic, archaeological, and architectural) resources within the influence of the project. Consultation with State and Federal agencies is but a step to determine what is already known about the area resources. It should not be taken for granted that all cultural resources are known to them.

Onsite examination by competent historians and/or archaeologists may be required to locate sites. All cultural resources in the area which may be influenced by the project are to be evaluated to determine if they are eligible for nomination to the National Register of Historic Places. Criteria for eligibility are published in Section 800.10 of "Procedures for the Protection of Historic and Cultural Properties." Agency responsibilities in the evaluation and nomimation of sites are covered in Section 800.4(A)(2).

If it is determined that sites meeting the criteria are within the influence of the project, the statement should indicate awareness of this and note progress of surveys of the affected area in compliance with Section 2(a) of Executive Order 11593.

Response: Port Hudson and Plaquemine Lock have been noted in the EIS as listed on the register. Please refer to the comments and responses of the Advisory Council on Historic Preservation.

Comment: Page 101, paragraph (4) The possibility of flood control and navigation structures generating adverse aesthetic impacts should be discussed.

Response: The referenced section concerns the present environmental setting. The impacts are addressed in paragraphs 4.03b and 5.03b which have been modified in accordance with the comment.

Comment: Environmental Impacts of the Proposed Action This portion of the draft statement fails to give adequate consideration to the potential impacts on biological resources and water quality from industrial, agricultural, and urban development that will be stimulated by increased flood protection and channelization.

Response: Explanation has been added to section 4.02a.

Comment: Terms used to describe the environmental impacts of the proposed action on biological communities: minor, significant, and strong should be qualified.

Response: The terms referred are qualifications of the relative importance of the impacts identified in the document. Due to the lack of sufficient quantitative data, this method was selected as being most appropriate.

Comment: Page 111, paragraph (1) This section of the statement implies that vegatative cover would be replaced and maintained on the levees, and that natural growth in borrow areas would resume at the cessation of construction activities. It should be noted,however,that resumption of plant growth does not produce an immediate protective vegetative cover, and may be some time before a sufficient vegetative cover is established, depending on local conditions following construction activities. Also, there may be considerable differences in the ecology of spoil and borrow sites and adjacent areas so that the species composition could be affected.

Response: Such a note to explain these facts have been included in Section 4.02c(4).

Comment: Page 112, paragraph (5) It is stated that dredging and spoiling cause concentrations of nitrogen and heavy metals to increase and possibly exceed criteria established by the Environmental Protection Agency. It is also stated that care must be taken in such dredging and subsequent spoil disposal, since these conditions could cause strong local impacts on water quality. Such care that would be taken in these areas should be discussed in detail.

Response: The construction division of each district of the U.S. Army Corps of Engineers has the responsibility for maintaining dredge operations within the criteria established by regulatory agencies. The individual districts may be contacted as to the manner in which these requirements are met within their individual jurisdictions.

Comment: Page 118, paragraph (6) This section states that there would be no adverse impact on man-made structures, such as pipelines. Should any mineral related problems arise during construction, we request that Bureau of Mines be informed.

Response: Comment acknowledged.

Comment: Page 120, Table 22 The data in Table 22 shows that project implementation would result in a 13,200-acre increase in edge and transitional habitat and an 11,400-acre increase in borrow pit areas. In addition, data in Table 26, page 149, indicates that these changes would have a minor positive impact on edge and transitional habitat and a strong positive impact on permanently filled borrow pit areas. 1) The specific locations of the additional edge and transitional habitat should be indicated. 2) The different types of edge and transitional habitat that would be created should be described in detail and acreages of the different types should be indicated. 3) It should be noted that although species inhabiting edge and transitional areas may be benefited in certain areas from project activities (i.e., road building) that would create additional edge and transitional habitat, the overall environmental impact of such activities may be adverse. 4) Also, the additional edge and transitional areas created would not necessarily be immune from subsequent destruction from agricultural activities of other human activities. 5) Information on surface area and bottom configuration of borrow pits should be provided as these factors significantly influence the potential value of these areas for fish and wildlife resources.

Response: Additions to the EIS locating these general areas is included in 4.02 b(5). More specific information is not available.

There is insufficient information to determinine specific types and acreages of edge and transitional habitats due to variances in local soils, drainage, and species composition of other local disturbed areas which will indicate what pioneer species will invade disturbed areas.

Section 4.02a discusses the overall impacts of the proposed project on biological features and the specific trade-off of habitats are included in 4.02b.

The subsequent impacts on altered lands are dependent primarily upon the landowners plans.

Borrow pits vary significantly in physiographic features following construction and generalized descriptions beyond those appearing in Section 2.07g(6)(a) would be impossible. The Environmental Assessment of the Mississippi River discusses borrow pits further in terms of their features, sedimentation, etc.

Comment: 4.03 Impacts on Historical/Archaeological Sites, c., page 142 This statement should be expanded to show compliance with cultural resource preservation guidelines. The statement admits that many cultural resources are in at least the immediate vicinity of the project's impact but "precise location" is not "generally" known. It is the constructing agency's responsibility to determine the precise location of all cultural resources in the area of the project's impact and to discuss these resources in the environmental document.

Identification of cultural resources should not be left up to construction workers who are not qualified historians or archaeologists. It is possible that the objects or sites will remain undetected after the required historic and archaeological surveys and evaluations have been made. It is important however that such sites or objects detected by construction activities be called to the attention of competent historians or archaeologists for examination and evaluation.

Underwater objects are numerous in the area of the project's impact. Underwater surveys and examinations should be carried out prior to construction.

Response: Please see comments and response of the Advisory Council on Historic Preservation.

Comment: Page 149, Table 26 Alternatives to the Proposed Action The table indicates that the project would have a strong negative impact on swamp forests in the project area. The statement on page 128, paragraph (4a), which indicates that there would be a minor negative impact on these areas seems contradictory.

Response: The statement on page 128 and Table 26 has been changed to read "...moderate negative impact."

Comment: The Relationship Between Local Short-Term Uses of Man's Environment Page 168, paragraph c It is stated that the majority of the newly created borrow pits would not fill in during the life of the project. The life of project features should be stated to make this statement meaningful.

Response: An addition to the paragraph referred to (7.01c) shows that the life of the project is 100 years.

(9) UNITED STATES DEPARTMENT OF THE INTERIOR, OFFICE OF SECRETARY (Southeast Region, Atlanta, Ga.) (Supplemental Questions)

Comment: We believe that insufficient detail has been provided in this draft statement to permit an adequate evaluation of the expected environmental impact on geology and hydrology.

Response: Comment noted. See specific comment following.

Comment: An indication of the amount by which the approximately 450 miles of levees would be raised, or the approximate volume of fill required should be included in the statement.

Response: See second response on page 186.

Comment: We suggest that the statement be expanded to include information on the probable grain size of 75 million cubic yards of sediments to be dredged, the estimated location of the major dredging, any areal constraints to disposal of dredge spoils, the degree of pollution of the sediments, and the seasonal constraints and other factors related to evaluation of environmental impact.

Response: See first response on page 181.

Comment: The statement should be expanded to include an explanation of the impact of the proposed construction on the hydraulics and why significant reductions have occurred in the flood-carrying capacity of the channel (page 4).

Response: Considering the size of the lower Mississippi River, the proposed construction will not significantly affect the flood-carrying capacity of the river. The size of the channel or any of the proposed works are negligible compared with the cross-section of the river.

See last response on page 223.

Significant reductions have occurred in the flood-carrying capacity of the river because of unusually high sediment bed loads as a result of the discontinued cut-off program of the 1930-40's.

Comment: Information relating to why the design state has been revised upward for 461 miles of levees after the 1973 flood (Table 1), how the 1973 discharges compare with the design flood and, how the 1973 stages compare with the design stages should also be included in the statement.

Response: See previous comment. The 1973 maximum discharge at Vicksburg was 1,880,000 c.f.s. at a stage of 53.1 feet, mean sea level. This compares with a design discharge at that point of 2,710,000 c.f.s. and a design stage of 64.7 feet, mean sea level. Additional details are available through District Offices in New Orleans, Vicksburg, and Memphis.

Comment: It should be stated whether or not the dikes or revetments reduce the flood-carrying capacity of the channel and, if so, by how much and for how long. It should be addressed whether it will be necessary to raise the levees again as more dikes and revetments are constructed. The dikes and revetments provide benefits for low-water navigation, but if they reduce the flood-carrying capacity of the channel, the benefits accrued to navigation could be offset by the reduction in benefits to flood control. We suggest this be accounted for in the cost-benefit analysis. Dredge spoil disposal should be discussed as should the effects of the dredging on the flood-carrying capacity (p. 153).

Response: In a river the size of the Lower Mississippi, dikes and revetments do not reduce the flood-carrying capacity of the river to any measurable extent. It should not be necessary to raise the levees again as a result of construction of more dikes and revetments. Generally the dredging will tend to improve the flood-carrying capacity by creating a deeper channel which is more efficient in transporting water.

Comment: It is not stated if the technical backup data to support the statement are from the RETA (ref. 5) and references 3 and 26, or if these reports were made available to reviewing interests. This point should be clarified in the final statement.

Response: Technical backup data to support the statement are from RETA (ref 5) and references 3 and 26.

Comment: The requirement for additional foreshore protection has been given as 93.9 miles in Table 1(p. 19), whereas this is given in the text as 74 miles (p. 7, paragraph f). The proposed linear expansion of revetments has been given as 295 miles on page 118 (#3), whereas this was given previously as 325 miles (p. 7, paragraph d). Clarification of these two points should be made in the final statement.

Response: Table 1 has been corrected and text 116.

(10) ADVISORY COUNCIL ON HISTORIC PRESERVATION (Washington, D.C.)

Comment: I. Compliance with Section 106 of the National Historic Preservation Act of 1966 (16 U.S.C. 470f). The Council must have evidence that the most recent listing of the National Register of Historic Places has been consulted (see Federal Register, February 19, 1974, and monthly supplements each first Tuesday thereafter) and that either of the following conditions is satisfied:

If a National Register property is affected by the project, the environmental statement must contain an account of steps taken in compliance with Section 106 and a comprehensive discussion of the contemplated effects on the National Register property. (Procedures for compliance with Section 106 are detailed in the Federal Register of January 25, 1974.)

Response: The appropriate Federal Registers have been consulted and no Register site will be affected by the proposed action.

Comment: "II. Compliance with Executive Order 11593 "Protection and Enhancement of the Cultural Environment" of May 13, 1971.

A. Under Section 2(a) of the Executive Order, Federal agencies are required to locate, inventory, and nominate eligible historic, architectural and archaeological properties under their control or jurisdiction to the National Register of Historic Places. The results of this survey should be included in the environmental statement as evidence of compliance with Section 2(a).

B. Until the inventory required by Section 2(a) is complete, Federal agencies are required by Section 2(b) of the Order to submit proposals for the transfer, sale, demolition, or substantial alteration of federally owned properties eligible for inclusion in the National Register to the Council for review and comment. Federal agencies must continue to comply with Section 2(b) review requirements even after the initial inventory is complete, when they obtain jurisdiction or control over additional properties which are eligible for inclusion in the National Register or when properties under their jurisdiction or control are found to be eligible for inclusion in the National Register subsequent to the initial inventory."

Response: The results of the survey are included in the EIS. Section 2(a) responsibilities for nomination will be carried out prior to implementation and Section 2(b) will be complied with.

Comment: "The environmental statement should contain a determination as to whether or not the proposed undertaking will result in the transfer, sale, demolition, or substantial alteration of eligible National Register properties under Federal jurisdiction. If such is the case, the nature of the effect should be clearly indicated as well as an account of the steps taken in compliance with Section 2(b). (Procedures for compliance with the Executive Order are detailed in the Federal Register of January 25, 1974, "Procedures for the Protection of Historic and Cultural Properties," pp. 3366-3370.)

Under Section 1(3), Federal agencies are required to establish procedures regarding the preservation and enhancement of nonfederally owned historic, architectural, and archaeological properties in the execution of their plans and programs.

The environmental statement should contain a determination as to whether or not the proposed undertaking will contribute to the preservation and enhancement of nonfederally owned districts, sites, buildings, structures, and objects of historical, architectural or archaeological significance."

Response: No existing Register sites will be negatively effected by the project. Eligible sites have not yet been determined in the project area. Sites located outside the project area will be preserved through the flood protection aspects of the proposed project.

Comment: "III. Whenever possible, comments of the Historic Preservation Officers for the affected States should be included in the statement."

Response: Each state was requested to comment on the EIS through the agency responsible for water resources which forwarded the statement to the State A-95 Clearinghouse.

(11) DEPARTMENT OF TRANSPORTATION, UNITED STATES COAST GUARD

Comment: This is in response to your letter of 30 September 1974 to Mr. H. F. DeSimone concerning a draft environmental impact statement for the Mississippi River Levees and Channel Improvement Project.

The Department of Transportation has reviewed the material submitted. We have no comments to offer nor do we have any objection to this project.

The opportunity to review this draft statement is appreciated.

Response: Comment acknowledged.

(12) FOREST SERVICE, USDA (Upper Darby, Pa)

Comment: The above statement was forwarded to us for comment by our Milwaukee office, as no National Forest lands are involved. Because of the size of the area and our lack of on-the-ground familiarity with much of the involved land, our comments must be of a general nature.

Response: Comment acknowledged.

Comment: We do not feel that the statement makes clear which of the levees and channelization segments are part of the proposed project.

Response: Because of their bulk, individual site descriptions were not included (461 miles of levee, 154 revetment locations, 165 dike locations, 52 foreshore protection locations, etc.) All appropriate details are available through the District Offices at New Orleans, Vicksburg, and Memphis. See page 6, section 1.05(a).

Comment: We presume that related projects on tributaries, not described here, will be covered by separate environmental statements. When this is done, more detailed descriptions of portions of the main stem project should be discussed where the impact differs from this general statement.

Response: Tributary projects will be handled in individual environmental impact statements.

Comment: The text classifies the northern portion (above Memphis) as "agricultural" but the histogram on page 48 classifies the greater part of terrestrial resources as woodland.

Response: The legend on Figure 3 (page 48) was reversed. This has been corrected.

Comment: The full impact of levee construction on riverside forests, and the nature and significance of the losses is not discussed.

Response: Paragraph 4.02a 3(a), 4.02b 1(a), 4.02b 2(b), 4.02b 3(b), and 4.02b 4(c) address the significance of expected reductions in forest associations and their faunal communities. Further delineation of impacts is not possible due to the lack of information on these communities. A section has been added to paragraph 5 to further explain the adverse impacts on terrestrial communities.

Comment: Plans should include provision for slowing down the movement of water because channelization is designed to speed the flow during flood periods. Consideration should be given to additional floodways like the New Madrid Floodway, restriction of development in floodplain and in upstream areas, conservation measures like grassed waterways diversions, terraces, grasses and legumes (e.g. crown vetch on slopes). Without supplementary measures like these, channelization can result in greater flooding and increased sedimentation.

Response: In the case of the lower Mississippi, channelization has a very minor impact on the cross-section of the river and hence the speed of flows. We agree with the recommendations relative to the entire Mississippi watershed. For the mainstem itself, floodways such as the New Madrid Floodway have been considered and rejected on economic and environmental grounds in favor of the proposed levee system.

Comment: Rare and endangered plant species should be discussed as well as animal species.

Response: Section 2.07 j(2) addresses the rare and endangered plants known to occur in the project area.

Comment: Thank you for the opportunity to review and comment on this statement.

Response: Comment acknowledged.

(13) DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
(Region VI, Dallas, Texas)

Comment: The Draft Environmental Impact Statement for Mississippi River Levees and Channel Improvement has been reviewed by the Department of Housing and Urban Development, and it has been determined that the Department will not have comments on the subject statement.

Response: Acknowledged.

(14) DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
(Region VII, St. Louis, Mo.)

Comment: From the information contained in the Draft Statement, it does not appear that there are any conflicts with the plans or programs of this HUD Area Office. We do, however, offer several suggestions. It was encouraging to read that generally your statements do look beyond selected elements of the environment and judge channel maintenance and improvements on the merits within the broad system of measures planned. Because of this, it was early recognized that tradeoffs must occur if desired gains are to be achieved from channel maintenance, and it appears that such tradeoffs are reasonable and practical from the short-term viewpoint.

Response: Acknowledged.

Comment: We feel that Federal Flood Insurance and the impact of this new law should be explained in the Draft Statement. The Flood Disaster Protection Act of 1973, passed by Congress late last year and signed by the President on December 31, 1973, will have a major impact on many communities in your service area. This Act requires that communities having a high flood potential join the program or forfeit Federal financial assistance. The purpose of the law is: (1) to protect flood victims by assuring the availability of reasonably priced flood insurance; and, (2) to minimize future flood damage by controlling development in areas subject to flooding. In accomplishing the latter, HUD and the Federal Government have been given a key role in land use decision making in communities applying for flood insurance.

Response: Communities in the study area are not considered to have a high flood potential vis-a-vis streams in the project area.

The Federal Flood Insurance Program provides flood insurance to people residing in areas affected by floods. Studies associated with the program identify flood hazard areas, develop flood frequency data, and compute floodway data. This information will enable the Federal Insurance Administration to prepare Flood Insurance Rate Maps and provide basic data required by local interest to initiate land use regulations which would prevent future development within high flood hazard areas. The primary impact on flood control would be the limiting of future development in areas subject to damaging floods. Implementation of these regulations in the study area will have little or no affect on the proposed action.

Comment: Hopefully, all communities within your project area have been contacted and informed that they contain one or more "flood risk" areas. Flood risk under the legislation is defined as a one percent chance of flooding in any given year, i.e. a probability of a flood once every 100 years. Each community has been asked to apply for admission to the flood insurance program after adopting regulations containing a building permit system. Those who do not join the program by July 1, 1975, will find land development and other real estate activity in the flood areas cut off from most sources of financial assistance. The ultimate purpose of the Flood Disaster Protection Act is to assure that a larger proportion of the flood loss costs will be covered in the future by insurance rather than by the use of public funds. We feel that the National Flood Insurance Program can promote the public interest by providing appropriate protection against the perils of flood losses and at the same time encourage sound land use by minimizing exposure of property to flood losses. The program is a cooperative effort between the Federal Government and the private insurance industry, which is represented by the National Flood Insurers Association. Special questions relating to the program should be addressed to the Federal Insurance Administration, U. S. Department of Housing and Urban Development, 451 Seventh Street, S.W., Washington, D. C. 20410

Response: Acknowledged.

Comment: There is no doubt that in the years ahead, complex development and environmental challenges along this 900 mile reach of the Mississippi River will occur. Therefore, we recommend that every effort be made to expand public information and citizen participation programs. Eventually, the time must come when the average individual recognizes that he can actively participate in solving one or more of the problems which he sees along this major drainage and transportation route. Thus, the individual recognition would create that sense of dedication to improvement which not only solves problems but helps prevent the growth of new ones.

Response: Public participation is an on-going part of the Corps overall program for water resources development. Each year, public meetings are held at major cities from Cairo, Illinois, to New Orleans, Louisiana, regarding this project.

Comment: Hopefully, continued study and research will also be spent on the fabric of interrelations among all living things in and along this river, both qualitatively and quantitatively. In the years ahead, there will be an increasing need to understand these interactions more reliably, more explicitly, and for deeper reasons. To deal with and respect this great river, it will not be enough to predict which way things will change; there will be a definite need to know how much change and for what reasons. It is about interactions and their mechanisms where more knowledge and understanding must be gained so as to restore quality to the total environment and to better understand the longer range impacts.

Response: We agree.

(15) DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
(Region IV, Knoxville, Tenn.)

Comment: We have only one comment concerning this draft statement. What measures, if any, are proposed to minimize the adverse impacts that have been identified with this project? This should include both short-term and long-term impacts.

Response: The adverse impacts on water bodies, structure woodland and cropland cannot be reduced by any known measures because of the physical placement of the proposed levees, dikes, etc. The impact on water quality can be minimized by performing the construction near to the river during the periods of low water in the river, that is summer and fall, then promptly reseeding cleared, erodible slopes. The impact on archaeological sites will be minimized by exercising care during the construction phase and stopping construction near any finding that may be of significance until it can be inspected by appropriate experts.

(16) DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
(Region IV, Jackson, MS)

Comment: It would be helpful if the extent to which proposed improvements will reduce 100-year levels can be estimated and included in the Environmental Impact Statement. Reductions in flood hazard elevations will contribute materially to our programs of Flood Plain Management.

Response: The 100-year flood levels were not addressed in the statement. It should be noted that the project flood flow line is greater than the 100-year flood level. Details for reduction in flood hazard for HUD programs of Flood Plain Management are presented in several flood insurance studies along the Mississippi.

Comment: The alternative of widening the leveed channel by setback of two to six miles is not considered a feasible alternative. In addition to the excessive cost, as noted in the impact statement, considerable difficulty would be encountered in handling existing development relocation payments, litigation resulting from eminent domain proceedings, and similar problems may also accrue if such a course of action is contemplated.

Response: Comment acknowledged.

Comment: We trust that these comments will assist you in finalizing your Environmental Impact Statement for this project.

Response: Comment acknowledged.

(17) DEPARTMENT OF HEALTH, EDUCATION AND WELFARE
(Region VI, Kansas City, Mo.)

Comment: Review of the above referenced document indicates that there is no apparent impact on programs of the Department of Health, Education and Welfare. It would appear that the impacts of the proposed action and the reasonable alternatives have been adequately addressed.

Response: Acknowledged.

(18) DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
(Region V, Chicago, Ill.)

Comment: We have reviewed the Draft Environmental Impact Statement for the above project. To our knowledge, and based upon the information provided, this project will not impact to any significant degree on the health, education or welfare of the population.

Response: Acknowledged.

(19) DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE (DALLAS, TEXAS)

Comment: Pursuant to your request, we have reviewed the Environmental Impact Statement for the above project proposal in accordance with Section 102(2) (c) of P. L. 91-190, and the Council on Environmental Quality Guidelines of April 23, 1971.

Environmental health program responsibilities and standards of the Department of Health, Education, and Welfare include those vested with the United States Public Health Service and the Facilities Engineering and Construction Agency. The U. S. Public Health Service has those programs of the Federal Food and Drug Administration, which include the National Institute of Occupational Safety and Health and the Bureau of Community Environmental Management (Housing, injury control, recreational health and insect and rodent control).

Accordingly, our review of the Draft Environmental Statement for the project discerns no adverse health effects that might be of significance where our program responsibilities and standards pertain, provided that appropriate guides are followed in concert with State, County, and local environmental health laws and regulations.

We therefore have no objection to the authorization of this project insofar as our interests and responsibilities are concerned.

Response: Comment acknowwedged.

Comment: Pursuant to Section 102(2)(f) of Public Law 91-190 we have reviewed this project proposal and find no indication of adverse environmental health impact where our program standards and responsibilities are concerned.

Response: Comment acknowledged.

(20) STATE OF ARKANSAS DEPARTMENT OF PLANNING
(State Clearinghouse)

Comment: The State Planning and Development Clearinghouse has submitted for review and comment the above mentioned document to the State Agencies of Arkansas which are responsible for reviewing Environmental Statements.

The comments of the Department of Planning, Department of Health and the Arkansas Archaeological Survey are enclosed for your consideration and utilization. We request that your agency address these comments in your planning.

If we can be of further assistance, please do not hesitate to let us know.

Response: The comments of the Department of Planning, Department of Health and the Arkansas Archaeological Survey have been addressed in separate parts of this section.

(21) STATE OF ARKANSAS DEPARTMENT OF COMMERCE DIVISION OF SOIL AND WATER RESOURCES

Comment: RE: Mississippi River and Tributaries, Mississippi River Levees and Channel Improvements Draft E.I.S.

We believe the previously mentioned report to be adequate and concise. Included please find Archaeological Survey and Health Department's comments, which are all we have received to this date.

Please notify the appropriate personnel that the report is adequate with inclusion and consideration of comments.

Response: Comment acknowledged. Comments from other agencies have been addressed in other portions of this section.

(22) STATE OF ARKANSAS, DEPARTMENT OF PLANNING
(State Planning and Development Clearinghouse)

Comment The above cited study area extends along the Mississippi River from Cairo, Illinois to Venice, Louisiana and includes the Arkansas River between Pine Bluff, Arkansas, and the confluence with the Mississippi River, the adjacent land and water between the mainline levees and, in areas where there are no levees, the land within the project flood flowline (revised 1973 flood flow lines).

Purpose of project is to make the Mississippi more navigable and flood prevention. This objective is to be accomplished through following features:

1. Levees - Approximately 450 miles of levee raised.

2. Revetments - Approximately 325 additional miles.

3. Dikes - Approximately 574 additional.

4. Foreshore - Approximately 74 additional miles.

5. Dredging - No set quantity.

Response: Comment acknowledged.

Comment: The EIS does not state specifically how much dredging will be done through this project. The miles of dredging to be done should be stated. The EIS also states that biological implications of present dredging operations have not been thoroughly catalogued. We suggest more studies should be made to determine effects of dredging on rivers biological communities.

Response: At present, the navigation channel is maintained by periodic dredging of more than 100 areas of the river channel and harbors between Cairo, Illinois, and Baton Rouge, Louisiana. Areas to be dredged are determined by periodic channel patrols which sound the depth of the channel. The number of crossings dredged as well as the amount of material displaced to maintain the channel is largely dependent on the river stage and the duration of low water stages. There are an average of 42 crossings or 36 million cubic yards of material dredged annually.

See also page 112, paragraph (5) and page 181, first response.

The suggestion is noted.

Comment: It is difficult to determine from the EIS the need for the 4,700-foot extension of the Slough Landing levee. The statement is made as to the need based on 18,000 acres which will be cut off by extremely high water which tends to cross the neck of the peninsula. Insufficient information is given to the importance of access to this area during high water.

Response: The primary purpose of the Slough Landing levee extension is to prevent the development of a major cutoff across the neck. If a cutoff were to develop it would adversely affect the port of New Madrid (see App. E, map numbered 1-8(1)) and would create instability in the river regime in this vicinity. An additional purpose of the proposed work is to provide some degree of protection (i.e. for intermediate river stages) to agricultural lands located on the peninsula.

Comment: The EIS states that dredging for harbor maintenance and construction may introduce dredge spoil to land and/or water that exceeds Environmental Protection Agency criteria for nitrogen and heavy metals. Since these can cause strong local impacts in terms of water quality, care must be taken in such dredging and subsequent spoil disposal. Exactly what care will be taken to alleviate this water quality problem?

Response: See page 181, first response.

Comment: The EIS states that 30,000 to 45,000 acres of additional land would be disturbed in the project area by construction activities. Increase of borrow pit areas alone would be 10,000 acres. What consideration has been given to reopening old borrow pits to acquire levee material instead of disturbing new areas? Also more detailed plans for disturbing areas within the White River National Wildlife Refuge should be made known, if any are planned.

Response: Old borrow pits are used where it is practical. Generally, it is found that the closest source of borrow is not only most economical but also requires minimum disturbance of new land. This project has no requirements which would entail disturbing areas of the White River National Wildlife Refuge.

Comment: The EIS states that barge transportation is far more effective per ton-mile than rail, pipeline, truck, and aircraft. This is based on the fact that significant fuel savings are made through barge transportation. We question fuel savings shown based on 1972 figures. Evidently fuel consumed in dredging channel alignment, dikes, revetment, and other necessary maintenance for barge operations were not considered. The EIS should consider this factor to show realistic figures for fuel savings.

Response: The flood control and navigation portions of this project are closely interrelated. River training devices which contribute to navigation are also essential to protect the integrity of the levee system. Even if there were no navigational use of the river, project features would remain essentially unchanged. Thus, the proposed project cannot be considered in transportation costs.

(23) ARKANSAS ARCHEOLOGICAL SURVEY

Comment: This environmental impact statement contains a limited viewpoint of the impact of the project on the archaeological and histo~~rical re~~sources along the Mississippi River. The statement is made on page 142 that "while 736 historical and archaeological sites are in the project area, it is likely that only a fraction of these known sites will actually be adversely affected. Destruction of a historical or archaeological site could occur if the area became a source of borrow, or the site could be preserved (although inaccessible) if it were sealed under a berm, levee, or revetment." This considers only one destructive element of the project. In addition to the borrow areas for levees are a number of the other destructive elements. The ground is prepared for levees so that sites which the report indicates may be preserved under levees can be damaged in the process of levee construction. Underseepage problems are partially controlled by cutoff trenches, sublevees and drainage wells, construction of which can damage or destroy sites. Sites may be damaged or destroyed in the construction of revetment and dikes used in river training. Also, realignment of channels and dredging to maintain navigable depths would have an adverse effect on sites located in these areas. While many sites are not known within the river, certain kinds of sites are found only within the river, such as boat wrecks and Pleistocene and/or early Recent age fauna that provide information in regard to earliest man in the Mississippi River valley. The project appears, therefore, to have far more potential for destruction than for preservation of historical and archaeological sites.

Response: The EIS will be revised to state the potentially destructive effects of levee site preparation implacement of revetments and dikes, cutoff trenches, sublevees, drainage wells, and dredging. No realignment of channels is proposed for the project.

Comment: A second point in which the impact statement is inadequate is in regard to sites as yet undiscovered. The statement is made on page 142 that "many of the archaeological and historical impacts may result in uncovering heretofore unreported historical and archaeological sites. Contract specification would require contractors to cease operations and advise the contracting officer immediately if any historical or archaeological sites are discovered." This type of contract specification is necessary because not all sites can be found from surface evidence; however, an intensive survey for as yet undiscovered sites is necessary before construction begins and plans for such a survey should be mentioned in the report. Investigation of sites to assess their significance is needed prior to project construction, as well as excavation of those sites where adverse effects of the project are unavoidable. An assessment of the significance of the total range of archaeological and historical resources is needed early in the planning stages so that this information can be used in planning decisions.

Response: PL 93-291 and Executive Order 11593 require preconstruction surveys and/or salvage operations.

Comment: A third point for which this impact statement is to be criticized is the publication of archaeological site locations in Appendix D. We find it inconceivable that an agency with legislated directives to protect sites and information could so blatantly expose them to destruction. We recognize the need for the agency to have site location information for its planning purposes, but feel strongly that such information does not serve the purpose of preservation by being publicized. Inclusion of specific site location information in the Environmental Impact Statement serves no purpose and furthermore in itself creates an adverse impact on the sites because it provides locations to individuals who are searching for treasure rather than scientific or historical information. Excavation by untrained individuals vandalizes the information in the sites and ruins them for investigation with scientific techniques just as does the agency's construction. We ask that the specific site location information in Appendix D be deleted from the final impact statement.

Response: All specific site information will be removed from the final environmental impact statement.

(24) ARKANSAS STATE DEPARTMENT OF HEALTH

Comment: This office has received and reviewed the U.S. Army Corps of Engineers' above referenced document. The information presented in the statement indicates that the health significance of this project will be minimal. It is pointed out that many municipalities and industries pump their wastewater over the top of the existing levees and where these are to be built higher provisions should be made to assure that the pumping will continue. Provisions should also be taken to assure that pump stations will be capable of operations at higher heads.

Response: The intent of the statement regarding that no health impact will occur refers to the project features and not to municipal or industrial discharge facilities as these are not included in the scope of the study.

(25) STATE OF ILLINOIS, DEPARTMENT OF CONSERVATION (Projects Task Force)

Comment: The State of Illinois Projects Task Force has reviewed your Draft Environmental Impact Statement, Mississippi River and Tributaries - Mississippi River Levees and Channel Improvement, and has no adverse comment to make thereon. However, we do note that:

The report does not give any Environmental Impact information on vector control, i.e., mosquito breeding, etc.

Response: Vector control of such species as mosquitoes is a state and local responsibility and methods of control vary by locality within the project area. However, a section discussing this has been inserted in the EIS.

Comment: The document lacks data on flood heights and flows of record and operations during those floods. Particular attention is focused on the fuse plug in the New Madrid Floodway.

Response: Historical Records of floods and flows are available in the Environmental Assessment. Design operation and specifications of the New Madrid Floodway as well as a physical description of the floodway are also presented in the Assessment. Detailed design and operation of this Floodway is available in Technical Memo Number 2-300, "Method of Operation of the Birds Point New Madrid Floodway, Missouri." Similar information for the Bonnet Carre Floodway is available in the Environmental Assessment, "Impacts Involved by the Operations of the Bonnet Carre and Morganza Spillway Upon Certain Estuarine Organisms (U.S. Army Engineer, New Orleans District, 1973) and "Bonnet Carre Spillway," (U.S. Army Engineer, Mississippi River Commission, 1969). This information is available at the Vicksburg District, U.S. Army Engineers.

Comment: The document lacks operational plan details for future floods.

Response: The Mississippi River and Tributaries project is based on the design flood shown in the EIS. The project stages reached by this design flood have been revised in the light of new data from the 1973 flood. Information on historical flows and projected flows is available at the Vicksburg District, U. S. Army Engineers.

Comment: The document lacks information on existing and proposed levee profiles.

Response: Information on typical levee cross sections is presented in project maps (Appendix E).

Comment: We appreciate the opportunity for review.

Response: Comment acknowledged.

(26) DEPARTMENT OF NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION (Commonwealth of Kentucky)

Comment: The Department for Finance and Administration has raised the following question. Since the construction and maintenance activities of this proposed action will probably disrupt fish and wildlife and damage water quality, will there be anything done to help alleviate these temporary problems?

Response: The impact on fish, wildlife and water quality will be minimized where possible. For example, construction close to the river will be done during the low flow periods where possible to reduce the probability of pushing material into the river. Where appropriate, disturbed areas will also be reseeded promptly to minimize erosion and subsequent local degradation of water quality.

Comment: The Department of Fish and Wildlife's review of the impact statement found it to be very thorough and to frankly state the adverse biological impacts to fish and wildlife.

Response: Acknowledged.

Comment: It is also obvious that the loss of 30,000 acres of mixed bottomland hardwoods and 2,500 acres of cropland is monetarily insignificant when compared to the accrued benefit of the project to river transportation.

Response: Acknowledged.

Comment: You cannot compare the monetary value of a shrinking woodland habitat to the value of ports and river barge commerce.

Response: We agree and have not attempted a comparison of that sort.

Comment: These bottomland hardwoods are becoming a scarce and endangered habitat that is irreplaceable. The loss of 2,500 acres of cropland will probably result in the clearing of more timber to replace cropland losses. The worst part about losing woodlands is that it takes 50 or more years to regenerate them.

Response: Acknowledged.

Comment: Some will never come back because swamp woods depend upon periodic flooding for their maintenance. Once the flooding regimen is stopped, the land reverts to a different successional series.

Response: The present impact statement concerns a project study area bounded by the levees or project flow line. Remaining swamp woods continue to be subject to periodic inundation. Those swamp woods outside the project area have been subject to an extended period of flood deprivation already as a result of historical patterns of levee construction over more than the past one hundred years by both Federal and non-Federal parties.

Comment: One interesting point is that there will be a decrease in surface acreage of 10,000 acres, which would become low-lying inundated area and river backwater. The river will become more constricted and confined by levees. This will result in larger fluctuations during periods of flooding because floodwater cannot spread out. If and when another flood of record does occur, damage will be greater than ever. We suggest that you designate some low-lying lands for use as flood storage areas and divert water to these areas when the need arises. They could be zoned for agriculture and recreation, and crop damages paid when necessary. Raising levee heights seems to be an endless process and not a solution.

Response: Low-lying areas have been surveyed and considered for flood storage areas. Most low-lying areas would themselves have to be leveed to restrict flooding beyond certain inland points. Overall, the river side levee system is the most economical.

Comment: The Division of Air Pollution suggested that care be taken to minimize any particulate emissions resulting from activities related to upgrading the levees, installing channel stabilization devices, and floodgate construction. Please adhere to the requirements of AP-3, Section 4, on Fugitive Dust and AP-2, on Control of Open Burning.

Response: All construction contracts require adherence by the Contractor to all applicable state and local laws and regulations. These include the indicated air pollution requirements.

(27) KENTUCKY HERITAGE COMMISSION

Comment: The draft environmental impact statement, Mississippi River and Tributaries Project was tremendously refreshing compared to most statements of this type that we review.

Response: Acknowledged.

Comment: This historical data was well organized although for future reference it would be beneficial to explain how the data was gathered (publications or field trips.)

Response: The data were compiled from the published and unpublished literature pertaining to the project area and environs.

Comment: Also, during each phase of work it would be helpful for maps of the area affected showing each archaeological, architectural, historical, or cultural site and structure.

Response: We disagree and are also removing data presently indicating specific sites to avoid potential for vandalism or unprofessional uses of these resources.

(28) STATE OF LOUISIANA, DEPARTMENT OF PUBLIC WORKS

Comment: Regarding comments from the Louisiana Department of Public Works, we have no additions or changes to recommend in the draft statement. We are confident that the draft statement is adequate and will fulfill requirements of this process. The Lower Mississippi Valley cannot afford any stopage, delay, or slowdown of continuing in a most aggressive manner the authorized flood control improvements for Mississippi River Levees and channel improvement. Therefore, this office would appreciate being notified of any advance comments or confusion from interest within the State of Louisiana so that we in our state may respond to these individuals or groups as appropriate.

Response: The comment is acknowledged. Comments from interests located in the State of Louisiana will be included in the Final Enviro mental Impact Statement.

(29) STATE OF LOUISIANA, DEPARTMENT OF PUBLIC WORKS

Comment: This letter is in response to your written request dated September 30, 1974, for distribution to state agencies and for review and comments on the draft environmental impact statement prepared for the Mississippi River Levees and Channel Improvement, a feature of the MR&T Project. We are pleased to comply with your request.

For your reference we have attached a copy of the memo addressed to state agencies, Attachment No. 1, to distribute copies of the draft EIS and requested review and comments. The initial agency distribution list was increased as a result of a recommendation from the Louisiana Commission on Intergovernmental Relations. Their letter dated October 17,1974, is also attached as Attachment II. These agencies were requested to return their comments either to the office of the Vicksburg District, Corps of Engineers, or to the Department of Public Works. As of this date, we have received only one inquiry other than the October 17 letter from Louisiana Commission on Intergovernmental Relations. The second inquiry was submitted to the Louisiana Department of Public Works from Mr. Clint Pray, Governor's Council on Environmental Quality. The response to this inquiry along with a copy of his letter is being mailed to you under separate cover. If comments other than these mentioned in this paragraph have been submitted to your office, we would appreciate your sending copies of such comments to us at your earliest convenience.

Response: List noted. Response to comments received can be found in other portion of this section.

Comment: We appreciate the opportunity to be of assistance in review of this draft EIS. Should you have further need for assistance from the Department of Public Works, please advise.

Response: Comment acknowledged.

(30) STATE OF MISSISSIPPI, BOARD OF WATER COMMISSIONERS (November 18, 1974)

Comment: In response to your letter of September 30, 1974, we have conducted State agency review of the above captioned EIS, and have attached for your information all pertinent material. As indicated by the enclosed material, agency response to the review request was minimal. And, of the comments received, none were critical of the EIS. However, the Mississippi Forestry Commission has indicated their concern for the expected loss of woodlands due to construction activities, and has suggested that means be found to lessen the amount of timber acreage lost due to project implementation. In summary, we have no objection to the EIS. However, we are concerned with the expected land use changes in the study area and subsequent environmental damages as a result of project implementation. We hope efforts will be made to lessen the chances of any potential problems occurring.

Response: Land use changes in the study area (i.e., outside of the levees or above the project flowline) are not expected to be significant as a result of the project. The alternative selected minimizes the environmental impact while meeting the needs of the area involved.

(30) STATE OF MISSISSIPPI, BOARD OF WATER COMMISSIONERS (December 2, 1974)

Comment: Enclosed herein for your consideration are additional comments received from the Mississippi Forestry Commission in regard to the above captioned EIS. We feel that the suggestions contained therin merit further consideration, and any proposed measures capable of alleviating the potentially harmful environmental and economic effects of the project in the study area should be carefully studied. Thank you for your cooperation in this matter, and if we may be of further assistance, please contact us.

Response: Comments from the Mississippi Forestry Commission are addressed in ensuing paragraphs.

(31) MISSISSIPPI FORESTRY COMMISSION
(November 27, 1974)

Comment: (Letter to Board of Water Commissioners) In addition to the comments in our letter to you concerning the Environmental Impact Statement for the Mississippi River Levees and Channel Improvements, dated October 28, 1974, we would like to offer the following comments that we have received from a forest landowner in the study area:

P. 79 We do not agree with the statement that the beaver population is declining. In some areas, beaver activity is responsible for heavy timber damage and loss, and it is on the increase.

Response: A statement to this effect has been included in the document on page 79.

Comment: P. 110 No mention is made of the effect on the timber and other elements of the environment from lower river stages caused by straightened channels. This increases lateral drainage and, in general, lowers the water table in the batture. This can become critical during long periods of low water as in 1954 when many millions of board feet of cottonwood were lost in the area concerned. We know of no way to measure the amount of probable damage.

Response: Comment acknowledged.

Comment: P. 110 Under these proposed projects, the borrow pit area would be increased by some 14,000 acres. The borrow pits from past projects were left in various conditions with no thought to their future use. Some are shallow, poorly drained areas that support no timber and little aquatic life, then dry up in the Spring or Summer. Others are too deep and too poorly drained to grow timber. Some of these have good populations of fish year round, while others are little more than stagnant, algae-chocked pools. The amount and quality of timber in these present borrow pits varies from good to non-merchantable for sawlogs, depending upon the average depth of water, degree of drainage, and soil type. As far as we know,no survey has been made on the percent of area in merchantable timber for the present borrow pits.

Most of the new borrow pit areas to be added could be left in good timber producing condition with proper planning and little additional cost. We are receiving some cooperation at this time from the Corps on this problem in Louisiana. The borrow pits, ideally, should not be left too deep; perhaps, three or four feet at the deepest part. They should be levelled and sloped away from the levee. Small drains or ditches should be made to the River, a slough, or low drainage area. This process should also reduce under levee seepage.

Since many of these new borrow pits would be added to the back edge of the old ones, and since the old pits would be cleared in many instances, the old borrow pits could be improved along with the new ones. This might mean as much as 20,000 acres of good timber producing area which could be planted if natural seeding is not satisfactory. To take advantage of this possibility is simply good land use planning, and the opportunity should not be ignored.

Response: Comment acknowledged. Additions have been included in the environmental statement in Section 2.07g(6)(a).

Comment: We believe these are valid and constructive comments and that they deserve careful consideration.

Response: Comment acknowledged.

(32) STATE OF MISSOURI OFFICE OF ADMINISTRATION
(State Clearinghouse)

Comment: The office of Planning, as the designated State Clearinghouse has coordinated a review of the above referred draft environmental impact statement with various concerned or affected state agencies pursuant to Section 102 (2) (c) of the National Environmental Policy Act.

Enclosed please find the comments received. None of the other state agencies involved in the review had comments or recommendations to offer at this time.

We appreciate the opportunity to review the statement and anticipate receiving the final environmental impact statement when prepared.

Response: Comments of other agencies have been addressed in other portions of this section.

(33) MISSOURI DEPARTMENT OF CONSERVATION
(Letter 12 November 1974)

Comment: We have reviewed the draft environmental statement for Mississippi River and Tributaries, Mississippi River Levees and Channel Improvement prepared by the Vicksburg District of the Corps of Engineers. The statement, as we understand it, is for continuation of work under the 1928 Flood Control Act. However, we are confused by Item N, Page 3 which states, "The present project dates from this Act (1928). . . " . A clear statement of work planned, authorized, etc. would be a most helpful beginning.

Response: This statement is a portion of the history of the project and merely points out the roots of the proposed project. A clear statement of the project features, all of which have been authorized, is presented in Section 1.03.

Comment: The statement mentions in several places "significant reductions have occurred in the flood capacity of the river". A more complete discussion of how this has occurred, how the proposed action differs from past action and how it will correct previous "mistakes" is necessary. Efforts to lower the flood stage were apparently successful, however, we understand that the river is not at equilibrium. We are concerned that the planned action will result in substantial losses of fish and wildlife habitat, and not alleviate the cause of increasing flood levels at similar flows. Data gathered on the Middle Mississippi River indicate dikes, levees and dredge spoil disposal in the floodway have aggravated the flooding problem. The proposal as outlined in the EIS seems to offer more of the same.

Response: The construction of the levee system which flanks both banks of the Mississippi River has increased flood stages to all lands presently on the river side of the levee system. Although this area is presently flooded to a higher elevation, the lands protected by the levee system are not flooded and thus reap vast benefits. The dike systems and dredge spoil will have an insignificant effect on river stages during minor floods which slightly exceed a bankfull elevation. This effect on river stage will decrease with an increase in the flood magnitude and will practically be non-existent during major floods. Studies to date have not adequately distinguished between the effects of levee confinement and the effects of channel stabilization and improvement on the higher stages that have been experienced. Lower Mississippi Valley Division has initiated studies to investigate the conditions that are being experienced and to assign the proper significance to the factors that are responsible for higher stages, where it can be determined.

Comment: Page 3, Item n - The project being discussed is not clear. What is authorized? What is proposed but not authorized? Are conflicts between flood control and navigation anticipated?

Response: (1) Page 3, Item n has been expanded to state that the FCA of 1928 authorized general and progressive channel stabilization and river regulation from Cape Girardeau, Missouri, to Head of Passes, Louisiana, including a 9-foot by 300-foot navigation channel from Cairo, Ill., to New Orleans, La. Stabilization for levee protection is being accomplished by revetments and contraction works and the navigation channel is being maintained by dredging. As noted in paragraph o, page 4, this act has been modified and amended many times.

(2) The authorized project is delineated in paragraphs 1.03 and 1.04.

(3) No conflict between flood control and navigation is anticipated.

Comment: Page 4 - Item p. - The loss of flood capacity in the river must be addressed in greater detail. How will the proposed action correct the loss of flood capacity when the proposed action is similar to previous action?

Response: The project levees and floodwalls are designed to confine the project flood discharge based on a computed flowline. The project flowline and hence the project levee grade had been established based on stage-discharge relationships during the floods of 1945 and 1950, and the corresponding channel and overbank conditions. Subsequent to these floods a trend to decreasing channel capacity has been noted for small to moderate floods, but these lesser flows did not provide the data needed to check flow capacity and to verify the flowline for high flood discharges. The 1973 flood broadened the data base sufficiently to substantiate the positive deterioration in channel capacity and to permit a quantitative analysis of the adjustment required to project design flowline to protect the Valley against flood flows of project flood dimensions. The proposed action, which is to raise levees to an elevation that will contain project flood flows with freeboard, will offset the loss of the flood carrying capabilities of the Mississippi River main channel. The reductions in discharge capacity have occurred in the reach of the river affected by the cutoff program which was conducted during the 1930's and 1940's. Apparently the river is still reacting to that program. (See also second response, page 266). Lower Mississippi Valley Division has initiated studies to investigate the conditions that are being experienced and to assign the proper significance to the factors that are responsible for higher stages, where it can be determined.

Comment: Page 4 - Item b., c. and d. - Are these elements all authorized? What was the date of the authorization? What has been the cost?

Response: (1) All of these elements are authorized.

(2) FCA of 1928 dated 15 May 1928 as modified and amended.

(3) Accrued expenditures for channel improvement through 30 June 1974 amounted to $811,308,800.

Comment: Page 5 - Item d. - Why was the flood flow line revised in 1973? How will the proposed action prevent further revision?

Response: See previous comments. In view of the dynamic nature of the Mississippi River, the comprehensive flood protection project must be under continuous evaluation amd modified when conditions so dictate.

Comment: Page 7 - Item e. - Side channels and chutes are important to fish and wildlife, and no doubt increase the river's ability to store and pass flood waters.

Response: Please refer to Section 2.07 for biological aspects. Side channels actually hinder the passage of water because a shallow divided flow is not as efficient as a single deep channel.

Comment: Page 8 - Item c.- The backwater areas in divided channels provide fish and wildlife habitat. Filling of such areas either by depositing spoil, or accretion from dike fields will result in a loss of habitat and reduction in flood capacity. Is this loss of flood capacity considered in the project?

Response: The loss of flood capacity as a result of filling in backwater areas is considered negligible because these represent relatively inefficient water carriers when compared to the main channel, and under flood conditions are a small portion of the overall cross-section.

Comment: Page 9 - Second Paragraph - We wonder how the 97 acres can be "flood free", when it is obviously located in the floodplain.

Response: As stated, by using levees and by raising the elevation of the park above the project flood flowline.

Comment: Page 22 - Figure 2 - This figure represents a "project design flood", however, the flows depicted from the Mississippi River at St. Louis are extremely small. The 1973 flood, a relatively small flood, had a volume of 850,000 cfs. The figure indicates flood flows of 240,000 cfs.

Response: This figure shows the project design flood on the Mississippi River downstream of Cairo, Illinois, and also the contribution from the major tributaries. For this flood, the Mississippi River at St. Louis will contribute 240,000 c.f.s. However, because of the meteorological conditions associated with the development of this particular flood, the contribution at Cairo is relatively small when compared to the project design flood for the segment of river at St. Louis, which is 1,300,000 c.f.s. During the 1973 flood, a maximum discharge of 850,000 c.f.s. occurred at St. Louis, which corresponds to about a 30-year frequency event. The project design flood for the Mississippi River below Cairo is primarily the result of a major flood on the Ohio River, with a reasonable contribution from the Mississippi River above Cairo. We recognize that there is a possibility of the occurrence of unusual combinations of meteorological and hydrological events that could produce a flood of larger magnitude; however, the occurrence of such a sequence would be extremely improbable.

Comment: Page 26 - b. - Standard Methods would alleviate this problem.

Response: We agree; however, it is the responsibility of each state to decide how the determination is made and what limits are to be set on their criteria.

Comment: Page 42 - Last Paragraph - Wildlife would reinvade the floodway soon after the water receded.

Response: Comment acknowledged. We agree.

Comment: Page 46, Item (2) - The superficial statement that ocean ranging animals make "occasional visits" to the estuary fails to address the importance of the visits. In many cases these occurrences are essential for the species existence.

Response: This section has been expanded to more adequately reflect this comment.

. Comment: Page 47 - Item (3) - The statement, "Half the aquatic habitat. . . is deep, fast water which is low in productivity", is interesting. Was the meandering Mississippi River made deep and fast by dredging cutoffs and dikes? Will the proposed action change this process or further reduce aquatic habitat?

Response: The longitudinal profile of the river shows greater relief in the upper basin, resulting in a faster flowing waterway with less siltation. The proposed action will alter aquatic habitat as explained in Section 4.02c.

Comment: Page 52 -Item (5) The statement fails to consider the fact that if the land were protected from flooding the habitat essential for terrestrial wildlife, as well as aquatic wildlife would be lost. We would be interested in seeing data presented on the impact of flooding vs. intensive agriculture on the "normal breeding cycles" of wildlife species.

Response: (1) The land between the existing levees (the project area), which is the area addressed on page 52, paragraph 5, will not be protected from flooding, but, in fact, is essential to the total flood carrying capacity of the river.

(2) The data referred to would be interesting to review. However, we are aware of no such information.

Comment: Page 52 - The loss of vegetative cover due to flooding is less serious since the habitat returns. When flood protection is provided, habitat is permanently cleared. In some cases, successional stages can be set back to the benefit of a variety of wildlife species.

Response: (1) This is a hypothetical comment since the habitat may or may not be cleared for agricultural purposes. The impact of the proposed operations are discussed in Section 4.02(b) and the permanent losses of habitats are considered in this section.

(2) The importance of edge and transitional habitats is discussed in Section 2.07f.(5).

Comment: Page 57 - We would be interested in the data that supports the last two sentences of the first habitat.

Response: This statement is supported by Table 7, which is a relative indication of the use of different habitats by fauna associated with them. Beyond these calculations, there is no further data to support these statements.

Comment: Page 65 - Item d. - Data to support the generality that "Mississippi tributaries are of degraded water quality" should be presented due to the importance of water quality to the riverine system.

Response: Data relating to tributary water quality is available for individual states along the lower Mississippi River from the U. S. Department of Interior, Geological Survey. This data was judged to be too bulky to include in this report. The statement referred to "many tributaries," not to all tributaries.

Comment: Page 65 - Item e. - The value of the river swamps far exceeds that of waste assimilation. We suggest you study Charles H. Wharton: Southern River Swamp. A Multiple Use Environment (1970).

Response: Charles Wharton's Southern River Swamp has been reviewed and used in the EIS (p. 65). The importance of swamps is also discussed in Sections 4.02a(3)(a) and (b).

Comment: Page 70 - Source material listed in Table 12 is not included in the "List of References".

Response: The bibliography has been revised to include these references.

Comment: Page 71 - No fish harvest data are presented for the Missouri reach of the Mississippi River.

Response: The commercial fisheries statistics for Missouri cannot be broken down to describe the portion of the Mississippi River in Missouri lying in the project area. EIS will be revised to show this.

Comment: Page 75 - Item (7)- The discussion of swamps and sloughs is very weak, and indicate either a lack of knowledge on their value, or superficial treatment of this extremely valuable ecosystem.

Response: A revision complete with additional benefits of river swamps has been included in this section.

Comment: Page 79 - Item (4)a.- The mainstem of the Mississippi River includes chutes and backwaters. Therefore it is misleading to state "The mainstem Mississippi River is dangerous for sport or commercial fishing".

Response: The arbitrary division of aquatic resources within the project area was determined in order to best address recognized habitats. The definition of mainstem used in this report does not include chutes and slackwaters, though their relationship to the mainstem cannot be ignored.

Comment: Page 82 - How will the project affect rare and endangered species? How does the Corps of Engineers propose to meet the requirements of the Rare and Endangered Species Act?

Response: A section specifically describing the effects of the project on rare and endangered species has been added to the EIS. The project is not expected to threaten the existence of any rare or endangered species.

Comment: Page 96 - Item (12) - The statement, "The project area is generally unprotected from flood damages" is not clear. Page 6 states that river training devices increase the flood carrying capacity. Once again, we are not clear on what the project is, and how it is expected to function.

Response: The project area is the area between the levees, and hence is unprotected. The study area includes the project area and extensive areas protected by the levees.

Comment: Page 100 - If "land uses in the Lower Mississippi Valley are well adjusted to the flood hazard" what is the real need to spend millions of dollars?

Response: Significant portions of the area are well adjusted to the small flood hazard resulting from existing levees and other structures. The thrust of the referenced comment is that developed areas have not been established where there is significant backwater and tributary flooding.

Comment: Page 102 - Item c. - A population of only 9,000 persons could probably be protected more efficiently if removed from the floodplain.

Response: The intent of the proposed project is not to protect these 9,000 people but rather the millions located landside of the levees.

Comment: Page 108 - Item g.- (1) This section disregards the "National Priority" placed on environmental values and completely ignores fish, wildlife and recreation.

(2) Data presented by railroads dispute the statement that barges are more efficient; and (3) Data are not presented to indicate the energy demand for project construction.

Response: (1) The purpose of the EIS is to address environmental values, whereas this section is to address other national priorities.

(2) Comment acknowledged.

(3) Comment acknowledged.

Comment: Page 109 - Item a. - The conversion of 10,000 acres of water to land will change fish, wildlife and flood carrying capacities. The design channel may be more efficient for some purposes, but if it does not have the capacity, higher levees, more floods, and greater dependency on artificial flood protection will be necessary. The end result will likely be more years like 1973, 1950, 1927, and 1913.

Response: See third response, page 222 and last response, page 223.

Comment: Page 110 - Item (2) - We doubt that scour will be permitted to develop or restore water areas. Data to support the statement "small lakes will not fill in during the life of the project features" should be presented.

Item (4) - Which project features will inhibit flows from tributaries? How will they inhibit flows? How much will be inhibited?

Response: Item (2) - It is difficult on a river the size of the lower Mississippi River not to permit scour to restore water areas. The statement on small lakes results from a review of United States Geographical Survey quad maps of such lakes over the past 50 years.

Item (4) - No project features will directly inhibit flow from tributaries, and it is not expected that any will have even a secondary effect; however, it is possible that natural river action in response to some feature may slightly modify the mouth of a tributary.

Comment: Page 112 - Item (5) - Data presented in Table 21 raises several questions. Why did dissolved solids decrease substantially below substantially dredging operation, while settleable solids increased?

Response: This is a most interesting question, and is one of several questions relating to dredging under study by the Waterways Experiment Station.

Comment: Page 117 - Item (2) - If the channel is pinned down and the the banks are stabilized, we fail to see how there will be an "increase in sediment contribution generated by the natural meander process of the river".

The stabilization and improvement in the channel of the Middle Mississippi River has resulted in higher stages at similar flows.

Response: The Missouri Department of Conservation's question is well taken. The word "increase" in the first sentence of Item (2) on page 117 been changed to "decrease."

As previously stated, the construction of the levee system which flanks both banks of the Mississippi River has increased flood stages to all lands presently on the river side of the levee system. Although this area is presently flooded to a higher elevation, the lands protected by the levee system are not flooded and thus reap vast benefits. The dike systems and dredge spoil will have an insignificant effect on river stages during minor floods which slightly exceed a bankfull elevation. This effect on river stage will decrease with an increase in the flood magnitude and will practically be non-existent during major floods. Studies to date have not adequately distinguished between the effects of levee confinement and the effects of channel stabilization and improvement on the higher stages that have been experienced. Lower Mississippi Valley Division has initiated studies to investigate the conditions that are being experienced and to assign the proper significance to the factors that are responsible for higher stages, where it can be determined.

Comment: Page 117 - Item (2) states dredging would decrease: Line 4 and 5 of Item (2) state dredging is not expected to increase. What are the facts?

Response: Line 4 of Item (2) refers only to new construction dredging along the channel, whereas lines 6 and 7 refer to all dredging, including possible dredging for new harbors.

Comment: Page 117 - Item (3) - The Lower Mississippi River no longer has a "natural alignment".

Item (4) - Constricting the river area, will aggravate flood problems and eliminate fish and wildlife habitat. The proposed action seems to counter the need for flood carrying capacity (Page 4, Item p.).

Response: Item (3) - By "natural alignment," it is meant a permanent alignment which utilizes the natural forces of the river to maintain an adequate channel for navigation and carrying flood flow, thereby minimizing dredging and possible damage to the levee system.

Item (4) - We anticipate that constricting the river to a well defined and efficient channel will not aggravate flood problems but will increase the capacity of the river to carry flood flow; hence, the aims of channel improvement are not in conflict with flood control. The EIS recognizes the impact on fish and wildlife habitat.

Comment: Page 118 - Item 4.02- What plans have been made to reduce impacts on fish and wildlife species? How will the project comply with the Rare and Endangered Species Act?

Response: No definite plan for or method of reducing the impact of channel improvement work on fish and wildlife has been developed. This has been the subject of numerous discussions and some experiments have been tried with limited success.

All applicable state and Federal regulations to protect the environment during construction and maintenance will be complied with. No significant impacts on rare or endangered species listed by the United States Department of Interior are expected.

Comment: Page 122 - Table 24 - Data in this table are misleading and in some cases incorrect. We question the improvement of habitat in borrow pits for riverine fish species.

Response: We would need specific criticisms to address these areas of comment. However, it can be stated that these judgements are partially subjective and represent the opinion of our staff.

Comment: Page 124 - Table 25 - If water areas are converted to land, how can they be listed in a table that attempts to indicate time to "recover"? This table is misleading. Aquatic habitat is lost to terrestrial, and good terrestrial habitat is converted to cleared agriculture land.

Response: Table 25, adapted from Shelford (1954), was included to show the relative time it would take for certain successional stages of vegetative associations to redevelop. It is not meant to assess habitat tradeoffs, but to add to the relative significance of the terrestrial communities described in Section 2.07.

Comment: Page 123- Item b. - What measures are included in the project to reduce or minimize habitat losses? The data should be presented in a more understandable manner. How many thousand acres of each habitat type will be lost due to the project?

Response: The losses and gains, expressed as acres, for each habitat type are given in Table 22 and Figures 6-14 and 16.

Comment: Page 132 - Item (1) - What is the purpose of creating a deeper channel? Is a 12 or 15 foot navigation channel part of this project? Data must be presented to support the statement "little or no effect on large river species". It seems that in order to deepen the river some backwaters and side channels would be eliminated. Will this not affect river fish species?

Data should be presented to support the statement that trading mayflies for caddisflies will not affect fish. Bottom habitat type, time of emergence, and habitat preference of each insect group are substantially different.

Response: The main purpose of creating a deeper channel is to maintain a 9-foot navigational channel. A 12-foot by 300-foot navigation channel was also authorized by the FCA of 1944; however, under present policy, a depth of 9 feet is all that is being maintained.

The statement "little or no effect on large river species" refers to the deepening of the main river channel by increased scouring. This is not expected to directly affect large river species of fish, planktonic elements, floating elements, or pelagic elements. However, these groups could be negatively impacted by loss of backwater areas in chutes and around dike fields as pointed out in section 4.02c(1).

The differences in bottom habitat type and bottom preference are the reasons given for the replacement of mayflies by caddisflies in areas where revetments are installed. It is not expected that the differences in times of emergence for caddisflies versus mayflies will be significant since only a portion of the river will be affected and since both species are available as food organisms at times other than the emergence period.

Comment: Page 135 - Item (2) - The closure of chutes and their filling with sediment reduces the cross sectional area of the river available to pass flood waters. Chute type habitat is important to certain species, while other species prefer slackwater. The elimination of chutes would no doubt reduce certain species.

Response: The sedimentation processes behind dikes on the lower Mississippi River are addressed on page 137. The importance of various habitats to associated organisms is acknowledged in section 4.07(a) and (c) and the impacts of the proposed actions are addressed throughout section 4.02.

Comment: Page 137 - Item a. - We believe the loss of slackwater will be a strong negative impact, which the creation of a limited acreage of borrow pit will not moderate. The loss of 20 percent of the slackwater acreage must be looked at as extremely detrimental to aquatic life.

Response: Section 4.02a(3) has been changed to reflect the overall impact on slackwater areas.

Comment: Item b. - Aquatic life cannot survive in areas filled by sediment. The fact that in "some cases" areas behind dikes don't fill is little consolation. What is being done to prevent filling and encourage backwater development?

Response: See following comments.

Comment: Page 140 - Item c. - This is misleading and fails to present objective disclosure of the environmental impacts. The positive impact referred to is based on a chance development, while the tremendous negative impact is nearly certain.

Response: The statement is not intended to be misleading but only to point out possible benefits from channel improvement works. The lack of permanent sedimentation behind dikes as described in Section 4.02c(3)(b) is not unusual for the lower Mississippi River.

Comment: The presentation of charts of one slackwater area is interesting: are plans being made to duplicate the effort on other reaches of the river? If not, why not?

Response: This graphic presentation (Figure 15) does not represent a specific slackwater area, but is an attempt to portray the fate of a typical diked area on the lower Mississippi River.

Comment: Page 142 - Item a. - The creation of 17,000 acres of sand will be at the loss of water area.

Item b.- What is the basis for the statement that there will be "greater visual diversity"?

Response: Item a. - Comment acknowledged.

Item b.- A combination of a natural and culturally-influenced landscape is more diverse (consisting of different, dissimilar and distinct elements) than a purely natural landscape.

Comment: Page 145 - Item (3) - The filling processes discussed are not entirely "natural". They are man induced by the placement of dikes, closing structures and revetments.

Item (4) - From a fish and wildlife standpoint the loss of habitat diversity is bad. In addition, similar losses of water areas to land, and agriculture has aggravated the flooding problems on the Middle Mississippi River.

Response: Item (3). The use of the word natural is intended to be that such fill occurs as the result of natural forces responding to the proposed project features.

Item (4). Ten thousand acres would represent less than a 3 percent change in total water area. This change in channel capacity and hydraulic roughness is negligible relative to flood flows.

Comment: Page 147 - Item a. - If the project will adversely affect 2,500 acres of cropland and 30,000 acres of woodland, why is the project necessary?

Response: To prevent the inundation of 26,000 square miles of cropland, woodland, cities, towns, and industrial land as well as to maintain the lower Mississippi River as a viable means of transportation.

Comment: Page 148 - Item 6.01 - This section seems to extravagate the consequences of no federal action.

Response: The comment is noted as the opinion of Missouri Department of Conservation.

Comment: Page 155 - Item 6.03 - If the existing project is based on "an integrated framework of mutually supporting structures" we fail to see how continued maintenance of that framework would result in failure of the project.

Response: Because of the dynamic nature of the Mississippi River, the comprehensive flood protection project must be under continuous evaluation and modified when conditions so dictate. Failure to modify results in failure of the project.

Comment: Based on experiences on the Middle Mississippi and Missouri Rivers, and readings of experts (Modern Hydrology, by Raphael Kazmann, 1972), we are concerned that raising levees is not the long term solution. Man must recognize his abilities are limited by natural forces. The raised levees will also be subjected to overtopping and failure.

Response: Comment acknowledged.

Comment: Page 157 - Item (1) - The statement that lands would be abandoned is not supported by our experiences. More and more land on the river side of levees is being cleared each year. A display of data on land being abandoned vs. land being cleared should be presented.

Item (2)- Loss of aesthetics would be very temporary and in the long run could provide for a more "diverse" setting.

Item (3) - With the proposed actions the historical and archaeological resources will suffer from man's activities.

Response: Item (1). In the hypothetical case proposed in this section, it is suggested that after failure of the project, the area presently developed landside of the levees will largely be abandoned for its present uses. It is quite possible it would still be farmed between inundations so that in that sense it may not be abandoned.

Item (2). Comment acknowledged.

Item (3). Comment acknowledged.

Comment: Page 157- Item (4) - The population of 9,000 people is quite sparse at present.

Response: The population referred to are the millions living landside of the levees. In the event of project failure, these people would tend to seek other areas to live.

Comment: Page 169 - Item (1)- Is the river presently in its "natural alignment"? What about cutoffs, dikes, etc.? We disagree with the statement that the impacts of channel stabilization devices are "short term". Experience on the Missouri and Mississippi Rivers indicates otherwise.

Response: No.

The definition of "short term" and "long term" in paragraph 7.01a, page 167, would seem to answer this comment.

The difference between the Lower Mississippi River and the Middle Mississippi and Missouri Rivers is explained in several places in the EIS.

Comment: Page 170 - Item b. - Additional dikes, revetment, etc., will not create "more diverse aquatic communities". On the contrary, there will be a loss of diversity due to closure of side channels and loss of aquatic habitat.

Response: The losses of various types of aquatic habitats are acknowledged throughout section 4.02. It is felt that the dikes, revetments, and riprap areas have positive as well as negative impacts. They represent a change from the natural situation but do present a greatly expanded area for attached organisms and they do provide habitats of greater variability in a river environment with limited physical variation.

Comment: Page 170 - 8.01 a. - Include "river side channels and backwaters" in the first sentence.

Response: Suggested phrase has been so included.

Comment: Page 173 - The Missouri Department of Conservation has not been contacted by the Corps of Engineers regarding this project. Therefore, we have not had meetings or other opportunities to offer comments and suggestions of project elements.

Response: All meetings of the Mississippi River Commission are well publicized, including meetings dealing with the project.elements. In addition, public meetings have been conducted on a scheduled basis at major cities between Cairo, Illinois, and Venice, Louisiana, since 1882. Such meetings include discussions of any feature of the Mississippi River and Tributaries Project. Each District is also available to discuss its portion of the MR&T river stabilization program with any interested person.

(34) MISSOURI STATE HIGHWAY COMMISSION

Comment: The Draft Environmental Impact Statement involving the Mississippi River and tributaries, Mississippi River Levees, and channel improvement by the U.S. Army District does not recognize the impact on State highway facilities should the floodway area be utilized. The Environmental Impact Statement should recognize the fact that a severe impact to the State Highway System will occur if the floodway is used.

Response: The United States Government owns flood easements for the Birds Point-New Madrid flooding. While severe damage to a portion of the state highway system would result from use of the Birds Point-New Madrid Floodway, the damage will be less than that which would occur should the floodway not be used and a failure of the main line levee result.

(35) STATE OF TENNESSEE, OFFICE OF URBAN AND FEDERAL AFFAIRS
(State Clearinghouse)

Comment: As the designated State Clearinghouse for Federal grant programs under OMB Circular A-95 guidelines, we have coordinated a review of the draft statement for the above referenced proposed project. Enclosed are comments submitted by the Tennessee Wildlife Resources Agency. These substantive remarks merit your attention and responsive consideration prior to finalization of the environmental impact statement. We appreciate the opportunity to review this proposal which generally emphasizes benefits of flood protection and improved navigation between Cairo, Illinois and Venice, Louisiana. While we do not object to the general proposals, we strongly urge that more detail be provided to outline the manner in which these measures are to be effected, particularly at the selected locations indicated in the enclosed comments. The State of Tennessee reserves the right to further evaluate these project features as additional information becomes available to us. If our office, as the State Clearinghouse, can be of assistance in this or other matters, please do not hesitate to contact us.

Response: The comments of the Tennessee Wildlife Resources Agency are addressed following these remarks. Additional detail has been put into the statement to better describe project plans and their projected impacts. Further public review can be made within thirty days of CEQ filing of the final impact statement, as published in the Federal Register.

(36) TENNESSEE WILDLIFE RESOURCES AGENCY

Comment: This project concerns flood control and navigation features of the Mississippi River and tributaries between Cairo, Illinois and Venice, Louisiana. This draft EIS describes the broad aspects of the project including levees, "river training" devices, and maintenance dredging.

Response: Concur.

Comment: As stated on page 8, levees are proposed to upgrade flood control by providing a minimum freeboard above the revised 1973 flood flow line. To accomplish this, approximately, 450 miles of levees are proposed to be raised along the mainstream between Cairo and Venice. The fill material will be obtained from borrow areas generally located on the river side of the levees. No detailed description is provided for individual projects, but, according to Map 1-8 (1), the Tiptonville-Obion Levee Extension, along with the Obion Diversion Channel, would be included.

Response: The comment accurately summarizes the work to be done with regard to levees. The Tiptonville-Obion Levee Extension, including the Obion Diversion Channel, is a related project. A description of the separate authority for this work, project explanation and impacts has been entered into this environmental statement (paragraph 1.07e).

Comment: According to pages 6-8, proposed river training devices include: (1) dikes for directing the channel into favorable alignment, (2) revetment of stream banks by means of underwater articulated concrete mattresses and riprap above low water levels on stripped and graded banks; and (3) foreshore protection by placement of large stones close to and parallel to the river bank in order to minimize the erosive action of waves. A total of 574 dikes would be added to the system at 165 locations (page 117). Maintenance dredging of existing 9-foot channels will be provided to maintain navigable depths in selected sections of the main channel.

Response: This description is accurate.

Comment: In a related project (page 9), the Mud Creek project of Lake County, Tennessee would provide a pumping station to excavate ponded water from that area when high stages on the Mississippi River prevent gravity drainage. A new inlet channel is proposed beginning at a point about 2,000 feet upstream from the existing Mud Lake culverts and extending northerly to the Mississippi River Levee. A 150-cfs pumping station is proposed to discharge the water into the Mississippi River.

Response: Concur.

Comment: The proposed Tiptonville-Obion Levee Extension and the Obion Diversion Channel would provide potential severe adverse effect on the Anderson-Tully Wildlife Management Area and on existing large natural lakes: If not properly designed, this project could cause severe sedimentation, resulting in the loss of trees on the W. M. A. and in the filling of valuable fishing and waterfowl lakes with sand. Since the draft EIS does not provide a detailed description of this particular project, it is recommended that a separate draft environmental impact statement be prepared for this project.

Response: The conclusion in this comment is not fully concurred in. The entire Lauderdale County part of the project area, including the Anderson-Tully Wildlife Management Area, Chisholm Lake, and Open Lake, presently receives sediment from three sources, the Mississippi

River, the Obion and Forked Deer Rivers, and off the bluffs to the east. Obviously, the project will not affect sediment coming off the bluffs. Construction of the levee is not expected to significantly change the amount of sedimentation these three areas receive from the Mississippi River. Should there happen to be a change, it should be in the direction of reducing the amount in Chisholm Lake. There should be no impact one way or the other on Open Lake from the levee as the lake is some four miles downstream. During discussions with Memphis District staff and in presentations at the 3 May 1974 public meeting, many local people, including representatives of Anderson-Tully, have stated that their worst sediment occurs when the Obion and Forked Deer Rivers overflow State Highway 88, just south of and parallel to the Forked Deer. This usually happens several times a year. Part of this overflow and sediment comes down the old channel of the Forked Deer River. To the extent that the diversion channel spoil bank blocks the connections between the present Forked Deer channel and its old channel, sediment from this source will be reduced. Also the diversion channel will be more efficient hydraulically than the present Obion-Forded Deer outlet, thus there will be some lowering of flood stages at the point of diversion. To the extent that this lowering carries upstream on the Forked Deer River, there will be some decrease in the frequency of flow over Highway 88. This will not be enough to solve the sediment problem from this source.

There has been some concern in the project area, which appears to be partially the reason for the comment, that construction of the diversion would dump all the diverted Obion-Forked Deer River floodwaters and silt down on Lauderdale County. Construction of the continuous spoil bank on the east side of the diversion channel will prevent this from happening.

In consideration of the Tennessee WRA's comment, the following is believed pertinent.

Should the 100-year flood on the Mississippi River occur today, 87,000 acres in Dyer and Lauderdale Counties would be inundated. The project would eliminate backwater flooding from the 100-year flood on 31,000 acres in Dyer County and reduce flooding on an additional 56,000 acres in both counties.

Siltation of croplands, woodland, and lakes in the project area and especially Lauderdale County will continue. The lakes, of which Chisholm Lake and Open Lake are the most prominent, are being filled with silt which will, in time result in a loss of their fish and wildlife values. Chisholm Lake, with its smaller size and shallower depth is in more immediate danger from filling. Construction of the project will reduce siltation from the Obion and Forked Deer Rivers, thus reducing damages to croplands and woodlands and prolonging the useful life of Chisholm Lake in particular.

It is estimated that 3,200 acres of privately owned woodlands within the project area will be converted to croplands even if the project is not constructed. The project is expected to induce clearing of an additional 4,700 acres of woodland for crop production, largely in Dyer County. This will result in the reduction of wildlife habitat and hunting opportunities, especially as associated with small game animals. The induced clearing acreage represents 9.8 percent of the existing woodlands in the project area.

Construction of the project will require clearing of an additional 1,350 acres of woodlands. About 900 acres of this right-of-way is Anderson-Tully lands. Approximately 550 acres consisting of the spoil bank and the berms, except for maintenance roads, could be reforested through natural succession or a deliberate program. While the initial loss of woodlands would amount to 6,050 acres, in time the loss could be reduced to 5,500 acres by reforestation.

The construction of the levee and diversion channel through the Anderson-Tully lands has impact beyond the loss of woodland acreage. The project splits these lands into two tracts. This will make movement from one part of the lands to another for timber harvest and various management purposes more difficult as only two of the three roads will bridge the channel. This will also make movement of animals more difficult, particularly small game, and may result in higher population losses from flooding as some animals on the west side of the channel may not be able to get to high ground. However, they could use the levee for some measure of refuge.

The Moss Island Wildlife Management Area will suffer some loss of water supply. Under present conditions, most of the WMA, below elevation 255, is flooded about once every two years by the Mississippi River. After construction, this elevation will be reached on an average of once every eight years. This will tend to reduce use of part of the WMA for waterfowl habitat and hunting. However, the permanent wetlands generally lie below elevation 245 and will still be flooded almost annually by the Mississippi. From this, it appears that the major impact of the project on Moss Island WMA will be to make a water management program more difficult to implement.

There are 10 known archaeological sites in the general project area. Only one is close to the actual construction, and it will not be disturbed by construction activities.

There will be some impacts on fishery resources in the area, both adverse and beneficial. However, these impacts are expected to be significant only in the local area.

A separate environmental impact statement for this project feature is not warranted.

Comment: Dikes and revetments would have a strong negative impact on slackwater areas (page 137). Slackwater is described on page 54 as, "very slow moving and shallow, providing important spawning and nursery sites for fishes and abundant food in the form of benthos and plankton" and "valuable for both commercial and sport fishing". It is projected (page 120) that slackwater would be reduced between Cairo, Illinois and Memphis, Tennessee by 3,300 acres or 35%. Since no description is given in the draft EIS concerning the Tennessee portion of the dike and revetment projects, we recommend that a separate environmental impact statement be prepared, including full details of proposed work in Tennessee.

Response: The dike and revetment program for the lower Mississippi River extends along seven states and has the same type of environmental impact on each state. We do not believe the NEPA requires nor would it be reasonable to prepare and coordinate seven impact statements on the same program, especially when it it considered that the Memphis District portion of the program impacts on five states other than Tennessee.

In the way of further explanation, the following should be considered. The miles of revetment and number of dikes discussed in the body of the impact statement are related to the whole river from Cairo, Illinois, to Head of Passes, Louisiana, and are based on best professional judgment as to what will probably be needed to complete the project.

There is in the Memphis District 320 miles of revetment and 223 dikes in 63 fields. Based on our best judgment as to what will be required to obtain the desired degree of stabilization of the river, it is estimated that the revetment program is about 80 percent complete and the dike program is about 31 percent complete. With the present state of the art of river training works, it is not possible to predict on a long-term basis just where work will be required and in what amounts. About the best we can do now is to estimate about five years in advance where either revetments or dikes will be needed and then adjust these locations in June or July of each year, based on what has occurred during the high water season just passed.

We believe that to address either of these programs on a state by state basis is not reasonable and would be equivalent to preparing an EIS completely out of context. The Memphis District will be glad to describe the revetment program to the Tennessee Wildlife Resources Agency from time to time at its convenience.

Comment: Underwater concrete revetments could have a strong negative impact on benthos and fish spawning areas along the Mississippi River. Sections of 3-inch thick concrete are proposed to extend from the bank to the deepest point in the channel (page 57). These concrete sections would extend up and downstream until the desired degree of protection would be provided. There are already 673 miles of revetment in the project area. The proposed project includes approximately 325 additional miles at about 154 locations (slightly conflicting figures on pages 12 and 163). We reserve our comments until we can learn the location and extent of such revetments in Tennessee. An EIS is recommended for inclusion of this project description.

Response: As stated at the top of page 11 of the draft statement, one of the purposes of the revetment program is to stop bank caving. Bank caving has an adverse impact on the benthic organisms and fish spawning in the reach of the river in which is occurs. Most revetments are located on the outside of bends where the velocities are concentrated. These assessment data show that these areas, due to high turbidity and high current velocities, are poor habitat for both benthos and fish. As stated on page 11, revetments are made up of a series of block or slabs connected together except that the gaps between blocks are not filled. Thus, a completed revetment resembles a cobblestone street with the mortar left out. It would not be unreasonable to expect the various aquatic organisms in the river to use these gaps for reproduction and shelter.

Also, it has been observed that on parts of many revetments, particularly the tangents, sand has built-up, restoring the natural bottom habitat conditions.

As stated in response to the previous comment, the present and projected mileages and locations refer to the entire lower Mississippi River.

For reply to the last part of this comment, see previous response.

Comment: We conclude that proposed bank riprap and foreshore protection would provide overall benefits to fish and wildlife by protection of stream banks.

Response: Comment acknowledged.

Comment: We recently commented on an EIS concerning maintenance dredging in the Tennessee portion of the Mississippi River. We do not object to the proposals as described in the EIS.

Response: Comment acknowledged.

Comment: Insufficient information is presented concerning the proposed pumping of ponded water from the Mud Creek area of Lake County (page 9). We will want to comment on a later EIS giving more specific details.

Response: Additional material has been added to this statement concerning the Mud Lake project. As a related project it is discussed in this impact statement.

Comment: The draft EIS broadly describes flood control and navigation projects of the Mississippi River and tributaries between Cairo, Illinois and Venice, Louisiana. While we do not object to these general proposals at this time, we conclude there is a potential threat to fish and wildlife habitat. We recommend that additional details be provided in separate EIS's concerning: (1) Tiptonville-Obion Levee Extension and Obion Diversion Channel, (2) dikes, (3) revetments, and (4) Mud-Creek Project of Lake County. We, therefore, recommend that additional EIS's be prepared concerning these projects.

Response: Projected impacts of project alternatives and the proposed plan on wildlife habitats have been illustrated in this statement. The dikes and revetments are primary features of the proposed plan and as such must be described herein. The Tiptonville-Obion Levee Extension and Mud Lake projects are closely related to the Mississippi River and Tributaries project and as such are discussed in this environmental impact statement.

Comment: We appreciate this opportunity for comment and look forward to further evaluation of these projects.

Response: The Tennessee Wildlife Resources Agency will be consulted during each appropriate project review.

(37) BOOTHEEL REGIONAL PLANNING COMMISSION AND ECONOMIC DEVELOPMENT COUNCIL

Comment: We have received no negative comments or recommendations as a result of the (newspaper) article (which the Commission published). Therefore, the Bootheel Regional Planning Commission endorses this Environmental Impact Statement as it applies to the Bootheel's Six Member Counties.

Response: Acknowledged.

(38) CENTRAL ARKANSAS PLANNING AND DEVELOPMENT DISTRICT, INC.

Comment: This office has no recommendations to offer in regard to the environmental impact statement prepared for the Mississippi River Levees and channel improvement. We do wish to state that the document was rather thorough and impressive even though we feel not qualified to render a valued judgement thereon.

Response: Acknowledged.

(39) NATCHEZ - ADAMS COUNTY PORT COMMISSION

Comment: It is a very comprehensive study and seems to me to be adequate in all respects.

Response: Acknowledged.

(40) ENVIRONMENTAL ACTION COUNCIL OF MEMPHIS, MEMPHIS, TENNESSEE

Comment: The Environmental Action of Memphis comments as follows on the draft environmental impact statement "Mississippi River and Tributaries Mississippi River Levees and Channel Improvement."

Section 1, Project Description, and Section 2, Environmental Setting, Pages 1 through 109, are well done and adequate. In fact, all residents of the valley should read it to learn or refresh their knowledge of the environment in which they live.

The meat of the statement is in Section 4, Environmental Impacts of the Proposed Action, Pages 109 through 144. The statment will stand or fall on the content of this section because it is supposed to state effects of the project upon the environment.

Response: Comment acknowledged.

Comment: In general the section seems adequate, but here are some comments:

Page 112, par. 5. A specific plan to alleviate adverse effects of dredging would be better than the statement "Care must be taken in such dredging and subsequent spoil disposal", otherwise what assurance is offered that care will in fact be taken to mitigate such effects?

Dredging is not a onetime operation but must be continued as a maintenance operation constantly throughout the life of the project. The adverse effects are therefore spread into future years. Perhaps more attention should be focused on elimination of most dredging in favor of alternative operations less damaging to water quality. Otherwise we can foresee many years of disturbance of the river.

Table 21 states that water quality effects of dredging has strong local impacts but is minor compared to ambient water quality. However, there is a question as to how far water quality may be affected by colloidal and other fine material. Probably all the way from Cairo to New Orleans.

Response: The factors presented in these comments have been considered and are for the most part addressed in the Environmental Assessment upon which the Environmental Impact Statement is based. Responsibility for assurance that care is taken in dredging and subsequent spoil disposed is assured by inspectors within the Construction Division of each district office. It is also recognized that dredging is a continuous operation; however, it is expected that maintenance of the channel will reduce sediment sources such as bank caving. This in turn will have a beneficial effect in that the annual amount of maintenance dredging along the channel should be reduced.

Comment: Page 120, Table 22. Note that borrow pits to supply fill material for levees and other items will increase by 11,400 acres, more than double existing area; also that 29,300 acres of forest will be lost by clearing for improvements, for borrow pits, etc. (Also see page 144, paragraph (2).

Response: This statement is correct and the facts have been considered in the determination of the impacts of the project.

Comment: Page 117, Paragraph 2. Probably a typographical error, but statement says "Channel stabilization techniques will increase sediment contribution generated by the natural meander processes of the river," thereby reducing dredging requirements. It would seem that channel stabilization will decrease sediment contribution.

Response: This comment is noted and the appropriate correction has been made.

Comment: Page 147, 5.03d. Economics. Losses of cropland resulting in $300,000 per year and timberland $300,000 to $450,000 per year would result from project, but the report somewhere states how many acres of crop and timberland will be protected from flooding and therefore result in increased production. This, too, is an impact of the project. The report does show that project benefits would be 17 times the cost (page 17, 1.09).

Response: The Lower Mississippi Valley does contain vast acreage of land which benefits from flood protection.

Comment: Based on the historical benefits of the completed portions of the Mississippi Flood Control project, we must conclude that the sum total of national and local goals would require the completion and continued maintenance of the project. No sensational adverse effects to the environment have been observed. In fact, up to now, the project has generally been without controversy except for purely local conflicts. To curtail the project, or fail to proceed, would on the other hand, undoubtedly generate extreme pressures from a multitude of residents who are now enjoying its benefits. If for no other reason, the Mississippi Valley must be protected from flooding to maximize its gigantic agricultural potential.

Response: Acknowledged.

Comment: We feel that the draft statement can be improved especially in Section 4. This section will benefit by considering all comments and by providing more specific assessments of project impact.

Response: The EIS is being revised based on comments received.

(41) ENVIRONMENTAL DEFENSE FUND
(Letter addressed to Vicksburg Engineer District)

Comment: The economic analysis for the project does not properly quantify and consider the costs of the destruction of 2,500 acres of cropland and 30,000 acres of woodland and associated wildlife habitat.

Response: We disagree. The analysis focused explicitly on economic activities associated with harvesting of crops and timber and takes into consideration the adverse impacts on fish and wildlife use which has resulted from the existing project.

Comment: We enclose with this letter a copy of a letter which we have sent to Colonel Heiberg of the New Orleans District Corps of Engineers relating to the Central Louisiana Coastal Study and the Draft EIS Deep Draft Access to the Ports of New Orleans and Baton Rouge, Louisiana. It has become apparent that channelization and flood control projects throughout the section of the Mississippi River described in your Impact Statement, and tributaries of the Mississippi River,have produced conditions whereby flood waters and sediments in those waters move much more quickly down the Mississippi River than would be the case under natural conditions. All of this water and sediment has to go somewhere. The two principal outlets are the Mississippi and Atchafalaya Rivers and their respective deltaic systems in backwater areas. The coastal area of Louisiana had, in the process, become the dumping ground for all the flooding water and sediments which the Corps of Engineers is trying to push through the upper Mississippi River. This program of action in the upper Mississippi has caused enormous problems for coastal Louisiana. These problems are described at length in our letter to Colonel Heiberg. We would request this letter be incorporated as part of our comments on your Impact Statement.

Response: See responses to comments in letter addressed to Colonel Heiberg, New Orleans District.

Comment: Because of the conditions which the Corps of Engineers has created in the upper Mississippi River, the New Orleans District Corps of Engineers is in the process of struggling to remedy the problems which have been heaped upon it. It is trying to develop some program of action for the Atchafalaya Basin center channel floodway area and the lower Atchafalaya Basin, the whole Louisiana coastal area between the Atchafalaya River and the Mississippi River and the lower Mississippi River and Delta area itself. The problems of maintaining existing navigational channels in the lower Mississippi and Atchafalaya Rivers, Atchafalaya Bayou and Mississippi Delta and preventing further erosion of coastal Louisiana and controlling flooding have been exacerbated greatly by channelization projects along the upper Mississippi River. Your proposed project as described in your draft impact statement may further exacerbate these conditions. Insofar as your project exacerbates these navigation, flooding and erosion problems, it should include the costs of rectifying these problems as a cost of the project. In your Impact Statement, you should calculate as precisely as possible all of the costs which your proposed projects along 900 miles of the upper Mississippi River will impose downstream, particularly in coastal Louisiana. We would also request that you furnish us with copies of any hydrologic studies and economic analyses which you have done to determine the impact of your proposed project on downstream Louisiana flood control navigation and erosion problems and the costs of these impacts.

Response: Problems and environmental impacts associated with the Corps of Engineers projects in the Atchafalaya Basin and the lower Mississippi River and delta area are covered in draft EIS's prepared by the New Orleans District on these respective projects. The Environmental Defense Fund is on the appropriate mailing lists and copies of these EIS's should be readily available in your offices.

Project related costs for the entire reach of the project have been calculated and are incorporated into the benefit/cost analysis. Because of the number and bulk of hydrologic studies and economic analyses it would be impractical to duplicate and distribute these documents. All of these studies and analyses are, however, available for inspection at the offices of the Mississippi River Commission in Vicksburg, Mississippi.

Comment: The proposed series of projects are designed in part to maintain and improve the "transportation capacity" of the Mississippi River. Such navigational projects of the Corps of Engineers in the upper Mississippi River constitute a 100% capital construction subsidy to the barge industries. Since the freight railroad industry is not comparably subsidized, the railroad industry is necessarily damaged by this financial crisis, as reflected by passage of the Regional Rail Reorganization Act of 1973. Your Impact Statement should discuss in detail the contribution which these proposed navigational and flood control projects will make to either an exacerbation or solution of this rail transportation problem. The consequences for energy consumption and other resource use in this country are enormous.

Response: It is recognized that there has been an uneven public policy toward the various transportation modes. The traditional policy of the United States has always been to construct and maintain waterway facilities for free use of the public. It has also been Federal, State, and local policy to construct and maintain the public highway system although all highway users contribute to its cost through Federal and State highway taxes. The railroads themselves were originally built generally over the country with the aid of local, State, and Federal grants and loans. During the 37-year period from 1934 to 1970, inclusive, a total of $2.8 billion in Federal monies was expended to improve railroad-highway intersections. The Regional Rail Reorganization Act of 1973 has authorized planning for restructuring rail service with necessary Federal financial assistance in the region comprising the northeast and portions of the midwest, which has fallen into serious physical disrepair and financial insolvency.

There is an overall economic gain to the nation when transportation is made available to the public at lower cost. Benefits to overland carriers are derived from waterway movement of low-cost raw materials and from feeder and transfer traffic developed as a result of the waterway. This will have an offsetting effect on losses to overland carriers of shipments better suited to water movement. It enables movement of previously undeveloped traffic which could not move because of prohibitive rates, lack of any transportation outlet, or physical isolation.

The solution of the rail transportation problem goes far beyond the problem of intermodal freight competition and unbalanced Federal investment policies. The causes of the rail problems as outlined in the Midwest-Northeast Rail Reorganization report by the Department of Transportation includes limited access to capital markets due to historic low-profit rates, shifts in regional transportation demand, adverse regulatory policies, operating inefficiencies, low service quality, resistance to change by management and labor, and lack of innovations in marketing and pricing strategies and operating practices. Factors influencing railroad efficiency include excess capacity in duplicate mainlines, excess local lines and switching, underutilization of freight cars, poor track maintenance, and freight car shortages. The Department of Transportation report states further that required improvements in rail operating efficiency cannot be achieved without significant reductions in interrailroad competition. Although water competition has forced railroads to take innovative steps in areas of rates, operating techniques and car design, competition from motor carriers is more significant because of the large number of trucks and their ability to provide reliable, high quality service.

Computations of modal energy efficiency released by the Department of Transportation in March 1974, as well as computations by the Federal Energy Administration in the "Project Independence Report" indicate water transportation to be very energy efficient. The Department of Transportation data show that one gallon of fuel would move 300 ton miles of freight by water, 180 ton miles of freight by rail, and 50 tons of freight by truck. The attached FEA tabulation also shows water to be more energy efficient than rail for moving tonnage over a given distance; however, one must exercise care in comparing the relative energy efficiency of water versus rail modes due to such factors as the relative circuity of the water and rail routes and the percent of backhauls available to each mode. By any criteria, water transportation appears to compare favorably with other modes of transport. In addition, requirements for equipment construction on a comparative basis indicate railroad cars cost about two and one-half times as much as barges per unit of capacity and require almost 50 percent more iron and steel. These differences in equipment construction cost are partial reflections of differences in energy requirements which would need to be brought into an objective, comprehensive comparison of the relative energy efficiency among modes. Such an analysis is not available at this time and is beyond the purview of the Corps of Engineers.

The intent of Congress that the inherent advantages of each mode of transportation be recognized and preserved is clearly stated in the declaration of policy in the Transportation Act of 1940. There are certain segments of transportation which waterways can perform better and cheaper than any of the other transport forms. It follows that our polices for development and regulation of waterways should be aimed constantly toward promoting their use for those specific purposes for which they are best adapted. However, both water and land transportation are vital to the maintenance and growth of the Nation's commerce. In reality, railways and waterways are more complementary than competitive. Barges frequently haul the raw materials and fuels to major manufacturing centers while the railroads haul the finished goods from manufacturing centers to market. Provisions of levees, upstream reservoirs, and other flood control works enable railroads to run main lines alongside major waterways. Statistics furnished by the National Waterways Conference concerning a recent study of five river valley railroads paralleling major waterways showed their ton-miles of revenue freight increased 52.2 percent during the period 1960-71. During the - same period all other railroads reported an increase of only 25.2 percent. Sound national transportation policy should be aimed constantly toward maintaining and enhancing competition between all modes of transportation.

The following table compares recent (1972) energy efficiency levels for the major transport modes and projects future levels based on an imported crude oil price of $7 a barrel. For the passenger modes, energy efficiency is expressed in passenger-miles/gallon of fuel: for the freight modes, ton-miles/gallon. The higher the value, the greater the energy efficiency.

ENERGY EFFICIENCY
Projected Energy Efficiency of Transportation Modes
Based on Crude Oil Price of $7/bbl

Passenger Miles (Passenger-miles/gallon)1/	1972	1980	1985
Urban Passenger			
Auto	23	25	28
Bus	79	90	90
Rail	42	47	49
Intercity Passenger			
Auto	49	53	63
Bus	118	120	120
Rail	36	43	45
Air	15	16	17
Freight Miles (Ton-miles/gallow)			
Freight Miles (Ton-miles/gallon)			
Urban Freight			
Truck	19	20	20
Intercity Freight			
Rail	197	208	203
Water (Domestic)	276	282	288
Pipeline	307	329	359
Truck	53	59	61
Air (Domestic)	5	5	5

1/ Based upon average load factors

Source: Derived from Jack Fawcett Associates, Inc., Project Independence and Energy Conservation: Transportation Sectors, August, 1974.

From: Project Independence Report, Nav. 1974, FEA.

(Letter addressed to Colonel E. R. Heiberg, III, District Engineer, New Orleans)

Comment: We have received the notice of a public meeting "To initiate a study of flood problems, in the area between the east Atchafalaya Basin Protection Levee and the Mississippi River and Bayou La Fourche from Morganza, Louisiana to the Gulf of Mexico." We have also received a copy of your DEIS Deep Draft Access to the Ports of New Orleans and Baton Rouge, Louisiana. This letter constitutes our comments on both the proposed study and the DEIS.

In our view, the problems, of the upper Atchafalaya Basin, the lower Atchafalaya Basin, including the area around Bayous Chene, Boeuf and Black and the Atchafalaya Bay, the portion of central coastal Louisiana which is the focus of the proposed study and the lower Mississippi River and Delta area are all interrelated. To some degree, these problems have been brought about by the fact that the Corps of Engineers over a period of decades has cannelized and levied the Mississippi River north of Louisiana, and its tributaries, to a point where vast quantities of water and silt now pour down into the Mississippi and Atchafalaya River Valleys under a range of climatic conditions. There was a time when the vast flood plains of the Mississippi could absorb much of this water and silt. Those times are now in the past. In this connection, we refer you to the September, 1974 DEIS on the Mississippi River and Tributaries, Mississippi River Levees and Channel Improvement of the Vicksburg office of the Corps of Engineers.

Since the Corps of Engineers has developed enormous channelization and levee works along the Mississippi, the huge volumes of water and silt must find an outlet. These huge volumes of water and silt constitute enormous natural forces that even the Corps of Engineers apparently is finding some difficulty in taming. Witness the dredging problem which you have been experiencing in the Atchafalaya Bay and in the various channelled navigation passages in the Mississippi Delta. These huge volumes of water and silt passing into the Gulf of Mexico through the Mississippi River and its principal tributary, the Atchafalaya River, could be a tremendous force for the good. But before that can happen, the responsible agency, charged with looking for a solution, must ask the right question, namely, what useful purpose can this water and silt serve? Unfortunately, the Corps of Engineers has traditionally looked on this water and silt not as a potential beneficial resource but as a nuisance. Thus, the lower Mississippi River and Mississippi Delta, the Atchafalaya River and the Atchafalaya Bay and Delta have been channelized and dredged or are being channelized and dredged or are planned for dredging with a view in mind to expedite the flow of silt to points deep in the Gulf. The result is that much of the sediment which could be developing huge new deltaic lobes west and east of both of the Mississippi and Atchafalaya River outlets is now being wasted. Thus, while the Atchafalaya Delta is growing at the rate of 6.5 square miles per year, leading coastal ecologists, including Dr. Sherwood Gagliano, fear that further channelization in the Atchafalaya Bayou will disrupt that deltaic process by causing more silt to be dumped deep in the Gulf. Further, the Mississippi Delta has almost stopped growing. Thus, while the sediment could be used to build new deltaic areas, nourish existing coastal areas and wetlands and build up the coast of Louisiana, much of it is being wasted. This is our basic criticism of the DEIS.

Response: The Atchafalaya Basin, though not included in this Environmental Impact Statement, was considered in the determination of impacts. The U. S. Army Engineers has prepared and is currently preparing baseline and impact studies for the Atchafalaya Basin, as well as the Morganza Floodway and Deep Draft section of the Mississippi River. For more detailed information, the following references available from the U. S. Army Engineers, Vicksburg District, are suggested:

U. S. Army. Corps of Engineers. Lower Mississippi Valley Division. Lower Mississippi Region Comprehensive Study - (Preliminary). Appendices A - History of study; B - Economics; C (partial) - Hydrology; E - Flood Problems; O - Coastal and Estuarine; R - Power.

Kolb, Charles R. Distribution and Engineering Significance of Sediments Bordering the Mississippi From Donaldsville to the Gulf. Louisiana State University, Department of Geology. January 1962.

U. S. Army. Corps of Engineers, New Orleans District, and Louisiana Wild Life and Fisheries Commission. Atchafalaya Basin Usage Study, Interim Report. July 1, 1971-June 30, 1972. 22 June 1973.

U. S. Army. Corps of Engineers, Lower Mississippi Valley Division. Report on Gulf Coast Deep Water Port Facilities: Texas, Louisiana, Mississippi, Alabama and Florida. Vols. I, II, and IV. Vicksburg, Ms. June 1973.

Louisiana Wild Life and Fisheries Commission. Cooperative Gulf of Mexico Estuarine Inventory and Study, Phase I, Area Description; Phase II, Hydrology; Phase III, Sedimentology; and Phase IV, Biology. 1971.

U. S. Army. Corps of Engineers, New Orleans District. Water Resources Development in Louisiana by the U. S. Army Corps of Engineers. 1973.

U. S. Army. Corps of Engineers, New Orleans District. Impacts induced by the Operations of the Bonnet Carre and Morganza Spillways Upon Certain Estuarine Organisms. 1973.

U. S. Army. Corps of Engineers, New Orleans District. Draft Environmental Statement: Atchafalaya River and Bayous Chene, Boeuf, and Black, La.; Associated Water Features-Gulf Intracoastal Waterway, Lake Palourde, Bayou Penchant, Atchafalaya Bay, Four League Bay, Gulf of Mexico. January 1972.

U. S. Army. Corps of Engineers. Topographic Laboratories. Inventory of Basic Environmental Data, South Louisiana, Mermentau River Basin to Chandeleur South with Special Emphasis on the Atchafalaya Basin. (Engineer Agency for Resources Inventories) September 1973.

Four diversion structures authorized by the Flood Control Act of 1965 are planned for diverting fresh water to the wetlands east and west of the Mississippi River. These structures, which were justified on fish and wildlife benefits, have not been constructed because of the lack of local interest. We concur that the silt-laden waters of the Mississippi River could be utilized for land building in the inactive delta regions of coastal Louisiana. Reference is made to the draft EIS Deep Draft Access to the Ports of New Orleans and Baton Rouge, Louisiana, prepared by the New Orleans District, dated July 1974, which includes a discussion of fresh water diversion as a mitigative measure. The Corps of Engineers is also continually studying various means of dredge spoil disposal as well as possible beneficial uses of the dredged materials such as marsh building. More detailed information is available in the following publication.

U. S. Army. Corps of Engineers, Waterways Experiment Station. Disposal of Dredge Spoil: Problem Identification and Assessment and Research Program Development. (M. B. Boyd, R. L. Saucier, J. W. Keeley, R. L. Montgomery, R. D. Brown, D. B. Mathis, and C. J. Guice) Technical Report No. H-72-8. Vicksburg, Ms.

Comment: So long as the Corps of Engineers continues to consider only "flood control" problems for the coastal Louisiana area, it is bound to continue to consider the water and silt loads of the Mississippi and Atchafalaya Rivers as nuisances rather than as resources. This is a problem that we have encountered both in the Atchafalaya River and Bayous Chene, Boeuf and Black project and the Atchafalaya Basin Center Channel project. At the core of the dispute between the Corps of Engineers and other parties is not so much the exact shape of the technical solution but the asking of the proper question. We are not taking the position that the Corps should do nothing in coastal Louisiana and the Atchafalaya Basin. It is apparent that some action must be taken in view of the fact that coastal Louisiana is not functioning as a natural system at the present time and in view of the extensive channelization of the upper Mississippi River. In this context, we are delighted by the fact that the Corps of Engineers is concerned about what is happening in the area between the eastern Atchafalaya Basin Protection Levee and the Mississippi River and Bayou La Fourche from Morganza, Louisiana to the Gulf of Mexico. Problems in that area of Louisiana are substantial. The most evident problem is the fact that coastal Louisiana is subsiding and disappearing at the rate of 16.5 square miles per year. It is also evident that fish landings in the Gulf of Mexico are declining either in absolute numbers with respect to certain species or in terms of effort per unit catch with respect to other species. Up until very recently, the Louisiana coastal area was an expanding deltaic area. These natural processes have suddenly reversed. It is the reversal of these natural processes which is contributing, in our view, not only to coastal subsidence and declines in the productivity of the Gulf fisheries along the Louisiana coast, but also to flood control problems.

Response: The Corps of Engineers has been well aware of the deterioration of the coastal zone for a considerable time. The rate of 16.5 square miles per year land loss in coastal Louisiana was determined in a study financed by the New Orleans District. The multiple problems associated with the loss of alluvial deposits and nutrients accompanied by erosion, compaction, and subsidence are being studied within the framework of the ongoing Louisiana Coastal Study, which is scheduled for completion during fiscal year 1981.

Comment: What is therefore needed in order to confront these basic problems of coastal Louisiana is a comprehensive study of all of the natural and man-made forces which are interferring with and reversing the natural processes of coastal development and deltaic growth and the productivity of the coastal areas. It is also essential that all channelization and flood control projects in the upper Mississippi be properly coordinated with your own efforts. In such a study, the Corps of Engineers could consider what kinds of human uses of the coastal area are compatible on the long term with the biological productivity of the entire area. Efforts to deal with flood control problems, in coastal Louisiana through more engineering works, dredging and channelization and navigation projects may only lead to frustration and degradation.

Thus, what distresses us about your proposed study is that it is a study of "flood problems." A study of "flood problems" suggests an emphasis on engineering flood control solutions to an extraordinarily complex problem. Your study should therefore not be so limited for fear that the results of the study will be prejudged and predetermined. Similarly, the DEIS looks upon the lower Mississippi Deep draft access problem simply as a "navigation" problem, not as an environmental management problem.

Response: These comments seem to be addressed to studies or EIS's. other than the Mississippi River and Tributaries EIS.

Comment: As an example of the kind of environmental management approach which makes sense to us and which will in the long run do more to take care of flood problems with disastrous consequences for human life and property, we refer you to the report entitled "An Environmental Approach to Multi-Use Management of the Louisiana Coast Zone" by Dr. Sherwood Gagliano. Although we cannot necessarily vouch for all of his conclusions and don't necessarily endorse all of his suggestions, at the very least he is asking the right questions. He is analyzing the natural forces at work, how those natural forces can be used for beneficial purposes, how the biological productivity of the area can be enhanced and restored and what kinds of human uses of the area are compatible with maintenance of the biological productivity of the area.

The DEIS also fails to consider adequately the impact of the projects described in the Mississippi River Levees and Channel Improvement DEIS of the Vicksburg District.

Response: These comments relate to the Draft EIS Deep Draft Access to the Ports of New Orleans and Baton Rouge, Louisiana, and are not in reference to this EIS.

Comments: Flood problems inevitably result from the improper use of flood plain areas. The Flood Disaster Protection Act of 1973 speaks to this problem. That Act requires that the uses of flood prone areas be compatible with the natural conditions which exist on flood plains. This Act underscores Congressional support for an extensive land use study in an area subject to periodic inundation like coastal Louisiana. Thus, your study should be a land use study considering what uses of this area are compatible with natural flood conditions. We would therefore suggest that you coordinate this study with HUD, which is responsible for the administration of the Flood Disaster Protection Act of 1973. We would further support the establishment of a Section 208 planning agency in coastal Louisiana under the 1972 Federal Water Pollution Control Act Amendments.

In this connection, we would request that, from the earliest stages, the Corps of Engineers work on and draft an Environmental Impact Statement analyzing the environmental impacts of a variety of alternate land use programs in coastal Louisiana. This study is clearly a massive federal action. The programs which the Corps develops through this study will have enormous environmental impacts. Here is an opportunity for the Corps to use NEPA as Congress intended -- to develop a program of action for a biologically extraordinarily productive region.

Our views on proper planning in Atchafalaya Bay and the lower and upper Basin are well known to you through correspondence and litigation. We would request that this material be incorporated herein by reference.

Response: The EIS was reviewed by HUD and their comments and our appropriate responses are included with this statement.

It is beyond the intent and scope of this EIS to discuss alternate **land-use** programs in coastal Louisiana.

(42) SIERRA CLUB, OZARK CHAPTER
(Olivette, Missouri, letter 5 December 1974)

Comment: P.4 - p. Why have such significant reductions occurred?

Response: See last response on page 223.

Comment: P.4 - d. Why is there no logical method to assign values and why was the premise adopted that a balanced plan exists, etc.?

Response: No logical method exists because individual features (i.e. dikes, revetments, levees) act synergistically on the river and altogether comprise the balanced plan. Each feature affects the effectiveness of others associated with it.

The balanced plan refers to a balanced engineering plan, which is the best total navigation and flood control plan for the lower Mississippi River in the opinion of the Corps of Engineers.

Comment: P.8, 1.07a. - Is production from cut off an authorized purpose?

b. Specific reference to Osceola Harbor authorization should be given.

Response: If this comment refers to "protection" of areas cut off by high water, the answer is yes. Flood control is an authorized purpose of this project, which includes the protection of the 18,000 acres of agricultural land paragraph 1.07a. addresses. Also, see page 211, third response.

Osceola Harbor is authorized by Public Law 86-645, Section 107 of the River and Harbor Act, 14 July 1960, as amended by Section 310, River and Harbor Act of 1965.

Comment: P. 18 - 1.09 Computations resulting in benefit-cost ratio should be given.

Response: Please refer to the attachment after the appendices. Details supporting the BCR are available in the Office of the President, Mississippi River Commission.

Comment: P. 28 - a. Should there not be mention made of the fact that Louisiana is losing land at the delta and the reasons for such loss.

Response: The change in the ratio of water to land in coastal Louisiana represents an average annual net land loss of 16.5 square miles. This land loss is attributed in part to natural processes such as subsidence, compaction, and erosion. It is a natural process for an inactive delta to deteriorate and an active delta to expand.

The land loss has been accelerated by man's activities such as the confinement of the Mississippi River and the construction of navigation and oil exploration channels.

Comment: P. 38 - (3) What is the cause of the wave action?

Response: The two primary causes of wave action on the Mississippi River are river traffic and wind.

Comment: P. 46 - (2) There should be a more detailed explanation of the term "major flyway".

Response: We concur and Section 2.07a. has been revised to reflect the comment.

Comment: P. 47-(3) There must be consideration given to the effect on such marsh/estuary system.

Response: See response above.

Comment: P.52-b. (1) Why are the terrestrial communities measured only between the levees?

Response: The project area was defined at the initiation of this study as the land between the levees because it is these lands and the levees themselves that will be directly affected by the proposed operations.

Comment: P. 55 - e. Why have bats been excluded?

Response: Bats have been excluded from Table 7, as have non-breeding birds, because of their transient habits. This does not reflect on the importance of these groups to their respective communities, but removes seasonal fluctuations in populations from affecting the results in Table 7.

Comment: P. 65 -(c) The source of the opinion on water quality should be given.

Response: The statement on water quality is based on Table 2 and associated text (Section 2.03), which was compiled from water quality criteria from agencies of the states in the project area.

Comment: P. 93 - Blank.

Response: Comment noted.

Comment: P. 100 - b. How can the E.I.S. ignore the fact that often a consensus does exist in respect to aesthetics.

Response: There may be underlying principles which engender a common basis for perceiving the aesthetic environment, but with respect to the project area, we see no consensus.

Comment: P. 101 -(4) It would be interesting to know how an overhead utility can be aesthetically pleasing. Much more definition is needed in this section.

Response: Some observers would consider the curves of such lines aesthetically pleasing. We do not agree that a higher degree of definition would add usefulness.

Comment: P. 101 -(5) How was the judgment arrived at regarding visual monotony?

Response: By observation.

Comment: P. 106-(1) The basis for the propositions contained must be given for the propositions to be adequately considered.

Response: See response on pages 249-252.

Comment: P. 107-(1) Certainly some information should be given as to the maintenance of productivity due to flooding.

Response: The role of modern agricultural techniques has vitiated the importance of flooding as a means of maintaining productivity.

Comment: P. 108 - g. Recent studies indicate that barges are not so energy effective, thus in order to make a judgment on this stated assumption, a basis for the assumption must be expressly given. We would be interested in knowing if all energy use relating to annual dredging is included in the computations.

Response: We do not know which studies you have reference to. The efficiencies were derived from published BTU ratings for the various modes. The energy use related to annual dredging is not included in the computations.

Comment: P. 109- 3. Should not some consideration be given to the national policy of limiting development in flood plains?

Response: The natural policy of limiting development in flood plains is assumed to apply to presently unprotected areas.

Comment: P. 111 - c.(1) What are the increased chances of pollution due to "spills" due to "improved navigation", resulting from increased traffic?

Response: The chances of increased pollution on the river due to "spills" resulting from anticipated increases in river traffic will probably be directly proportional to the actual traffic increase. Further details are not available due to the lack of data pertaining to the actual number of spills under various concentrations of traffic.

Comment: P. 117-(2) What is a properly aligned channel for various considerations?

Response: In the context of the paragraphs on page 117, a properly aligned channel is an alignment which utilizes the natural course of the river and, therefore, minimizes the dredging requirements.

Comment: P. 118 -(6) Doesn't such production stimulate flood plain development contrary to national policy?

Response: No. The national policy of limiting development in flood plains is assumed to apply to presently unprotected areas. As for the project area, the man-made structures mentioned in the referenced section do not constitute "development."

Comment: P. 142 - b. The greater visual diversity should be adequately explained.

Response: Visual diversity is related to proportional works of various land use. By removing selected land uses from present uses, diversity will increase. The extent of the project area is large in comparison to acreage to be affected.

Comment: P. 143 - f. Again there is a need for facts and figures on the basis for such assumption that less total energy will be used.

Response: Please refer to Section 2.08g.

Comment: P. 144 - h. Doesn't this lead to the conclusion that flood plain development will be encouraged?

Response: A distinction should be drawn between the geomorphic flood plain and that portion of it which is subject to flooding at some given interval. The provision of a high degree of flood protection, already in place, would argue that the study area, exclusive of the project area, is not a flood plain for the purposes of national policy.

Comment: P. 145 - b.(2) What about spills and prop wash?

Response: Section 5.01b(2) has been revised to include these sources of pollution.

Comment: P. 151 -(2) Is continued growth and development being advocated?

Response: No, an impact under the no-action alternative is being identified.

Comment: P. 155 - b.(2) Why would levees be overtopped and breached and is the proposed alternative the least costly alternative?

Response: The proposed increases in levee elevations are designed for protection against a project design flood. If levees are not upgraded to the designed elevations, they would be breached and overtopped in the event of a flood equal to or greater than the magnitude of the project design flood.

From a construction viewpoint, the no-action alternative is the least costly, but in considering flood damages, the no-action alternative would obviously be the most costly.

Comment: P. 157 - d.(1) Why would some lands be abandoned and to what extent?

Response: Under the alternative of providing flood protection at present levels (no levee raising, no new levees), a higher degree of flood risk exists and would eventually result in flooding in the study area. This would result in a possible relocation of flood plain land uses to an unknown extent.

Comment: P. 157 - (5) Same assumption is noted regarding energy consumption without a proper foundation having been laid.

Response: See Section 2.08g.

Comment: P. 158 - c. What will be the energy cost due to such maintenance increase?

Response: Unknown.

Comment: P. 168 - h. Would this result in an increase or decrease in soil fertility?

Response: This would result in a decrease in fertility due to a decrease of nutrient desposition associated with flooding. However, artificial fertilizers are of much greater importance to modern agricultural practices than natural fertilization resulting from periodic floods.

Comment: P. 171 - d. Same as h.

Response: Same as above.

Comment: P. 171 - f. How much and computations behind such amounts must be furnished.

Response: Computation sources and amounts are given in Section 2.07.

Comment: Further, we would like to state that the alternative of flood plain acquisition has not been considered. Likewise, all alternatives should be stated in comparison with the plan, such as with 6.08d. Moreover, costs are never stated and in order to make valid judgments computations should be furnished. Finally, must not the entire Mississippi River be considered in consideration of the lower Mississippi project.

Response: Flood plain acquisition of the lower Mississippi Valley is not considered even remotely feasible. We disagree that the alternaves must be compared with the recommended plan. Costs are not relevant because alternatives all fail the test of meeting flood protection and navigation goals. We disagree that the entire river need be considered. Impact statements along the upper Missisisppi River have been or are in the process of completion.

(43) NORTHEAST MISSOURI STATE UNIVERSITY
(Missouri Chapter of the American Fisheries Society)

Comment:

General Criticisms:

No external costs are computed or estimated. Many strong negative environmental effects.

Response: Comment acknowledged.

Comment: Missouri stretches of the river are hard hit.

Response: Comment acknowledged.

Comment: The river is dynamic and in many instances inadequate data are available to draw rational conclusions.

Response: Comment acknowledged.

Comment: From one place to another various arguments seem inconsistent.

Response: See specific criticisms below.

Comment: This proposal is not directed at true maintenance but at reconstructing a river.

Response: See specific criticisms, particularly response to specific criticism No. 1.

Comment: The project will increase the cost of flood protection, encourage flood plain development and consequently continue to increase the cost of federal disaster relief . . . up from 52 million in 1953 to 2.5 billion in 1973! As stated [6.03b.(2)] "This is not to say that any recommended plan can absolutely guarantee complete protection . . ."

Response: Comment noted.

Comment: We believe we have a series of serious questions here. We will send the Corps postage if they will inform us of meetings on levees and channel improvement on the Mississippi River in the future. We will attempt to join their meetings (Sec. 9. Public Participation p. 172 DREIS).

Response: All meetings of the Mississippi River Commission are widely publicized and both Northeast Missouri State University and the Missouri Chapter of the American Fisheries Society are invited to participate in these meetings.

Comment: Specific Criticisms:

The proposed action includes reconstruction "450 miles of levee must be raised", channelization, dike and revetment construction: "River Training", bank protection: "articulated concrete mattress underwater . . . 20 concrete blocks . . . each 4 feet long, 14 inches wide, and 3 inches thick . . ." (1.29 ft^3) to cover 5.17 ft^2 . . . 1 $mile^2$ = 27,878,400 sq. ft. or 5,392,340 mattresses or 6,956,118 cubic feet of concrete or 257,634 yards of concrete/mile or at 4.00/yard is 1,030,536 dollars/ mile. How many miles of this is required? Our copy of the EIS lacked your economics sheet but this alone is staggering! Isn't this more than maintenance? See cover sheet, Description of Action (paragraph 2).

Response: Description of Action (Paragraph 2) states "The proposed action addressed by the statement is the maintenance of the existing project features and the completion of those authorized". Cost of revetment is approximately correct. As presented in 1.05d, the proposed project requires approximately 325 additional miles of revetment in 154 locations.

Comment: Construction would cause the loss of 2,500 acres of cropland and 30,000 acres of woodland and . . . wildlife habitat (cover sheet 3b, Adverse Environmental Impacts). Does this cropland yield as well as some on the Chariton bottom - up to 200 bushels of corn per acre? What is its real value for crop yield in the next 15 or 20 years?

Response: Corn is not a significant crop in the project area. Cotton and soybeans with yields of 580 lbs/acre and 23 bu/acre, respectively, in the study area are assumed representative for the project area.

Comment: With regard to 1.06 c . . . Did the river straighten itself into ". . . excessively straight reaches in which no definite concentration of flow exists."?

Response: Yes, with the exception of two manmade cutoffs: the Hardin cutoff and the Jackson cutoff. By-in-large their reaches are the result of natural processes present in a meandering river such as the Lower Mississippi.

Comment: If the flood of 1927 (1.102n) indicated the need for flood control and the flood of 1973 (1.102 p) indicated serious reductions have occurred in the flood capacity of the river, we believe that some attention needs to be directed here to How and Why. The EIS doesn't do this! Why has the flood capacity of the river decreased?

Response: The flood capacity of the river has degraded between 1927 and 1973 primarily in response to the cutoff program of the Corps of Engineers during the late 1930's and early 1940's. This program, which was abandoned in the 1940's, resulted in more rapid cutting of the river banks due to the faster flow and the accumulation of a significant bed load of sediment. This additional sediment has acted to reduce the flood capacity of the river.

Comment: We doubt 1.06d . . . flood protection is a valid reason for the project. Won't some of the floodway be filled? Further what about the data cited in our specific comment No. 2?

Response: A purpose of the project is to provide flood protection to the large potentially vulnerable areas outside the levees or above the project flowline (the project study area). To this end, the smaller average annual flood damages within the project area are accepted in trade-off. See the response to comment 2 about the data cited in that comment.

Comment: Why don't you indicate which maps have relationships to several paragraphs 1.06b, 1.06c, 1.07a, etc. Map 1-(1) shows authorized, under-construction and completed structures, as does 1-8(2) and so does 1-9. 11-1(1) shows existing revetments as does 1-11(2). 1-11-1(1) and 1-11-1(2) show existing dikes. 2.5 shows authorized navigation channel. The 2.7 series shows projects under special authorization. The 1-2 map seems to say we dredge everywhere. Do any of the maps really show the work locations? Or will the plan be to redo the whole river? Of what value is a map labelled "proposed dredging . . . not indicated . ." and still calling the map" . . . channel improvement dredging"? This wastes money and paper.

Response: These maps are not intended to show project features proposed for this statement, but rather the features of the total Mississippi River Levees and Channel Improvement Project as explained in footnote 1 of the attachment. Section 1.05 has been modified to reference public notices recently published by each of the involved District Offices which describe details of the proposed construction of dike fields, revetment and foreshore protection. The location of levees to be raised is described in the second response on page 186.

Comment: Does paragraph 1.07a relate to figure 2-7.4? Mile 889? Exactly what is proposed? How will it be accomplished? What costs?

Response: See third response on page 211.

Comment: How are the projected tonnages computed - e.g. 209,000 per annum in paragraph 1.07b for the Osceola harbor?

Response: Paragraph 1.07b briefly describes another related project. The method of projection is presented in the authorizing document for the Osceola harbor project.

Comment: Is Figure 1 the proposed completely trained river?

Response: No. Figure 1 is a general map of the study area and project area. Detailed maps of the project area are presented in Appendix E.

Comment: Would it be possible to see the economic data that went into the benefit-cost ratio calculation? Did this include any value for the crop or forest land affected except acquisition? What benefits are included?

Response: Details supporting the benefit-cost ratio are available in the Office of the President, Mississippi River Commission. The classification of benefits is shown on the economic addendum attached to the environmental impact statement. In addition to the costs of lands obtained by acquisition, costs of converting forest land to crop land were developed. In determining the effects of converting forest land to crop land, the cost of land clearing and conversion, as well as loss of net returns from forest lands, were deducted from project benefits. See also second response, page 247.

Comment: Table 1 proposes to build twice as many levees as already in existence! To nearly double the revetments and increase by 60% the foreshore protection. Again we ask, isn't this a great deal more than maintenance.

Response: Table 1 levee information referred to is a calculation of existing levees to be modified and not built. The EIS covers O&M of the existing project features and the completion of those authorized as summarized in Table 1.

Comment: Figure 2 shows 240,000 cfs flow as the "Project design flood". This is rather low. Last year's flood (and 1844, 1892, 1903, 1908, 1901, 1927) carried more than 850,000 cfs. Does this design then seem adequate?

Response: Figure 2 shows the project design flood on the Missisisppi River downstream of Cairo, Illinois, and also the contribution from the major tributaries. For this flood the Mississippi River at St. Louis will contribute 240,000 c.f.s. However, because of the meteorological conditions associated with the development of this particular flood, the contribution of Cairo is relatively small when compared to the project design flood for the segment of river at St. Louis, which is 1,300,000 c.f.s. During the 1973 flood, a maximum discharge of 850,000 c.f.s. occurred at St. Louis which corresponds to about a 30-year frequency event. The project design flood for the Mississippi River below Cairo is primarily the result of a major flood on the Ohio River, with a reasonable contribution from the Mississippi River above Cairo. We recognize that there is a possibility of the occurrence of unusual combinations of meteorological and hydrological events that could produce a flood of larger magnitude; however, the occurrence of such a sequence would be extremely improbable.

Comment: 2.06b levees and 2.06c(1)d. harbors suggest that spoils are regularly dumped into the river. If this is the general case then can't local effects ultimately destroy any remaining natural river fauna because dredging is done wherever needed?

Response: A statement on the effects of dredging has been added to Section 4.02c(1). See also first response, page 181.

Comment: P. 42 2.06e floodways (1) The third paragraph of this sequence . . . "Operation of the floodway is expected to severely disrupt the biotic community . . ." Have these external costs been included in the B/C accounting? How great is the impact on the economic status of the local area?

Response: Costs involved in operation and maintenance of the Birds Point-New Madrid Floodway are considered in the overall operation and maintenance costs for the MR&T Project.

Comment: The general statement of Biological overview is weak. The Mississippi is the heart of one of the major flyways for waterfowl and some kinds of destruction of flooded land will tend to reduce success of migratory flocks.

Response: Appropriate additions have been made to the overview Sections 2.07a(2) and 5.03. The anticipated impacts on water fowl are presented in Table 23, p. 121.

Comment: If the project is to take parts of the delta then why haven't these delta lands been given "detailed study"? Why take the delta?

Response: The project is not projected to take parts of the delta lands, other than for borrow pits and levee widening on the river side of the present levees. The impacts of this proposed action are presented in Section 4.

Comment: 1) Is paragraph 2.07a(3) a summary of table 5? 2) How did the river get deep and fast up north? 3) What is"good aquatic habitat"? 4) If all channel and "local spoil areas" were removed what would be left?

Response: 1) Paragraph 2.07a(3) is, in part, a summary of Table 5. 2) Longitudinal River profiles show the river is faster flowing upstream due to relative slope of the basin. 3) The phrase "good aquatic habitat" is not used in paragraph 2.07a(3). The more productive riverine aquatic habitats per unit area generally occur in shallow, slower moving unpolluted waters 4) Since there is no data or estimates of the extent of "local spoil areas," this question cannot be answered.

Comment: In order to put the logic of helping the land creatures with the project against the logic of retarding the fishes paragraph 2.07a(5), we wonder just how much data is available on either side of the argument? We feel this report does not provide enough information to use these strawmen as guides.

Response: Paragraph 2.07a(5) does not state that the project will help "the land creatures" or retard the fishes. It tries to explain the effects of flooding as we know them on terrestrial and aquatic communities under the presently existing situation between presently existing levees. No implication of benefit to either land or aquatic forms as a result of proposed actions was intended.

Comment: 2,07c(5) Lakes and borrow pits are restocked and sometimes have their diversity enhanced by flood waters. Local fishermen have found this good in oxbow lakes on the Chariton River. Detritus can be a food source.

Response: Oxbow lakes are not "restocked" to any significant degree by flood waters. Floods are important to fish populations of oxbows in that flood water brings nutrients into such systems and the fluctuating water levels positively affect sport fish populations by improving reproduction, food availability, growth, and survival. See page 74, paragraph (6).

Comment: Table 7 and the related summary statement cannot be supported by looking at preferred habitat lists or even the lists of migratory birds given. More than 400 species of birds are listed in Table 14 of appendix C, while only 120 or so are included in the habitat list (1.4). The bulk of the summary paragraph is not true. Many aquatic, especially migratory birds, will be found in the swamp areas.

Response: Table 7 and related summary are meant to give a relative indication of species diversity by habitat. As stated in the text, nonbreeding birds were not included in the calculations. They were not included, in order to eliminate any seasonal changes in habitat use by migratory forms. Our indications concerning use of swamps by waterfowl are that these areas are much less important than slackwater, borrowpit and lake areas.

Comment: Some of the most valuable wildlife land (Table 8), the swamp forests makes up less than 1% of the land in the project area. What does the project do to this land?

Response: Paragraph 4.02b(4) addresses the effects of the proposed action on swamp forest.

Comment: How can nitrate citations be discussed p. 87, 2.07gl(c) when no specific data are given in section 2.03? What is the BOD at several stations? Why are so many stations left out of the table 2? When and where was D.O. measured to be generally ppm?

Response: Appropriate reference has been added.

Comment: Even if man is not polluting, rivers and swamps are valuable. Who are Leven and Read? Your reference list is poor! What other values are there in river swamps?

Response: Levin and Read was a misprint. Wharton, 1970, Southern River Swamps (see corrected bibliography) is the appropriate source. He discusses further values of river swamps.

Comment: Table 13 contains literature citations not included in the reference lists!

Response: The references on Table 13 have been added to the bibliography.

Comment: What about Missouri fisheries for table 12?

Response: Commercial fisheries statistics for Missouri are not separable as to the portion of the Mississippi River in Missouri lying in the project area. The EIS will be revised to show this.

Comment: Very little data is given to support the paragraph on p. 75 on swamps and sloughs. Photosynthesis can occur at relatively low light intensitives. Further, the trees and higher vegetation make significant contribution to the food chains and webs that are developed in swampy areas. Who has measured the relative value of either for you?

Response: Paragraph 2.07g(7) has been amended to reflect this statement.

Comment: How does the project affect any animals or plants now designated by federal or state law as endangered or rare?

Response: The impacts of the proposed project features on the threatened or endangered species are addressed in Section 4.02d, which has been added to the final environmental statement.

Comment: Should the Mississippi Kite be added to table 17?

Response: No. This species is not listed as threatened or endangered by the United States Department of the Interior, the Audubon Society, or any of the states in the vicinity.

Comment: If the population is 9,000 in the project area, will these people be relocated?

Response: A small portion of the population may need to be relocated. This will be accomplished in accordance with the provisions of the Federal Uniform Relocation Act.

Comment: Are not all of the gross agricultural statistics low--p. 106?

Response: We disagree. The estimates are based on regional averages.

Comment: What is the source of energy estimates for rail and large transport? Railroads have disputed these. Waterways are more circuitous and still require offloading and handling by railroad or truck. Where is environmental protection mentioned in the national priorities section of this report? (page 108, Section g.)?

Response: See response on pages 249-252. Environmental protection is not mentioned specifically on a national priority because that is a function of the EIS procedure and various legislation and administrative law.

Comment: Paragraph 4.01a ends with a sentence suggesting that flooding over levees may occur" . . . river stages may undergo a larger range of fluctuation . . " Is it just possible that this is precisely the problem illuminated by the 1973 flood at St. Louis?

Response: The intent of the sentence referred to is not to suggest that flooding over levees may occur, but rather in areas where the flood plain is constrained by levees close to the river banks, the river stage may undergo a larger fluctuation because of the absence of storage of water on a wide flood plain. The magnitude of these fluctuations is planned for and appropriate flood control measures taken. This phenomena was a contributing factor in the 1973 flood experience at St. Louis.

Comment: How is it that floods will not cause siltation in all lakes (paragraph 4.01b(2)) instead of just small ones? Isn't it true that it will just take longer to fill larger lakes as compared to small ones?

Response: Eventually, all lakes will silt in, but due to the scouring processes of flood waters, this process is retarded in larger lakes, (See following comment and response).

Comment: What kind of rates of sedimentation have been measured for small lakes and borrow pits in similar relationships of those in the project area to the river? What is the projected life of the project features? Paragraph 4.01b(2).

Response: The small lakes and/or borrow pits vary considerably in their rates of sedimentation depending on their individual position respective to the river, soil types, depth, etc. Shallow or small lakes dry out more quickly than larger ones allowing terrestrial vegetation to become established and grow, which in turn serves as a stabilizing factor for the substrate during highwater flow. Because of these factors, it is extremely difficult to project a life for such features. However, most borrow pits are expected to have a life expectancy approaching the project life (i.e. 100 years).

Comment: "The majority of the project ..." Which features may potentially affect the row of tributaries of the Mississippi River?

Response: The indirect impacts of the proposed project features on tributaries of the Mississippi River are expected to be minimal and are considered to be part of this statement. Separate statements, if necessary, have been or will be written for each tributary.

Comment: 4.07d(2) says that sedimentation will increase. Doesn't this speak directly to our comment 33 above because sand and silt would be added to backwaters? The paragraph continues "subsequently reduce maintenance dredging ..." and ends" . . . not expected to significantly increase ..." dredging. Isn't this trying to cover two bases with the same player?

Response: The filling of slackwater areas and the uniqueness of the diked backwaters on the lower Mississippi are addressed in Section 4.02C(3). Section 4.02d(2) states that dredging is likely to be reduced if the proposed project features are added. The misleading statement referring to no significant increase in volume of dredged material has been deleted from the statement.

Comment: There is no 4.07d(3).

Response: The numbers between Sections 1.05 and 4.01d(3) do show discrepancies which have been corrected in the text.

Comment: How can construction of the channel fail to raise the flood level at some ports along the river while reducing its carrying capacity?

Response: A channel will not be "constructed," but rather the natural channel will be maintained by dredging the points where the channel crosses from one side of the river to the other. These points tend to accumulate sand and become shallower than the rest of the natural channel. The impact of such work on a river the size of the lower Mississippi in terms of its flood level and carrying capacity is not expected to be measurable.

Comment: Section 4.02, paragraph 2 proposes quantifying effects. (1) Paragraph 3 seems to be backpeddling. (2) Paragraph 3(a) does not conclude with an evaluation. (3) If deer are worth no more than $5.00 stamp each, the one year data on the numbers taken by hunters suggests a minimum value of 180 thousand dollars.

Response: (1) Paragraph 4.02 (3) is meant to explain the "best effort" at quantifying the impacts and the difficulty involved with such a process.

(2) The specific impact evaluations for each vegetative community are included in the following paragraphs in Section 4.02(b).

(3) The deer kill figures are available only by county or management unit, of each state. These units are included in the project area in part only, so the totals for each are not identical with project area yields. Quantitive estimates, therefore, of the value of project land habitat and wildlife population are impossible.

Comment: The presentation in table 25 at first glance has 247 marks indicating affects on game species ignoring the main river stem--of these that are filled--in 42 are labelled not applicable. Ten are labelled no significant effect. Ninety-three times, species will be negatively affected significantly. Nineteen positive minor affects. Thirty times some significant positive influence is suggested. Nearly 60% of the times game organisms occur or could occur in the area they will be negatively affected. For non-game species, the second is the same or worse. What method does the Corps use to compute this external cost in its Benefit/Cost analysis?

Response: Without-the-project and with-the-project average annual conditions are analyzed to determine losses in game and fish habitat (including open land) attributable to the project. These losses in habitat are then converted to a dollar value by multiplying the man-day use for fishing and hunting by a unit value per day of use. This unit value varies with type of activity. Similarly, losses in trapping and miscellaneous use (general recreation, bird-watching, nature study, etc.) are computed and the total average annual loss is charged against the project. For fish and wildlife losses for which there are no established unit values, no losses are charged against the project due to lack of creditable methods for their evaluation. However, it should be noted that benefits external to the project area are likewise excluded for the same reason and are believed to be far in excess of the economic value of the fish and wildlife value in question.

Comment: We believe that the strong losses to paddlefish, sturgeon, walleye, sauger, catfish and drum will in no way be offset by the addition of borrow pit habitat. These fishes do not do as well in borrow pits as buffalo and carp. Again we ask, because this table is principally negative effect how these valued in the benefit/cost analysis?

Response: It was estimated that there would be only minor negative effects on the main river population of paddlefish, sturgeon, walleye, sauger, catfish, and drum. Effects ranging from minor to significant were expected in chute areas while significant to strong effects were expected in slackwater areas. The degree of effect was largely determined by the amount of habitat affected. The positive effects were estimated to range from minor to strong depending upon the amount of new borrow pit habitat created and the adaptability of the species to this habitat. All of the species mentioned were judged capable of living and growing within the new borrow pit habitat though some species were not expected to reproduce or to grow rapidly. The annual river overflow is expected to enhance these borrow pits so that the species would maintain continuous residence. There might be a minor negative overall effect but this was not thought to be amenable to quantification. See response to previous comment.

Comment: The report says ". . .significant negative impacts ..." miles 955 to 900 but that recovery is rapid. It does not make it clear from what development will occur. Where will replacement habitat develop? Will it? Once more we wonder how much in dollars the Corps has assigned this negative impact.

Response: This early successional community that will be affected between miles 955-900 is significant (c.f. Figure 6, p 125). Paragraph 4.02b(1)(b) states that with stabilization of waterflow conditions due to the proposed project, more early successional communities may develop to replace those lost on exposed sand bars, etc.

Comment: On these significant impact paragraphs, 4.02b(1),(2),(3), where is mention of the game species or their economic value?

Response: Section 4.02a discusses the relationship between vegetative communities (habitat) and the losses to wildlife.

Comment: In table 22 and Figure 11 an addition of 39,400 acres of "other" land will be added by the project. Added to what? The report suggests cropland losses such that 2,500 acres will be lost. How are these details reconciled in paragraph 4.02b(5)(a). I don't believe cropland can be included here.

Response: The project will create 39,400 acres of "other" lands as described in paragraphs 4.02b (6),(a), and (b) by replacing or destroying woodland, etc. as presented in Table 22.

Cropland is considered as terrestrial community and is utilized by many game species as feeding areas. The loss of cropland is judged to be overshadowed by the gain in sand bars, plantations and managed grasslands in the biological sense and the overall impact on "other" communities is therefore considered positive.

Comment: Won't the greatest effect on the fish community likely be destruction of food sources, 4.02c?

Response: It is estimated that the largest negative impact will result both from loss of food sources and loss of breeding areas in chutes, shallows, and natural slackwater areas. This negative effect is expected to be moderated by the development of new slackwater areas around dike field as discussed in 4.02c(2) and (3) and figure 15. The addition of borrow pit areas is also expected to compensate for the habitat losses in chutes, shallows, and natural slackwater areas.

Comment: How can you judge the overall affect of filling chutes as positive. If productivity is higher here some of the fishes are surely feeding and breeding here. Loss of these areas may significantly damage what remains of the fishery.

Response: See previous comment and response.

Comment: Again paragraph 4.02c(2). We wonder about efficiency of water flow relative to data collected in 1973 flood at St. Louis. See 4.02c(3) How can these be reconciled? Even if we miss some logic here what dollars and cents values are applied here as external cost?

Response: Sections 4.02c(2)and(3) have been rewritten to account for this discrepancy.

Comment: Paragraph 4.03a suggests increase of 17,000 acres of sand bar! Is this from former aquatic habitat?

Response: The sand bars will be created from various other areas, including some early successional vegetation, late successional vegetation, and river shallows.

Comment: Is 4.03e a serious proposal that grass will be grazed in the project area?

Response: Yes, a continuation of current practice by private cattlemen. This is an important factor in controlling vegetation on many levees.

Comment: Section 4 gives a long list of significant negative affects and then section 5 says there is no way to assess which changes are adverse or beneficial. See comments 45 and 46 in specific list and 4 in general comments!

Response: Comments 45 and 46 have been addressed. Section 5 attempts to present an overview of the adverse environmental effects which cannot be avoided should the proposal be implemented. The comment on there being no way to assess which changes are adverse or beneficial refers only to the change in the physical character of water bodies in the area.

Comment: Your section 5.02d fails to place economic value of losses to fisheries, to game, to mining. It is a wholly inadequate appraisal!

Response: Fish and wildlife losses (and benefits) which are attributable to construction of the project have been included in the project's economic evaluation and are summarized in the economic addendum. See also last response, page 274.

Comment: Section 6.01c does not direct itself to biology at all. It is a defense of this proposal. Reread sections 2.07 and 4.03. Even here we see that the river has some biology.

Response: Paragraph 6.01c(1) explains that the no action alternative would result in a reversion to "natural successional trends." Successive paragraphs explain the effects of this reversion on wildlife species and natural vegetative associations.

Comment: We sincerely doubt that the evaluation of impact tradeoffs is accurate. See #3 above! River flowline is now higher--a negative impact perhaps because part of the project is completed. The table itself suggests that true maintenance--not described here--would have the least negative impact on biota. We doubt that National defense goes in this table.

Response: Comment noted. Table is not specified. Part of the mission of the Corps of Engineers is to be responsible for navigable waterways with regard to their importance and maintenance for use in the national defense.

Comment: We cannot really predict frequency of damage from here but we suspect that simply viewing flow cross sections at various points would give telling evidence that the flood carrying capacity is reduced significantly by this project.

Response: Comment acknowledged. Our judgement is that the impact of the project on flood capacity of the river is not expected to be significant.

Comment: We doubt 6.02d that lands would be abandoned if a true maintenance posture were adopted. Farmers still farm bottoms profitably.

Response: Section 6.02d does not refer to abandonment of farmlands if maintenance proceedures are adopted, but states that "migration out of the study area would accelerate should project maintenance activities be suspended."

Comment: In the event of project failure . . . ?

Response: Comment not understood. History has shown that there is always a possibility of failure in all human endeavors. The challenge is to minimize this possibility.

Comment: People seem to be moving to population centers anyway. What's 6.02d(4)?

Response: Acknowledged. There is no section 6.02d(4).

Comment: What year is projected for the river to be transport traffic saturated? What are the bases for the estimate? Why isn't this expanded here?

Response: The precise year of projected river traffic saturation cannot be predicted with any accuracy because of the large number of variables affecting the projection. It is most probable that other factors would come into play before saturation occurred that would prevent the river traffic from ever reaching saturation.

(44) DAVID A. MARCELLO, ATTORNEY AT LAW

Comment: As I explained to you in our phone conversation of December 6, I represent individuals who live in Port Sulphur, Louisiana, and whose interest in the above-named project is in that portion of it identified as Item No. M-41.7-R, Port Sulphur Levee Enlargement and Setback. The New Orleans District Office of the Corps has advised us that they will rely on the EIS prepared by your office as a basis for its activities in implementing Item No. M-41.7-R.

Response: Comment acknowledged.

Comment: Our first concern with the draft statement is that it makes no mention of the Port Sulphur Project specifically, nor does it devote any discussion to the various environmental impacts of this project on the local area. There are a number of impacts unique to Port Sulphur that are not adequately addressed by the proposed EIS, nor even mentioned by the document. I am enclosing a copy of pleadings filed in regard to this project; they discuss in some detail the environmental and social concerns of my clients. We also prepared at an early stage of the case an informational booklet which--while since found inaccurate in some minor respects--still conveys a good overall picture of the project and its impacts.

Response: The draft statement does not specifically mention the Port Sulphur Project due to the large scope of the proposed action. The Port Sulphur Project is included as are other levee setback projects, levee raising projects, dike-revetment projects, and dredging projects. These features of the proposed action are so interdependent and interrelated that a composite statement is appropriate to properly evaluate the projects. To provide local details on each proposed project feature would result in an unwieldy and impractical statement that would not allow the public to evaluate the physical, human, environmental, and economic impacts of the proposed action. The EIS has been revised and now covers generally the impacts associated with levee setbacks [See section 4.01d(1)].

Comment: The Corps' regulations governing preparation of impact statements assert that separate statements should be prepared where "activities are unique or where known substantial environmental conflicts presently exist or can reasonably be anticipated to exist." Other sections of the regulations specify that supplemental EIS data may be needed where there has been filed an "umbrella statement" addressing a continuing program of activities. We feel that circumstances in the Port Sulphur area are uniquely different from those which pertain elsewhere, because of the following factors (discussed more fully in the enclosed materials):

Response: We disagree that the Port Sulphur setback is unique. This is substantiated by replies to subparagraphs 1 to 4.

Comment: (Subparagraph 1) The predominant crop in this area is oranges (nowhere mentioned in the draft EIS, which discusses soybeans). This crop can only be grown in the southernmost reaches of the Mississippi, and the proposed project threatens a substantial portion of that crop.

Response: Section 4.d(1) of the EIS has been revised to acknowledge the presence of citrus crop along the lower reaches of the Mississippi River. Between Fort Jackson and Venice, Louisiana, levee work has been done and is underway which required relocation of Louisiana Highway 23 and the removal of orange trees.

Comment: (Subparagraph 2) The most fertile ground for cultivation is next to the river levee, and because of the narrow strip of land on which residents of this area live, loss of that portion required for Item No. M-41.7-R will be an irreplaceable and irreversible commitment of an invaluable resource.

Response: It is true that most fertile ground for the cultivation of oranges is next to the river levee. This is unfortunate, but loss of a portion of the affected orange groves is a small consideration compared to the consequences of a levee failure and resulting loss of not only the orange groves but other property in the surrounding area.

Comment: (Subparagraph 3) Geographic considerations unique to Port Sulphur will result in a substantial alteration of the social and economic character of the community if M-41.7-R is implemented as presently planned.

Response: Social and economic changes in Port Sulphur as a result of the project will not be dissimilar to those in the community of Gravolet, Louisiana, where a levee setback has necessitated the relocation of Louisiana Highway 39 and the subsequent relocation of 16 houses and 1 business.

Comment: (Subparagraph 4) The plans of parish and highway officials to relocate the area's main traffic artery next to the river levee is a direct outgrowth of the proposed project and should be considered in preparing the more detailed supplementary EIS for this project.

Response: The Corps of Engineers will be required, as a result of the Port Sulphur Setback, to relocate the existing two-lane road to current design standards. Any further development is a matter to be discussed with Parish and Highway Department officials.

Comment: Because of these factors and others, we feel that a supplementary EIS is needed, discussing this project separately and assessing its impacts in far more detail than the proposed statement does.

Response: At this time, we do not believe this project warrants preparation of a supplementary EIS.

Comment: Highway and parish planning for the fourlaning of the river road is a matter of particular concern to my clients and one which we feel should be treated as a "related project" requiring some discussion and consideration in the EIS. Paragraph 9(g)(2) of the regulations requires that the EIS discuss links between a proposed project and others (both public and private) likely to impact the environment; some consideration should be given to federal, state and local land use plans for the Port Sulphur vicinity in light of the Corps' project. Paragraph 9(g)(1) calls for consideration of both primary and secondary effects, both economic and social.

Response: Although the four-lane highway has been rerouted from alongside the levee, the final alignment has not been established.

Comment: We are concerned that no notice of filing the EIS for this project was given to us, except well after the fact by indirect means. I should be included on the project mailing list to receive copies of all materials related to this work. We should have been included on the mailing list much earlier, as a consequence of our repeated verbal and written requests for such information and certainly as a result of litigation having been filed in the matter. More time for detailed comment on the draft EIS would allow for a more definite picture of our objections to it, though this letter and the accompanying materials should convey some of our more serious concerns.

Response: It is indeed unfortunate that you did not receive a copy of the draft EIS as soon as they were distributed. The failure of an early mailing was an inadvertent error. Your name has been added to the list for receipt of the final EIS.

Comment: I would like to receive some indication of the specific type of project we are dealing with according to the Corps' analysis of Item No. M-41.7-R. Is this a continuing construction project, a new project, or one authorized but not yet started? This categorization will determine precisely which regulations govern the project, so please indicate the regulatory scheme the New Orleans Office should be following.

Response: The Port Sulphur Levee Enlargement and Setback Item, M-41.7-R, is part of the Mississippi River Levees Project, and as such, is classified "Continuing Construction."

Comment: In considering man-made structures affected by the project, the draft EIS makes no mention of homes and other structures involved in its implementation. This impact is quite substantial in the Port Sulphur community.

Response: Section 4.01d(1) has been revised to reflect this comment.

Comment: The draft EIS deals inadequately with the project's impact on endangered species of plant, fish, and other forms of life. This data should be assembled prior to implementation activities and included in the final EIS, so that project planning can take account of such considerations.

Response: Section 4.02e has been added in response to this and other similar comments.

Comment: Various alternatives should be considered in the implementation of Item No. M-41.7-R. The adverse effects of this project could be minimized by consideration of construction and other alternatives. In view of the fact that floodwall construction at New Orleans has protected the historic French Quarter for many years, the rejection of alternative construction methods in a single paragraph on page 167 of the draft EIS is too negative and ill-considered a conclusion.

Response: Alternatives were considered and found to be unsatisfactory, either from a stability standpoint, or from other aspects. A floodwall is unacceptable not only from the prohibitive cost, but from the fact that debris, barges, etc., could knock a section of the floodwall out during high water, resulting in disastrous consequences. It is true that the French Quarter of New Orleans has been protected by a floodwall for a number of years. It should be noted that the French Quarter floodwall is protected by development between it and the river which makes collision of a barge into the floodwall impossible.

Comment: We strongly disagree with the conclusion expressed on page 172 that "no major environmental issue concerning the levees and channel improvement on the Mississippi River between Cairo and Venice has been identified . . . ." If in fact no such issues have been identified, this may indicate the inadequacy of the public participation process that has been followed.

Response: The statement referred to on page 172 is not a conclusion but rather a statement of fact. As a result of the public meetings held in recent years dealing with the levees and channel improvement work between Cairo and Venice, no major environmental issues have been identified. Such issues have been identified in other forums.

Comment: This letter communicates some of our concerns about the way in which M-41.7-R has been reviewed by the Corps. We do not feel that the draft EIS adequately addresses our concerns--nor is it likely ever to adequately address such concerns, since it deals with a huge geographic area. We believe a separate EIS should be prepared on Item No. M-41.7-R and cite in further support of this belief the CEQ guidelines relative to preparation of impact statements and their requirement that controversial actions be fully assessed. The National Environmental Policy Act intended that environmental data be gathered and used in the planning process as a means of assuring the public that environmental damage would be thoroughly considered, and this assurance the residents of Port Sulphur do not have.

I look forward to hearing more from you regarding the preparation of this EIS. I will be happy to supply you with further information and comments about the project, which time constraints prevent at this time.

Response: Your opinion is acknowledged. We feel we have complied with the National Environmental Policy Act based upon the available data as we understand it.

(45) FOREST SERVICE, USDA
(Southeastern Area, State and Private Forestry, Atlanta, Ga.)

Comment: We comment the scope of this environmental assessment covering maintenance and improvement of the main stem of the Mississippi River from its junction with the Ohio to the Gulf of Mexico. However, since proposed and authorized tributary projects will impact the main stem, all authorized and planned tributary improvement works should be fully considered in assessing the environmental impacts of this project. For example: A costly feature of this proposal (both environmentally and in cash) is the raising of approximately 450 miles of levee to provide minimum free board above increased (project flood) floodwaters in the main stem of the Mississippi. Yet, a major proposal in the West Tennessee Tributaries Project is the channelization of the Obion and Forked Deer Rivers to expedite the flow of floodwaters into the main stem of the Mississippi River. Therefore, with the limited information provided, some of the proposed actions appear to be in conflict.

Response: Please see first response to comment by United States Environmental Protection Agency, Dallas, Texas.

Comment: The report also fails to disclose planned measures to contain flooding on the Ohio River to keep flood discharges into the Mississippi within the limits of the raised Mississippi levees.

Response: This environmental impact statement covers the Mississippi River and Tributaries project and related projects between Cairo, Illinois, and Venice, Louisiana. The Ohio River cannot be included in this statement but the hydrologic conditions that exist along the Ohio River are studied and are considered when it becomes necessary to modify levee dimensions to prevent flooding in the project area.

Comment: Project area "portions" should be better defined. On page 47, the statement is made that the Northern portion of the project area is characterized as agricultural and the central portion as woodlands. Yet, Figure 3, "Distribution of Terrestrial Resources" shows in graph form that woodland resources comprise a greater proportion of the terrestrial resources in the Northern portion (between Mile 955 and 700) and the woodland resources constitute less than half the terrestrial resources in the Central portion (between mile 700 and 400).

Response: The error on Figure 3, page 49, that caused this confusion has been corrested.

Comment: The stated expected net annual return of \$10-\$15 per acre from woodlands (page 151) based on 1970 conditions is too conservative. An investment analysis of bottomland hardwood stands conducted by Forest Service Specialists Utz, Balmer and Shropshire in 1973 reveals that the net annual equivalent income from a medium bottomland hardwood site is from \$28 - \$37 per acre depending upon the recognition given to qualify.

Response: It is true that some bottomland hardwoods can produce \$28 to \$37 per acre; however, these values are not applicable to the entire 773,000 acres in the project area. The values in the EIS were based on 1970 growth rates and stumpage prices which could be applied to the entire area. If subsequent studies, which are applicable to the project area, are made available they will be given consideration.

Comment. The statement on page 100 (1); "The Mississippi River, the largest in the United States offers a wide range of conditions aesthetically attractive to people of various tastes" seem to contradict the statement on page 101 (5), "Although the river is vast, it is nearly featureless."

Response: The term "featureless" in the statement, "Although the river is vast, it is nearly featureless, and the observer often cannot get a true sense of its dimensions," refers to the fact that often there is no familiar object (i.e., boat, barge, etc.) in the water that can provide a measure of scale and a reference point to enable an individual to fully appreciate the size of the segment of the river being observed.

Comment: Reference is made to our letter of November 14, 1974, containing comments on the draft environmental impact statement entitled Mississippi River and Tributaries, Mississippi River Levees and Channel Improvement.

Subsequent local comments received by this office indicate that the authorized project measures covered by the statement may be generally insufficiently identified, analyzed and discussed to guage local impacts and their effects on local environments. For example: The Tiptonville-Obion Levee Extension and Obion River Diversion Channel projects cut through a hardwood bottom. Yet, the impact chart on page 176 (Figure 8) shows no loss of bottomland hardwoods between mile 900 and 500 of the River.

By means of this letter, we amend our former comments on the draft statement to include a recommendation that a separate EIS be prepared for the combined Tiptonville-Obion Levee Extension and Obion River Diversion Channel projects and for other major project actions significantly affecting the quality of the human environment.

Response: Section 1.07e has been revised to provide additional information on the Tiptonville-Obion Levee Extension and Obion River Diversion Channel projects. Figure 8 has been corrected and now shows a loss of bottomland hardwoods between mile 900 and 800 of the river.

The draft statement does not describe the combined Tiptonville-Obion Levee Extension and Obion River Diversion Channel projects in greater detail due to the large scope of the proposed action. We do not believe the projects are unique enough to warrant preparation of a separate environmental impact statement.

LIST OF REFERENCES

(1) Gulf South Research Institute. Environmental Inventory for the Mississippi River, Cairo, Illinois, to Venice, Louisiana, Vols. 1-4, Contract No. DACW 38-F3C-003F, Baton Rouge, Louisiana, U.S. Army Corps of Engineers, Vicksburg District, March 1973.

(2) U. S. Department of the Interior, Geological Survey. Water Resources Data for Arkansas, 1971.

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APPENDIX A

GLOSSARY

Aerobic - Refers to life or processes occurring only in the presence of free oxygen; refers to a condition characterized by an excess of free oxygen in the aquatic environment (see Anaerobic).

AHP - Above Head of Passes (Venice).

ALWP - Average low water plane.

Algae (Alga) - Simple plants, many microscopic, containing chlorophyll. Algae form the base of the food chain in aquatic environments. Some species may create a nuisance when environmental conditions are suitable for prolific growth.

Allochthonous - Pertaining to those substances, materials or organisms in a waterway which originate outside and are brought into the waterway (see Autochthonous).

Anadromous - Pertaining to fishes that spend most of their life in salt water but enter freshwater to spawn; e.g., salmon, shad, striped bass, etc. (see Catadromous).

Anaerobic - Refers to life or processes occurring in the absence of free oxygen; refers to conditions characterized by the absence of free oxygen (see Aerobic).

Aphotic Zone - That portion of a body of water to which light does not penetrate with sufficient intensity to have any biological significance (see Euphotic Zone).

Arboreal - Inhabiting or frequenting trees.

Artificial Substrate - A device placed in the water (for a specified period of time) that provides living spaces for a multiplicity of organisms; e.g., glass slides, concrete blocks, multiplate samplers, rock baskets, etc. The primary purpose of artificial substrates is to allow the investigator to collect organisms in areas where the physical habitat is limiting or cannot be adequately sampled using conventional methods.

Assimilation - (1) Removal of dissolved or suspended materials from a water mass by biological, chemical and physical processes; (2) conversion or incorporation of absorbed nutrients into body substances.

Association - All organisms occupying a given habitat.

Aufwuchs - (Periphyton)

Autochthonous - Pertaining to those substances, materials, or organisms originating within a particular waterway and remaining in that waterway (see Allochthonous).

Autotrophic (Holophytic) - Self nourishing; denoting those organisms that do not require an external source of organic materials but can utilize light energy and manufacture their own food from inorganic materials; e.g., green plants, pigmented flagellates (see Heterotrophic).

Backwater Slough - Water turned back in its course by an obstruction, an opposing current, or the tide.

Batture - An elevated part of a riverbed formed by gradual accumulation of alluvium, especially the land between the low-water stage and the levees along the banks of the Lower Mississippi River. Pertains primarily to the Louisiana-French region of the Mississippi River. Geographic, not geologic term. (Glossary of Geology, Geological Institute of America).

Bayou - (1) A creek, secondary watercourse, or minor river that is tributary to another river or other body of water; (2) any of various usually marshy or sluggish bodies of water.

Benthic Region - The bottom of a waterway; the substratum that supports the benthos.

Benthos - Bottom-dwelling organisms. These include: (1) sessile animals such as sponges, barnacles, mussels, oysters, worms, and attached algae; (2) creeping forms such as snails, worms and insects; (3) burrowing forms, which include clams, works, and some insects; and (4) fish whose habits are more closely associated with the benthic region than other zones; e.g., flounders.

Berm - A gently sloping embankment emplaced along a levee.

Biocoenosis - The plants and animals comprising a community.

Biomass - The total amount of living material in a particular habitat or area; or, an expression dealing with the total weight of a given population of organisms.

Biota - All life of a region.

Biotic Factors (Biological Factors) - In ecology, those environmental factors which are the result of living organisms and their activities; distinct from physical and chemical factors; e.g. competition, predation, etc.

Bloom - A readily visible concentrated growth of aggregation of minute organisms, usually algae, in bodies of water.

Borrow Pit - An excavated area where material has been taken for use as fill at another location.

Brackish Waters - Those areas where there is a mixture of fresh and salt water, or, the salt content ranges between 0.5 to 30 percent.

Carnivorous - Pertaining to animals that feed on other animals (see Hervivore).

Carrying Capacity - The maximum quantity of organisms that any particular habitat can support over an extended period.

Catadromous - Pertaining to fish that spend most of their life in fresh waters; but migrate to the sea to spawn; e.g., American eel (see Anadromous).

Catastrophic Drift - Massive drift of bottom organisms under conditions of stress such as floods or toxicity (see Drift Organisms, Incidental Drift, Periodic Drift).

Channel Crossings - That area of the navigable channel which occurs between meander bends.

Channelization - The act or process of confining a channel to a single, well-defined channel or bed.

Chemical Stratification - Differentiation of water bodies into layers with differing inorganic chemical characteristics (dissolved oxygen, dissolved carbon dioxide, ammonia and nitrates/nitrites, phosphates, suflates, manganates, iron); thermal stratification.

Chenier - A stranded beach rim particularly left in delta areas following further building of the active delta.

Chute - A narrow channel with a free current, other than the main channel of the Mississippi River.

Clean Water Association - An association of organisms found in any natural, unpolluted environment. These associations are characterized by the presence of species that are sensitive to environmental changes caused by introduction of pollutants. In many cases, the presence of a wide variety of species with relatively few individuals representing any of this is also a characteristic (see Sensitive Organisms, Tolerant Association).

Coastal Plain - A plain between the sea and higher land, usually at a low elevation.

Coastal Zone - Coastal waters and adjacent lands which exert a measurable influence on the uses of the sea and its ecology. The zone extends onshore to the upper reaches of the tidal zone and adjacent shore areas (see Estuary).

Community - All forms of life inhabiting a common environment.

Competition - The effort of two or more individuals or species of a community to utilize some of the same environmental resources.

Consumers - Organisms which feed upon other organisms; often divided into primary consumers (Herbivores), secondary consumers (Carnivores which eat primary consumers), etc. (See Heterotrophic, Trophic Level).

Decomposers - (Reducers).

Delta (Alluvial Fan) - A fan-shaped deposition of silt, sand, gravel or other fine materials from a stream. These occur when the hydraulic gradient lessens abruptly, as in the discharge of a stream into a lake, or a river into an ocean.

Density (Population, Species) - The number of individuals per unit area or volume.

Detritus - Fragments of detached or broken down material.

Dike - A river training device, constructed usually of large blocks of stone built across the flow of a stream to assist in its channelization.

Diurnal - (1) Refers to an event, process, or specific change that occurs every day; usually associated with changes from day to night: (2) pertaining to those organisms that are active during daytime (see Nocturnal).

Diversity - Pertaining to the variety of species within a given association of organisms. Areas of high diversity are characterized by a great variety of species; usually relatively few individuals represent any one species. Areas with low diversity are characterized by a few species; often relatively large nubmers of individuals represent each species.

Dominant - Species which by their activity, behavior, or number, have considerable influence or control upon the conditions of existence of associated species; species which "controls" its habitat and food web.

Drift Organisms - Benthic organisms temporarily suspended in the water and carried downstream by the current (see Incidental Drift, Periodic Drift, Catastrophic Drift).

Dystrophic Lakes - Shallow lakes with brown water, high humic material and organic matter content, low nutrient availability, poor bottom fauna, and high oxygen demand; oxygen is continually depleted and pH is usually low. In lake aging, the "age" between a eutrophic lake and a swamp.

Ecological Niche - The role of an organism in the environment, its activities and relationships to the living and nonliving environment; food and nutrition relationships are of primary importance (see Habitat).

Ecology - Interrelationships between organisms and their environment.

Ecosystem - A community, including all the component organisms, together with the environment, forming an interacting system.

Emersed Aquatic Plants (Emergent) - Plants that are rooted at the bottom of a body of water, but project above the surface, e.g., cattails, bulrushes, etc. (see Floating Aquatic Plants. Submersed Aquatic Plants).

Environment - All external influences and conditions affecting the life and development of an organism.

Epilimnion - The water mass extending from the surface to the thermocline in a stratified body of water; the epilimnion is less dense than the lower waters and is wind-circulated and essentially homothermous (see Hypolimnion).

Estuary - That portion of a coastal stream influenced by the tide of the body of water into which it flows; a bay, at the mouth of a river, where the tide meets the river current; an area where fresh and marine waters mix (see Coastal Zone).

Euphotic Zone- The lighted region of a body of water that extends vertically from the water surface to the depth at which photosynthesis fails to occur because of insufficient light penetration.

Eutrophic Lakes - Lakes which are rich in nutrients and organic materials, therefore, highly productive. These lakes are often shallow and seasonally deficient of oxygen in the hypolimnion.

Eutrophication - The natural process of the maturing (aging) of a lake; the process of enrichment with nutrients, especially nitrogen and phosphorous, leading to increased production of organic matter (see Eutrophic Lakes).

Extirpation - The extermination of a species from part of its range.

Facultative - Refers to the capability of an organism to live under varying conditions, e.g., a facultative anaerobe is an organism that although usually living in the presence of free oxygen can live in the absence of free oxygen.

Fall Overturn - A physical phenomenon that may take place in a body of water during early autumn. The sequence of events leading to fall overturn include: (1) cooling of surface waters producing convection currents from top to bottom, (3) circulation of the total water volume by wind action, and (4) verticla temperature equality. The overturn results in a uniformity of the physical and chemical properties of the entire water mass.

Fauna - Animal life.

Floating Aquatic Plants - Rooted plants that wholly or in part float on the surface of the water; e.g., water lilies, water hyacinth an duckweed (see Emersed Aquatic Plants, Submersed Aquatic Plants).

Floodplain - That portion of a river valley which would be flooded during flood stages if there were no artificial levees.

Flora - Plant life.

Floodwall - A wall aligned parallel to the river whose purpose is to protect a landside from flood damage.

Food Chain - Dependence of a series of organisms, one upon the other, for food. The chain begins with plants and ends with the largest carnivores; e.g., phytoplankton - zooplankton - forage fish - game fish.

Food Cycle (Food Web) - All the interconnecting food chains in a community.

Forage Fish - The act of seeking and actively capturing food items (forage), as in forage fish. Those species which are eaten by larger predaceous or piscivorous fishes.

Fossorial - Adapted to digging; existing almost entirely underground.

Game Fish (Sport Fish) - Those species of fish considered to posses sporting qualities when taken on fishing tackle; e.g., salmon, trout, black bass, striped bass, etc. Game fish are usually considered to be more sensitive to environmental changes than rough fish.

Habitat (Biotope) - A specific type of place that is occupied by an organism, a population, or a community.

Herbivore - An organism that feeds on plant material (see Carnivorous).

Heterotrophic (Holozoic) - Pertaining to organisms that are dependent on organix material for food (see Autotrophic).

Higher Aquatic Plants (Pond Weeds) - Those plants whose seeds germinate in the water phase, or substrate of a body of water and which must spend part of their life cycle in water. This groping includes plants which grow completely submersed as well as a variety of emersed and floating leaf types.

Hypolimnion - The region of a body of water that extends from the thermocline to the bottom and is essentially removed from major surface influences (see Epilimnion).

Incidental Drift - The casual, random drift of organisms (see Drift Organisms, Catastrophic Drift, Periodic Drift).

Indicator Organisms - A species, whose presence or absence may be characteristic of environmental conditions in a particular area or habitat; however, species composition and relative abundance of individual components of the population or community are usually considered to be a more reliable index of water quality.

Insectivore - Any of an order (Insectivora) of mammals comprising the miles, shrews, hedgehogs, and related forms that are mostly small, insectivorous and nocturnal.

Interior Slough - Remote from the border of shore - inland.

Invertebrates - Animals without an internal skeletal structure; e.g., insects, mollusks, crayfish (see Vertebrate).

Lake - A considerable inland body of standing water.

Larva - The immature form of an animal which is unlike its parents. Larva are usually self-feeding but must pass through some sort of metamorphosis before assuming the characteristics of the adult; in insects, the wormlike stage between the egg and the pupa.

Lentic - Pertaining to standing (non-flowing) waters such as lakes, ponds, and swamps (see Lotic).

Levee - An embankment to prevent flooding; or a small continuous dike or ridge of earth for confining the irrigation checks of land to be flooded.

Limiting Factor - A factor whose absence, or excessive concentration, exerts some restraining influence upon a population through incompatibility with species requirements or tolerance.

Limnetic Zone - The open-water region of a lake, especially in areas too deep to support rooted aquatic plants. This region supports plankton and fish as the principal plants and animals (see Littoral Zone).

Littoral Zone - The shallow area that extends from shore to the lakeward limit of rooted aquatic plants; the shoreward region of a body of water; in marine ecology, the tidal zone (see Limnetic Zone).

Lotic - Pertaining to flowing waters such as streams and rivers (see Lentic).

Macroorganisms - Those organisms retained on a U.S. standard sieve No. 30 (openings of 0.589 mm); those organisms visible to the unaided eye (see Microorganisms).

Macrophyte - Any plant that can be seen with the naked, unaided eye; e.g., aquatic mosses, ferns, liverworts, rooted plants, etc.

Marsh - A tract of soft wetland usually characterized by monocotyledons (as grasses or cattails).

Microorganisms - Those organisms which pass through a U. S. standard sieve No. 100 (openings of 0.149 mm); those minute organisms invisible or only barely visible to the unaided eye (see Macroorganisms).

Nanoplankton - Very minute plankton not retained in a plankton net equipped with No. 25 silk bolting cloth (mesh, 0.03 to 0.04 mm).

Nekton - Macroscopic organisms swimming actively in water; e.g., fish (see Plankton).

New Plankton - Plankton retained in a plankton net equipped with No. 25 silk bolting cloth (mesh, 0.03 to 0.04 mm).

Nocturnal - Pertaining to those organisms that are active at night (see Diurnal).

Nuisance Organism - A plant or animal species detrimental, annoying or obnoxious to man.

Nymph - An immature developmental form characteristic of the pre-adult stage in insects that do not have a pupal stage; e.g., mayflies and stoneflies (see Larva).

Overturn (Turnover) - The period of mixing, by top to bottom circulation, of previously stratified water masses. This phenomenon may occur in spring and/or fall; the result is a uniformity of physical and chemical properties of the water at all depths (see Thermal Stratification, Chemical Stratification Fall Overturn).

Oxbow - A river meander resembling the capital Greek letter omega; a flood plain lake formed by an abandoned meander.

Periodic Drift - Drift of bottom organisms at regular or predictable intervals such as diurnal, seasonal, etc. (see Drift Organisms, Catastrophic Drift, Incidental Drift).

Periphyton (Aufwuchs) - Attached microscopic organisms growing on the bottom, or other submersed substrates, in a waterway.

Pesticide - Any chemical preparation used to kill pests. Includes insecticides, herbicides, fungicides, etc.

Pests - (Nuisance Organisms).

Photosynthesis - The metabolic process by which simple sugars are manufactured from carbon dioxide and water by plant cells using light as an energy source.

Phytoplankton - The plants of the plankton. Unattached microscopic plants subject to movement by wave or current action (see Zooplankton).

Plankton - Suspended microorganisms that have relatively low powers of locomotion, or that drift in the water subject to the action of waves and currents (see Benthos, Periphyton, Nekton).

Pools - Areas of a stream, where the velocity of current is reduced. The reduced velocity provides a favorable habitat for plankton. Silts and other loose materials that settle to the bottom of pools are favorable habitat for plankton, and for burrowing forms of benthos (see Riffle).

Population - A group of interacting individuals of the same species, area, or community.

Potamoplankton - True riverine plankton; an assemblage of true plankton species characteristic of flowing water, as distinguished from those species of the periphyton community and/or those potentially developing in reservoirs or other standing bodies of water (these last two named groups may become dislodged from substrates or washed into the river but are often not true potamoplankton).

Predator - An animal that kills and consumes other animals (see Prey).

Prey - An animal that is killed and consumed by other animal (see Predator).

Primary Productivity - The total quantity of protoplasm produced by autotrophic organisms per unit of time in a specified habitat.

Producers - Organisms that synthesize organic material from inorganic substances; e.g., plants (see Consumers, Reducers).

Productivity - Rate of protoplasm formation or energy utilization by one or more organisms; total quantity of organic material produced within a given period in a specified habitat; or capacity or ability of an environmental unit to produce organic material (see Primary Productivity, Secondary Productivity.

Profundal - Of or relating to the bottom and deep-water area which is beyond the depth of effective light penetration.

Project Area - The area between the mainline levees, or, if levees are not present, the 1973 flow line.

Raised Levee - A levee whose height has been increased (or which is to be increased) to provide a greater degree of flood protection.

Refuging - Behavioral pattern in which species roosts large centrally-located colonies, and radiate out from these localities for daily foraging activities.

Revetment - A facing (as of stone or concrete) to sustain an embankment.

Rapids - Areas of a stream where velocity of current is great enough to keep the bottom clear of all loose materials, thus providing a firm substrate. The surface of the water is disrupted by turbulent currents. This area is occupied largely by specialized benthic or periphytic organisms that can firmly attach or cling to a firm substrate (see Riffles).

Raptor - Bird of prey.

Reducers (Decomposers) - Those organisms, usually bacteria or fungi, that break down complex organic material into simpler compounds (see Producers, Consumers).

Respiration - The complex series of chemical and physical reactions in all living organisms by which the energy and nutrients in foods is made available for use. Oxygen is used and carbon dioxide released during this process.

Riffles - Fast sections of a stream where shallow water races over stones and gravel. Riffles usually support a wider variety of bottom organisms than other stream sections (see Rapids).

Riverine - Any water bodies where the primary source of water is from the main stem river.

Rough Fish - Those species of fish considered to be of poor fighting quality when taken on tackle; e.g., carp, gar, suckers, etc. These fish are considered undesirable in most situations. Most species in the group are more tolerant of widely changing environmental conditions than game fish.

Salt Marsh - Low area adjacent to the sea that is covered with salt tolerant vegetation and regularly flooded by the high tide; similar inland areas near saline springs or lakes, though not regularly flooded.

Seepage Berm - Berm on landside of levee.

Sensitive Organisms (Intolerant Organisms) - Organisms that exhibit a rapid response to environmental changes and are killed, driven out of the area, or as a group are substantially reduced in numbers when their environment is fouled (see Tolerant Association).

Sessile - Pertaining to those organisms that are attached to a substrate and not free to move about; e.g., periphyton.

Slough - A creek in a flood marsh or tide flat, backwater.

SMSA - Standard Metropolitan Statistical Area.

Species - An organism or organisms forming a natural population, or groups of populations, that transmit specific characteristics from parent to offspring. Each species is reproductively isolated from other populations with which they might breed. Hybrids, the results of interbreeding, usually exhibit a loss of fertility.

Spoil - The material dredged from the bottom of the channel.

Sport Fish - (Game Fish).

Stability Berm - Berm on riverside of levee.

Standing Crop or Standing Stock - The quantity of living organisms present in an environment at a selected point in time.

Stratification (Density Stratification) - Arrangement of water masses into separate, distinct, horizontal layers as a result of differences in density; may be caused by differences in temperature, dissolved or suspended solids (see Thermal Stratification, Chemical Stratification).

Study Area - The Lower Mississippi River Alluvial Valley, or, in terms of political boundaries, those counties bordering the Mississippi River between Cairo, Ill., and Venice, La.

Sublittoral Zone - The part of the shore from the lowest water level to the lower boundary of plant growth; transition zone from the littoral to profundal bottom.

Submersed Aquatic Plants (Submerged) - Higher aquatic plants that grow, or are adapted to grow, beneath the surface of the water; e.g., pondweed, coontail, etc.

Substrate - The bottom material of a waterway; the base or substance upon which an organism is growing; a substance undergoing oxidation.

Summer Kill - A complete or partial kill of a fish population in ponds or lakes during the warm months; variously produced by excessively warm water, by a depletion of dissolved oxygen, and by the release of toxic substances from a decaying algal bloom, or by a combination of these factors (see Winter Kill).

Surface Aquatic Plants - (Floating Aquatic Plants).

Swamp - Wet spongy land saturated and sometimes partially or intermittently covered with water, usually supporting water tolerant trees such as bald cypress and tupelo gum.

Taxon (Taxa) - A "kind" of organism. Any taxonomic unit or category of organisms; e.g., species, genus, family, order, etc.

Territory - The area which an animal defends against intruders.

Thalweg - The line connecting the deepest points longitudinally along a channel; generally the center of the navigable channel.

Thermal Stratification - The layering of water masses owing to different densities in response to temperature. The condition of a body of water in which the successive horizontal layers have different temperatures, each layer more or less sharply differentiated from the adjacent ones, the warmest (or the coldest) at the top (see Overturn).

Thermocline (Mesolimnion, Metalimnion) - The transition zone between the warm epilimnion and cold hpyolimnion of stratified bodies of water; temperature change equals or exceeds $1^{o}C$ for each meter of depth (see Thermal Stratification).

Tidal Marsh - A low, flat marshland that is intersected by channels and tidal sloughs, usually covered by high tides; vegetation consists of rushes, grasses, and other salt tolerant plants.

Toe (levee) - The line marking the distal extent of a levee; marked by a change of slope reflecting the juxtaposition of the levee and other land.

Tolerance - Relative capability of an organism to endure or adapt to an unfavorable environmental factor.

Tolerant Association - An association of organisms capable of withstanding adverse conditions within the habitat. This association is often characterized by a reduction in the number of species (from a clean water association) and, in the case of organic pollution, an increase in individuals representing certain species.

Transect - Line used to cut across an area to identify salient biological organisms; with respect to land use, a representative area selected in place of a complete inventory of land uses.

Trophic Level - One of the parts of a nutritive series in an ecosystem in which a group of organisms in a certain stage in the flood chain secures food in the same general manner. The first or lowest trophic level consists of producers (green plants); the second level of herbivores; the third level of secondary carnivores. Most bacteria and fungi are organisms in the reducer (decomposer) trophic level.

Ubiquitous Organisms - Organisms that can tolerate a wide range of environmental conditions or variation; organisms that are so active or numerous as to seem to be present or existent in all types of environments (see Tolerant Association, Sensitive Organisms).

Unicellular - Refers to an organism that consists of only one cell; e.g., blue green algae, protozoa, bacteria. These organisms may, however, be filamentous or colonial in form.

Vertebrates - Animals that have an internal skeletal system (see Invertebrate).

Wetland - A land containing much soil moisture; in land use classification system used here, an area characterized by the existence of willows as the dominant natural vegetation.

Winter Kill - The death of fishes in a body of water during a prolonged period of ice and snow cover; caused by oxygen exhaustion due to respiration and lack of photosynthesis (see Summer Kill).

Zooplankton - The animals of the plankton. Unattached microscopic animals having minimal capability for locomotion.

APPENDIX B

PHYSICAL DATA

TRIBUTARIES OF THE MISSISSIPPI RIVER

Location of Confluence with Mississippi River

Tributary	River Mile (AHP)	County	State
Mayfield Creek	950	Ballard/Carlisle	Kentucky
Bayou Du Chien	927	Fulton	Kentucky
Obion Creek	922	Fulton	Kentucky
St. Johns Bayou	889	New Madrid	Missouri
Obion River[a]	820	Dyer	Tennessee
Middle Fork Forked Deer River	804	Lauderdale	Tennessee
Lower Fork Forked Deer River	798	Lauderdale	Tennessee
Hatchie River[a]	774	Lauderdale/Tipton	Tennessee
Loosahatchie River	741	Shelby	Tennessee
Wolf River	739	Shelby	Tennessee
Nonconnah Creek	725	Shelby	Tennessee
St. Francis River[a]	672	Phillips	Arkansas
White River[a]	599	Desha	Arkansas
Arkansas River[a]	582	Dehsa	Arkansas
Yazoo River[a]	437	Warren	Mississippi
Hennesseys Bayou	426	Warren	Mississippi
Big Black River[a]	408	Claiborne	Mississippi
Bayou Pierre	395	Claiborne	Mississippi
Coles Creek	376	Jefferson	Mississippi
St. Catherine Creek	361	Adams	Mississippi
Homochitto River	341	Adams	Mississippi
Old Homochitto River	325	Adams/Wilkinson	Mississippi
Old River Outflow			
Old River Outflow Channel[b]	315	Concordia	Louisiana
Buffalo River	313	Wilkinson	Mississippi
Lower Old River[b,c]	304	Concordia	Louisiana
Bayou Sara	266	W. Feliciana	Louisiana
Thompson Creek	256	E. Feliciana	Louisiana

[a] Major tributary stream

[b] Major outflow channel

[c] Closed 12 July 1963

MAJOR LAKES IN THE PROJECT AREA BY STATE[a]

River Mile[b]	County	Name	Size (Acres)	Oxbow
		MISSOURI		
940 W	Mississippi	Lucas Bend	287	Yes
930 W	Mississippi	Wolf Island Bend	242	Yes
926 W	Mississippi	Unnamed	62	
917 W	Mississippi	Unnamed	155	
916 W	Mississippi	Unnamed	150	
878 W	New Madrid	Unnamed	218	
878 W	New Madrid	Two Unnamed Lakes	183	
865 W	Pemiscot	Unnamed	140	
864 W	Pemiscot	Unnamed	44	
863 W	Pemiscot	Robinson Lake	35	
850 W	Pemiscot	Unnamed	237	
837 W	Pemiscot	Unnamed	25	
		KENTUCKY		
944 W	Carlisle	Forked Lake	25	
940 E	Carlisle	Lake No. 4	31	
941 E	Carlisle	Black Lake	20	
941 E	Carlisle	Fish Lake	90	
925 E	Fulton	Unnamed	37	
895 E	Fulton	Stonewall Lake	58	
886 E	Fulton	Gigler Slough	56	
		TENNESSEE		
722 E	Shelby	Unnamed	81	
721 E	Shelby	North Horn Lake	461	
		ARKANSAS		
717 W	Crittenden	Blue Lake	62	Yes
717 W	Crittenden	Unnamed	100	
708 W	Crittenden	Horseshoe Lake	3,036	
694 W	Lee	Council Lake	960	Yes

[a] Lakes 20 acres or greater are considered to be major lakes.

[b] W = western side of the Mississippi River,
E = eastern side of the Mississippi River.

MAJOR LAKES IN THE PROJECT AREA BY STATE[a] (Cont)

River Mile[b]	County	Name	Size (Acres)	Oxbow
685 W	Lee	Unnamed	25	
683 W	Lee	Old River Lake	20	Yes
682 W	Lee	Old Walnut Bend	250	Yes
674 W	Lee	Unnamed	22	
670 W	Phillips	Unnamed	30	
669 W	Phillips	Porter Lake	160	
668 W	Phillips	Brushy Lake	60	
654 W	Phillips	Unnamed	50	
649 W	Phillips	Dustin Pond	35	
634 W	Phillips	Unnamed	156	Yes
629 W	Phillips	Unnamed	81	
626 W	Phillips	Mellwood Lake	810	Yes
615 W	Desha	Knowlton Crevasse	22	
610 W	Desha	Unnamed	134	
602 E	Desha	Unnamed	118	
601 W	Desha	Half Moon Lake	20	Yes
601 W	Desha	Wall Lake	50	
600 W	Arkansas	Garland Lake	187	Yes
600 W	Arkansas	La Grues Lake	20	
600 W	Arkansas	Owens Lake	35	
600 W	Arkansas	Jim Smith Lake	84	
599 W	Arkansas	Old River Lake	62	
598 W	Desha	Skinner Lake	45	
595 W	Desha	Yancopin Lake	22	
592 W	Desha	Smith Lake	70	
589 W	Desha	Jefferson Lake	60	
589 W	Desha	Lake Pelican	46	
585 E	Desha	Unnamed	110	
580 W	Desha	Ozark Lake	137	
565 W	Desha	Holly Brush Crevasse	93	Yes
555 W	Desha	Unnamed	94	
547 W	Chicot	Paradise Lake	900	Yes
543 W	Chicot	Panther Forest Crevasse	56	
541 E	Chicot	Archer Lake	50	
535 W	Chicot	Whiskey Chute	78	Yes
533 W	Chicot	Unnamed	34	
527 W	Chicot	Lake Port	50	
520 W	Chicot	Unnamed	187	
514 W	Chicot	Matthews Bend	530	Yes
508 W	Chicot	Unnamed	28	

MAJOR LAKES IN THE PROJECT AREA BY STATE[a] (Cont)

River Mile[b]	County	Name	Size (Acres)	Oxbow
		MISSISSIPPI		
715 E	DeSoto	Mud Lake	243	Yes
714 E	DeSoto	Horn Lake	850	Yes
703 E	Tunica	Unnamed	44	
702 E	Tunica	Old River Lake	56	Yes
697 E	Tunica	Unnamed	36	
692 E	Tunica	Unnamed	27	
688 E	Tunica	Unnamed	31	
673 E	Tunica	Unnamed	28	
673 E	Tunica	Tunica Lake	3,152	Yes
672 E	Tunica	Unnamed	25	
671 E	Tunica	Mud Lake	25	
671 E	Tunica	North Lake	35	
670 E	Tunica	Duck Lake	65	
670 E	Tunica	Flower Lake	344	
659 E	Coahoma	Unnamed	30	
658 E	Coahoma	Unnamed	118	
640 E	Coahoma	Horseshoe Lake	270	Yes
639 E	Coahoma	Bend of Island 63	575	Yes
633 E	Coahoma	Old River	50	Yes
631 E	Coahoma	Ward Lake	40	
627 E	Coahoma	Unnamed	56	
625 E	Coahoma	DeSoto Lake	1,525	Yes
625 E	Coahoma	Chute of Island 66	162	
620 E	Coahoma	Fish Lake	20	
620 E	Coahoma	Lake Charles	31	
613 E	Bolivar	Unnamed	27	
605 E	Bolivar	Old River Lake	190	Yes
604 E	Bolivar	Unnamed	34	
600 E	Bolivar	Unnamed	39	
596 E	Bolivar	Lake Concordia	391	Yes
589 E	Bolivar	Unnamed	65	
586 E	Bolivar	Unnamed	56	
576 E	Bolivar	Lake Beulah	800	Yes
575 E	Bolivar	Lake Vermilion	50	
575 E	Bolivar	Unnamed	93	
574 E	Bolivar	Lake Whittington	3,564	Yes
560 E	Bolivar	Mound Crevasse	75	
549 E	Washington	Unnamed	209	

MAJOR LAKES IN THE PROJECT AREA BY STATE[a] (Cont)

River Mile[b]	County	Name	Size (Acres)	Oxbow
546 E	Washington	Unnamed	70	
542 E	Washington	Unnamed	65	
540 E	Washington	Lake Ferguson	1,740	Yes
539 E	Washington	Unnamed	70	
525 E	Washington	Lake Lee	1,800	Yes
521 E	Washington	Unnamed	140	
514 E	Washington	Unnamed	100	
510 E	Washington	Lake Jackson	320	Yes
509 E	Washington	Carolina Chute	96	Yes
509 E	Washington	Unnamed	48	
500 E	Issaquena	Unnamed	260	
500 E	Issaquena	Skipwith Crevasse	60	
482 E	Issaquena	Unnamed	259	
478 E	Issaquena	Three Unnamed Lakes	110	
470 E	Issaquena	Unnamed	37	
467 E	Issaquena	Unnamed	93	
466 E	Issaquena	Albermarle Lake	563	Yes
462 E	Warren	Old River	912	Yes
450 E	Warren	Forest Home Chute	100	
450 E	Warren	Halpino Lake	330	
448 E	Warren	Taylor Lake	37	
447 E	Warren	Paw Paw Bend	72	Yes
447 E	Warren	Unnamed	30	
446 E	Warren	Yazoo Lake	171	
438 E	Warren	Centennial Lake	345	
428 W	Warren	Hodges Lake	58	
425 W	Warren	Unnamed	56	
425 W	Warren	Palmyra Chute	215	Yes
424 E	Warren	Paine Lake	60	
422 E	Warren	Unnamed	70	
421 E	Warren	Horseshoe Lake	45	
420 E	Warren	Lake Karnac	81	
417 E	Warren	John Thomas Lake	37	
417 W	Warren	Unnamed	31	
416 W	Warren	Cypress Lake	193	
416 W	Warren	Old Chute	90	
415 W	Warren	Duck Lake	32	
415 W	Warren	Long Lake	70	
415 W	Warren	Unnamed	44	
415 W	Warren	Chute Lake	68	
415 W	Warren	Unnamed	35	
408 E	Claiborne	Rock Lake	38	
407 E	Claiborne	Gin Lake	30	

MAJOR LAKES IN THE PROJECT AREA BY STATE[a] (Cont)

River Mile[b]	County	Name	Size (Acres)	Oxbow
406 E	Claiborne	Hamilton Lake	30	
404 E	Claiborne	Coon Island Lake	58	
391 E	Jefferson	Bush Lake	35	
390 E	Jefferson	Flatland Lake	140	
389 E	Jefferson	Piazza Lake	96	
387 E	Jefferson	Rodney Lake	665	Yes
383 E	Jefferson	Gilliam Chute	135	
382 E	Jefferson	Bell Cow Lake	65	
379 E	Jefferson	Holmes or Trulys Lake	120	
379 E	Jefferson	Gum Ridge Chute	75	
377 E	Jefferson	Duck Pond	88	
377 E	Jefferson	Junkins Lake	108	
376 E	Adams	Fields Lake	64	
373 E	Adams	Yeager or Thornbug Lake	125	
367 W	Adams	Unnamed	50	
366 W	Adams	Marengo Lake	45	Yes
366 W	Adams	Flat Lake	25	
356 W	Adams	Unnamed	165	
353 E	Adams	Long Lake	57	
338 E	Adams	Butler Lake	125	
338 E	Wilkinson	Round Lake	22	
326 E	Adams	Unnamed	56	
324 E	Wilkinson	Blue Lake	32	
323 E	Wilkinson	Lake Mary	2,250	Yes
323 E	Wilkinson	Long Lake	20	
323 E	Wilkinson	Big Lake	145	
323 E	Wilkinson	Horseshoe Lake	95	
323 E	Wilkinson	Sam Miles Lake	52	
318 E	Wilkinson	Artonish Lake	90	
314 E	Wilkinson	Belmont Lake	38	
		LOUISIANA		
505 W	East Carroll	Gassoway Lake	800	Yes
504 W	East Carroll	Bunch's Cutoff	455	Yes
501 W	East Carroll	Old River	307	
498 W	East Carroll	Unnamed	64	
484 W	East Carroll	Unnamed	125	Yes
483 W	East Carroll	Holly Brook Crevasse	50	
471 W	East Carroll	Transylvania Chute	87	
466 E	East Carroll	Albermarle Lake	716	Yes
462 E	East Carroll	Old River	1,088	Yes

MAJOR LAKES IN THE PROJECT AREA BY STATE[a] (Cont)

River Mile[b]	County	Name	Size (Acres)	Oxbow
452 W	Madison	Cabin Teele Crevasse	35	
424 W	Madison	Long Lake	31	
419 E	Tensas	Viney Lake	32	
418 W	Madison	Blue Hole	25	
414 W	Tensas	Palmyra Lake	1,150	Yes
413 W	Tensas	Bayou Styx	118	
413 W	Tensas	Buckridge Crevasse	62	
413 W	Tensas	Bar Lake	20	
412 E	Tensas	Long Lake	20	
412 E	Tensas	Brushy Lake	24	
411 W	Tensas	Two Unnamed Lakes	62	
410 W	Tensas	Lake St. Joseph	1,600	Yes
409 W	Tensas	Yucatan Lake	2,000	Yes
409 W	Tensas	White Oak Lake	44	
407 W	Tensas	Duck Lake	43	
405 W	Tensas	Disharoon Lake	32	
403 W	Tensas	Old River Lake	80	
400 W	Tensas	Lake Lakanardia	130	
		Lake Bruin	3,460	
392 W	Tensas	Unnamed	68	
380 W	Tensas	Garten Chute	50	
378 E	Tensas	Kings Point Lake	60	
378 E	Tensas	Burnett Chute	41	
376 W	Concordia	Unnamed	55	
375 W	Concordia	Lake St. John	2,688	
372 W	Concordia	Lake St. John	174	Yes
370 W	Concordia	Grassy Lake	31	
369 W	Concordia	Mud Lake	243	
369 W	Concordia	Brandenburg Pit	40	
368 W	Concordia	Grassy Lake	35	
366 W	Concordia	Marengo Bend	1,158	Yes
345 W	Concordia	Glasscock Lake	2,310	Yes
345 W	Concordia	Unnamed	118	Yes
332 W	Concordia	Two Unnamed Lakes	68	
303 W	Pointe Coupee	Unnamed	25	
302 W	Pointe Coupee	Flat Lake	65	
301 E	W. Feliciana	Lake Killarney	467	
300 E	W. Feliciana	Charity Lake	31	
297 E	W. Feliciana	Sugar Lake	105	
297 W.	W. Feliciana	Bundy Lake	35	
297	W. Feliciana	Raccourci Lake	100	
290 W	Pointe Coupee	Raccourci-Old River	4,160	Yes
287 E	W. Feliciana	Ratliff Lake	27	

MAJOR LAKES IN THE PROJECT AREA BY STATE[a] (Cont)

River Mile[b]	County	Name	Size (Acres)	Oxbow
286 W	Pointe Coupee	Bay Lake	50	
286 W	Pointe Coupee	Mondu Lake	90	
286 E	W. Feliciana	Unnamed	40	
285 W	Pointe Coupee	Shaw Lake	115	
285 E	W. Feliciana	Unnamed	38	
272 E	W. Feliciana	Lake Platt	37	
271 E	W. Feliciana	Cobb Lake	22	
270 E	W. Feliciana	Black Fork Lake	25	
257 E	W. Feliciana	Deep Lake	30	
254 E	E. Feliciana	Faulkners Lake	83	
253 E	E. Feliciana	Alexander Lake	2	
253 E	E. Feliciana	Unnamed	25	
253 E	E. Feliciana	Stumpy Lake	30	
252 E	E. Feliciana	Brooks Lake	20	
242 W	W. Baton Rouge	Gar Pond	35	

HARBORS IN THE PROJECT AREA

River Mile	Bank	Location
Ohio River		
978	W	Cairo, Illinois
951	E	Wickliffe, Kentucky
922	E	Hickman, Kentucky
900	E	Cates, Tennessee
888	W	New Madrid, Missouri
875	W	Linda, Missouri
875	E	Tiptonville, Tennessee
848	W	Caruthersville, Missouri
838	W	Booth Point, Tennessee
834	W	Cottonwood Point, Missouri
831	E	Heloise Ldg., Tennessee
827	W	Huffman Ldg., Arkansas
819	E	Continental Grain Terminal, Tennessee
810	W	Borfield, Arkansas
783	W	Osceola, Arkansas
793	E	Gold Dust Grain Co., Tennessee
770	E	Richardson and Raldolph, Tennessee
735	E	Memphis, Tennessee
664-659	W	Helena, Arkansas
665.6	E	Union 76 Oil Co., Delta Rev't.,Mississippi
652.6	E	Friars Point, Mississippi
609.7	Eq	Dennis Landing, Mississippi
570.6	W	Desoto Landing, Arkansas
551.4	W	Texas Eastern Trans. Corp., Arkansas.
552.7	W	Cargill Grain Terminal, Arkansas
538	E	Greenville, Mississippi (on Lake Ferguson)
531	W	Riverside Soybean Co., Arkansas
530	W	Cities Service O.P. Gas Dock, Arkansas
513.5	W	Grand Lake Landing, Arkansas
510.5	W	Vicinity Cracraft Revet., Arkansas
497.4	E	Mayersville, Mississippi
494.4	E	Sohio Petroleum Dock, Mayersville, Mississippi
484.4	W	Lake Providence, Louisiana
467.5	W	Goodrich Landing, Louisiana
457.2	W	Madison Parish Port Site, Louisiana
437	E	Up the Yazoo Diversion Canal, Vicksburg, Mississippi
426	E	Oak Bend Landing, Mississippi

HARBORS IN THE PROJECT AREA (Cont)

River Mile	Bank	Location
396.4	W	Newellton, Louisiana
373.2	W	Canebrake, Louisiana
364-361		Natchez, Mississippi-Vidalia, Louisiana
278.3	W	Morganza, Louisiana
265.3	E	St. Francisville Casting Field, Louisiana
260.4	E	St. Francisville, Louisiana
235-226	W&E	Baton Rouge, Louisiana- Port Allen, Louisiana
217.2	W	Manchac, Louisiana
210-204.8	W	Plaquemine, Louisiana
203.8	E	Sunshine, Louisiana
201.6	E	St. Gabriel, Louisiana
199.9	E	Plaquemine, Louisiana
187-170	E	White Castle-Donaldsonville, Louisiana
166	W	Lauderlae, Louisiana
160.4	E	Uncle Sam, Louisiana
159.8	W	Burton Lane School and Church, Louisiana
159.3	W	Near St. Amelia, Louisiana
157.8	W	St. James, Louisiana
150.8	W	Vacherie, Louisiana
146-145	E	Gramercy, Louisiana
139-138	E	Reserve, Louisiana
135-133	E	Laplace, Louisiana
127	W	Union Carbide Corp., Louisiana
125-127	E	Good Hope, Louisiana
125	W	Oil Transport Co., Louisiana
120	E	Destrahan, Louisiana
120	W	Lone Star, Louisiana
118	E	St. Rose Landing, Louisiana
118	W	Farmers Export Co., Louisiana
115	W	American Cyanimid Co., Louisiana
115	E	Kenner, Louisiana
107.5	W	Avondale Shipyards, Louisiana
106-87	E	Vicinity New Orleans, Louisiana
79	E	Louisiana Southern Railroad, Louisiana
77	E	Freeport Nickel Co.
76	W	Belle Chasse, Louisiana
75-73	W	Concession, Louisiana
63-61.5	W	Alliance, Louisiana
57.0	W	Myrtle Grove, Louisiana
55.3	E	Harlem, Louisiana

HARBORS IN THE PROJECT AREA (Cont)

River Mile	Bank	Location
54.3	W	Junior, Louisiana
51.7	E	Darant, Louisiana
49	E	Pointe a la Hache, Louisiana
41.2	W	Potash, Louisiana
40.4	E	Neston, Louisiana
39.0	W	Point Sulphur, Louisiana
38.8-35.5	W	Homeplace, Louisiana
35.1	E	Daisy, Louisiana
32.2	W	Nairn, Louisiana
27.8-25.7	E	Ostrica, Louisiana
27.5-24.6	W	Buras, Louisiana
20.2	E	Fort St. Phillip, Louisiana
18.6-16.0	W	Boothville, Louisiana
16.9	E	Olga, Louisiana
14.7-10.6	W	Venice, Louisiana

APPENDIX C

BIOLOGY

APPENDIX C

BIOLOGY

HABITAT TABLES

SPECIES AND ABUNDANCE TABLES

TABLE 1

SOME VASCULAR PLANTS OF UNPROTECTED FLOOD PLAIN, CAIRO, ILLINOIS

		Habitat Type *				
		2	3	4	5	7
Graminae						
Bromus commutatus	Hairy brome grass					X
Festuca elatior	Tail fescue					X
Leersia oryzoides	Rice cutgrass		X			
Sorghum halepense	Johnson grass		X			X
Andropogon virginicus	Broom sedge					X
Cyperaceae						
Carex hyalinolepis	Sedge		X			X
Liliaceae						
Allium vineale	Field garlic					X
Salicacae						
Populus deltoides	Cottonwood	X				
Salix interior	Sandbar willow			X		
Salix nigra	Black willow		X			
Ulmaceae						
Celtis laevigata	Sugarberry		X			
Ulmus rubra	Slippery elm		X			
Moraceae						
Morus alba	White mulberry		X			
Urticaceae						
Urtica dioaca	Nettle	X		X		
Boehmeria cylindrica	False nettle	X		X		
Polygonaceae						
Polygonum coccineum	Smartweed		X			
Chenopodiaceae						
Chenopodium album	Lamb's quarters	X		X		
Phytolaccaceae						
Phytolacca americana	Pokeweed	X				
Plantanaceae						
Platanus occidentalis	Sycamore		X			

TABLE 1 (Cont)
SOME VASCULAR PLANTS OF UNPROTECTED FLOOD PLAIN, CAIRO, ILLINOIS

		Habitat Type *				
		2	3	4	5	7
Rosaceae						
Potentilla monospeliensis	Cinquefoil					X
Rubus trivialis	Southern dewberry		X			
Leguminosae						
Amorpha fruticosa	False indigo		X	X		
Geraniaceae						
Geranium carolinianum	Cranesbill					X
Anacardiaceae						
Rhus glabra	Smooth sumac					X
Toxicodendron radicans	Poison ivy		X			
Aceraceae						
Acer saccharinum	Silver maple		X			
Balsaminaceae						
Impatiens biflora	Touch-me-not	X				
Vitaceae						
Vitis riparia	Riverbank grape		X			
Onagraceae						
Oenothera biennis	Evening primrose					X
Umbelliferae						
Chaerophyllum procumbens	Chervil		X			
Asclepiadaceae						
Ampelamus albidus	Bluevine					X
Convolvulaceae						
Cuscuta cuspidata	Dodder		X			
Ipomoea pandurata	Morning glory		X			
Scrophulariaceae						
Veronica arvensis	Speedwell					X
Bignoniaceae						
Campsis radicans	Trumpet creeper		X			

TABLE 1 (Cont)
SOME VASCULAR PLANTS OF UNPROTECTED FLOOD PLAIN, CAIRO, ILLINOIS

		Habitat Type *				
		2	3	4	5	7
Caprifoliaceae						
Lonicera japonica	Japanese honeysuckle					X
Sambucus canadensis	Elderberry					X
Curcurbitaceae						
Sicyos angulatus	Bur cucumber		X			
Compositae						
Ambrosia trifida	Giant ragweed		X			
Aster lateriflorus	Aster		X			X
Eupatorium purpureum	Joe-Pye weed		X			
Xanthium commune	Cocklebur		X	X	X	X

* Habitat Type
- 2 - Younger stand
- 3 - Early secondary succession
- 4 - Young bar
- 5 - Sand and mudflat
- 7 - Old field

Cultivated fields and older stands were not represented in the Cairo study site transects.

Water and developed land were additional categories considered.

Source: Terpenning (27)

TABLE 2
PREFERRED HABITAT OF AMPHIBIANS OF THE PROJECT AREA

Common Name	WOODLAND		OPENLAND			
	Bottom-land Hardwoods	Swamp	Bayous Marshes	Edge-Transition (Grassland)	Lotic Water	Lentic Water
Marbled salamander	x					
Mole salamander	x					
Small-mouthed salamander	x			x		
Three-toed amphiuma	x	x	x	x	x	x
Dwarf salamander	x	x				x
Newt (eft)	x	x			x	x
Lesser siren					x	x
Northern cricket frog		x	x			
American toad	x	x	x	x		
Woodhouse's (Fowler's) toad	x	x	x	x		
Eastern narrow-mouthed frog	x	x	x			
Cope's (southern) gray treefrog	x	x				
Green treefrog	x	x	x	x		
Spring peeper	x	x	x			
Squirrel treefrog	x	x		x		
Chorus frog	x	x	x	x		
Bullfrog					x	x
Green (Bronze) frog		x	x			
Pickerel frog			x	x		
Leopard frog	x	x	x	x		

Source: R.E.T.A. (5) and G.S.R.I. (1)

TABLE 3
PREFERRED HABITAT OF REPTILES OF THE PROJECT AREA

Common Name	WOODLAND Bottom-land Hardwoods	Swamp	OPENLAND Bayous Marshes	Edge-Transition (Grassland)	Lotic Water	Lentic Water
American alligator		x	x		x	x
Snapping turtle		x	x		x	
Mobile cooter (slider)		x			x	x
Cooter (Missouri slider)		x			x	x
Painted turtle		x				x
Pond slider (red-eared turtle)		x	x		x	x
Chicken turtle		x			x	x
Map turtle		x	x		x	x
Mississippi map turtle		x	x			x
False map turtle		x			x	x
Mud turtle		x	x		x	x
Alligator snapping turtle		x	x		x	x
Keel-backed musk turtle		x	x		x	x
Stinkpot		x	x			x
Box turtle	x					
Smooth softshell turtle					x	x
Spiny softshell turtle		x	x		x	x
Green anole	x	x		x		
Six-lined racerunner				x		
Five-lined skink	x	x				
Broad-headed skink	x	x				
Ground skink	x	x		x		
Copperhead	x	x				
Cottonmouth	x	x	x			
Racer	x	x	x	x		
Timber (Canebrake) rattlesnake	x	x	x	x		
Ringneck snake	x			x		
Corn snake	x	x		x		
Rat snake	x	x		x		
Mud snake		x	x		x	x

TABLE 3 (Cont)
PREFERRED HABITAT OF REPTILES OF THE PROJECT AREA

Common Name	WOODLAND: Bottom-land Hardwoods	WOODLAND: Swamp	OPENLAND: Bayous Marshes	OPENLAND: Edge-Transition (Grassland)	OPENLAND: Lotic Water	OPENLAND: Lentic Water
Eastern hognose snake	x	x		x		
Prairie kingsnake				x		
Common kingsnake	x	x	x	x		
Milk snake	x	x				
Green watersnake		x	x		x	x
Plain-bellied watersnake			x		x	x
Banded watersnake		x	x		x	x
Diamond-backed watersnake			x		x	x
Rough greensnake	x	x		x		
Graham's watersnake		x	x		x	x
Glossy watersnake		x			x	x
Pigmy rattlesnake	x	x	x			
Brown snake	x	x	x	x		
Western ribbonsnake	x	x	x	x		x
Common gartersnake		x	x	x		x

Source: R.E.T.A. (5) and G.S.R.I. (1)

TABLE 4
PREFERRED HABITAT AND STATUS OF BREEDING BIRDS IN THE STUDY AREA[1]

Species	Habitats[2]: River-Bar-Bare Sand	Early Successional	Late Successional	Mixed Bottomland Hardwoods	Swamp Forest	Edge	Status[3]: Cairo, Ill.-Memphis, Tenn.	Memphis, Tenn. - Baton Rouge, La.	Baton Rouge, La.-Gulf of Mexico
Herbivorous[4]									
Bobwhite		X	X	X		X	C	C	FC
Rock Dove						X	C	FC	FC
Mourning Dove		X	X		X	X	A	A	FC
Ruby-throated Hummingbird				X		X	FC	FC	FC
Horned Lark						X	C	FC	–
House Sparrow						X	A	A	A
Red-winged Blackbird		X			X	X	A	A	A
Cardinal		X	X	X	X	X	A	A	A
Blue Grosbeak						X	U	FC	–
Indigo Bunting		X	X			X	A	A	FC
Painted Bunting			X			X	U	C	C
Dickcissel						X	C	C	–
American Goldfinch		X				X	C	U	–
Rufous-sided Towhee		X	X	X			C	C	C
Grasshopper Sparrow						X	U	FC	–
Lark Sparrow						X	U	U	–
Chipping Sparrow						X	FC	U	–
Field Sparrow						X	C	FC	–
Song Sparrow		X				X	FC	–	–
Insectivorous									
Cattle Egret		X	X	X	X		FC	C	C
Killdeer						X	C	C	FC
Yellow-billed Cuckoo		X	X	X	X	X	C	C	C
Yellow-shafted Flicker			X	X	X	X	FC	FC	U
Pileated Woodpecker				X	X		FC	FC	FC
Red-bellied Woodpecker			X	X	X		C	C	FC
Red-headed Woodpecker				X	X	X	FC	C	–
Hairy Woodpecker			X	X	X		U	FC	FC
Downy Woodpecker		X	X	X	X	X	FC	FC	FC
Eastern Kingbird						X	FC	C	FC
Great Crested Flycatcher			X	X	X		FC	FC	FC
Eastern Phoebe						X	U	U	–
Acadian Flycatcher			X	X	X		FC	FC	–
Eastern Wood Pewee			X	X	X		C	FC	–
Carolina Chickadee		X	X	X	X	X	FC	C	C
Tufted Titmouse			X	X			C	C	C
White-breasted Nuthatch			X	X			U	U	–
Brown Thrasher				X					
Warbling vireo			X						

TABLE 4 (Cont)
PREFERRED HABITAT AND STATUS OF BREEDING BIRDS IN THE STUDY AREA[1]

Species	Habitats[2]: River Bar-Bare Sand	Early Successional	Late Successional	Mixed Bottomland Hardwoods	Swamp Forest	Edge	Status[3]: Cairo, Ill.-Memphis, Tenn.	Memphis, Tenn. - Baton Rouge, La.	Baton Rouge, La.-Gulf of Mexico
Insectivorous (Cont)									
Brown-headed Nuthatch				X			–	U	–
House Wren				X		X	–	U	–
Bewick's Wren						X	–	U	–
Carolina Wren			X	X	X		C	C	A
Short-billed Marsh Wren						X			–
Catbird		X	X			X	FC	FC	–
Brown Thrasher			X	X		X	FC	C	U
Wood Thrush			X	X			FC	C	–
Blue-gray Gnatcatcher			X	X			C	FC	FC
White-eyed Vireo			X	X			FC	C	C
Bell's Vireo		X				X	–	U	–
Yellow-throated Vireo				X	X		FC	FC	–
Red-eyed Vireo		X	X	X			FC	FC	C
Warbling Vireo		X	X		X	X	FC	FC	–
Black-and-white Warbler				X			U	FC	–
Prothonotary Warbler			X	X	X		FC	C	C
Swainson's Warbler				X			–	U	–
Worm-eating Warbler				X			U	U	–
Parula Warbler			X	X	X		FC	C	C
Yellow Warbler		X					U	–	–
Cerulean Warbler				X			FC	–	–
Yellow-throated Warbler					X		U	–	–
Prairie Warbler					X	X	U	U	–
Louisiana Waterthrush			X	X			U	U	–
Kentucky Warbler			X	X			FC	U	–
Yellowthroat		X				X	C	C	C
Yellow-breasted Chat		X				X	C	C	FC
Hooded Warbler			X	C			U	FC	C
American Redstart		X	X				FC	U	–
Orchard Oriole			X			X	C	C	A
Baltimore Oriole		X	X	X		X	C	C	–
Summer Tanager				X			FC	C	U

TABLE 4 (Cont)

PREFERRED HABITAT AND STATUS OF BREEDING BIRDS IN THE STUDY AREA[1]

Species	Habitats[2]						Status[3]		
	River Bar-Bare Sand	Early Successional	Late Successional	Mixed Bottomland Hardwoods	Swamp Forest	Edge	Cairo, Ill.-Memphis, Tenn.	Memphis, Tenn. - Baton Rouge, La.	Baton Rouge, La.-Gulf of Mexico
Aerial Insectivores[5]									
Chuck-will's-widow				X			U	U	–
Whip-poor-will				X			U	–	O
Common Nighthawk						X	–	U	FC
Chimney Swift						X	C	C	C
Tree Swallow				X	X	X	–	U	–
Bank Swallow						X	U	–	–
Rough-winged Swallow						X	FC	FC	U
Barn Swallow						X	C	C	–
Purple Martin						X	C	C	C
Omnivorous									
Turkey				X			–	FC	–
Blue Jay			X	X	X	X	C	C	C
Common Crow		X	X	X	X	X	C	C	C
Fish Crow		X	X				FC	FC	FC
Mockingbird						X	C	A	C
Robin			X	X		X	C	C	–
Eastern Bluebird						X	FC	FC	–
Starling						X	A	C	C
Eastern Meadowlark						X	C	A	FC
Boat-tailed Grackle		X	X				–	U	C
Common Grackle		X	X	X	X	X	A	A	A
Brown-headed Cowbird					X	X	C	C	FC
Top Carnivores[6]									
Turkey Vulture			X	X			U	FC	FC
Black Vulture			X	X		X	–	C	FC
Mississippi Kite			X	X	X		FC	FC	FC
Sharp-shinnned Hawk				X			–	U	–
Red-tailed Hawk						X	U	U	–
Red-shouldered Hawk			X	X			U	FC	FC
Broad-winged Hawk			X	X			–	U	–
Sparrow Hawk						X	U	–	–
Screech Owl			X	X			U	–	–
Great Horned Owl			X	X			–	U	–
Barred Owl			X	X	X		FC	U	–
Loggerhead Shrike						X	C	FC	FC

TABLE 4 (Cont)
PREFERRED HABITAT AND STATUS OF BREEDING BIRDS IN THE STUDY AREA[1]

Species	Habitats[2]: River Bar-Bare Sand	Early Successional	Late Successional	Mixed Bottomland Hardwoods	Swamp Forest	Edge	Status[3]: Cairo, Ill.-Memphis, Tenn.	Memphis, Tenn.-Baton Rouge, La.	Baton Rouge, La.-Gulf of Mexico
Aquatic Foragers[7]									
Anhinga					x		-	U	-
Great Blue Heron			X	C	C		FC	U	FC
Green Heron		X	X	X	X	X	FC	FC	C
Little Blue Heron			X	X	X		C	C	FC
Common Egret			X	X	X		FC	FC	FC
Snowy Egret			X	X	X		-	U	-
Louisiana Heron			X		C		-	FC	FC
Black-crowned Night Heron			X	X	X		U	U	-
Yellow-crowned Night Heron		X	X	X	X		U	FC	FC
American Bittern						X	-	U	-
White-faced Ibis						X	-	-	FC
White Ibis					X		-	U	-
Mallard						X	C	U	-
Mottled Duck						X	-	-	FC
Blue-winged Teal						X	U	U	-
Wood Duck			X	X	X		U	FC	FC
Hooded Merganser			X	X	X		-	U	-
Least Tern	X						FC	-	-
Belted Kingfisher						X	U	U	FC

1 Data from Gulf South Research Institute Inventory.

2 See text for further elaboration.

3 The following categories were based on numbers observed per 30 breeding bird censuses:

U	10	Uncommon
FC	10-99	Fairly Common
C	100-999	Common
A	1000	Abundant

4 Many normally herbivorous species feed their young a large number of insects.

5 These species normally forage over large areas (especially over water) and capture their prey while airborne.

6 Includes scavengers.

7 These species forage primarily in water, but breed in terrestrial habitats (with the exception of the American Bittern and White-faced Ibis).

SOURCE: R.E.T.A. (5) and G.S.R.I. (1)

TABLE 5

PREFERRED HABITAT OF MAMMALS IN THE STUDY AREA

	WOODLAND				OPEN LAND		
	Mixed Hardwood	Willow Sycamore	Cypress	Brushland - Edge	Unmanaged Grassland	Marshland	Semi-Aquatic
GAME MAMMALS							
Swamp rabbit	X	X				X	
Eastern cottontail				X	X		
Fox squirrel	X			X			
Grey squirrel	X						
White-tail deer	X	X	X	X		X	
FURBEARERS							
Opossum	X	X		X	X		
Woodchuck				X	X		
Muskrat			X			X	X
Nutria			X			X	X
Beaver			X			X	X
Grey fox	X	X		X	X		
Red fox	X	X		X	X		
Coyote	X	X		X	X		
Spotted skunk	X	X		X			
Striped skunk				X	X		
Long-tailed weasel	X	X			X	X	
Mink			X			X	X
Otter			X			X	X
Bobcat	X	X	X	X	X	X	
Raccoon	X	X	X	X		X	

Source: R.E.T.A. & G.S.R.I.

TABLE 5 (Cont)
PREFERRED HABITAT OF MAMMALS IN THE STUDY AREA

	WOODLAND				OPEN LAND		
	Mixed Hardwood	Willow Sycamore	Cypress	Brushland - Edge	Unmanaged Grassland	Marshland	Semi-Aquatic
NON-GAME SPECIES *							
Shorttail shrew	X	X		X	X	X	
Least shrew					X	X	
Southwestern shrew				X	X	X	
Eastern mole					X		
Bats (15 species)	X	X	X				
Eastern chipmunk	X	X					
Southern flying squirrel	X	X					
Eastern harvest mouse					X	X	
Western harvest mouse				X	X		
Fulvous harvest mouse				X	X		
Deer mouse	X	X		X	X		
White-footed mouse	X	X		X	X		
Cotton mouse		X				X	
Golden mouse		X	X	X		X	
Rice rat						X	X
Eastern woodrat		X				X	
Cotton rat					X		
Southern bog lemming						X	X
Pine vole							
Prairie vole							
Meadow jumping mouse					X	X	

* The house mouse (Mus musculus), the black rat (Rattus rattus), and the Norway rat (Rattus norvegicus) are introduced species (Family Muridae) that are particularly adapted to living with man and are found associated with buildings, sewers, and dumps.

Source: R.E.T.A. (5) & G.S.R.I. (1)

TABLE 6
AN ANNOTATED LIST OF RARE AND ENDANGERED FISH OF THE STUDY AREA

Southern brook lamprey	Non-parasitic, no records from Mississippi River but probably occurs. Inhabits clear, permanent flow streams.
American brook lamprey	Clear, permanent flow streams of medium to large size. Ohio River confluence south to White River drainage, Arkansas.
Lake sturgeon	Large northern rivers and lakes. Once supported substantial fishery in Missouri, now rare. Limits of range. May be intolerant of heavy siltation.
Atlantic sturgeon	Marine species which ascends rivers in spring to breed. Bottom-feeder. Overfished in early 1900's. Rare.
Pallid sturgeon	Few records. Recently taken north of New Orleans. Prefers strong current over firm sandy bottom, swift-flowing channels in large, silt-laden rivers. A bottom-feeder. Rare.
Shovelnose sturgeon	Smallest, most abundant of sturgeons. Probably overfished. Feeds over clean gravel and sand bottoms of chutes and bars. May be more common in larger tributaries. Scarce below Baton Rouge.
Alligator gar	Largest gar. Predaceous. Spring spawner. Inhabits bayous, coastal marshes, lakes, and sluggish pools and overflow waters of large rivers. Probably never common in Missouri and Illinois near northern limit of range. Common in southern reach of project area.
Alabama shad	Rare in Mississippi River. Once supported limited commercial fishery in Missouri. Scarce in Louisiana stretch. Spawns in Missouri waters and young return to Gulf before their second summer.
Cypress minnow	Quiet pools and slackwater of lowland streams. Intolerant of continuous turbidity. Scarce southern species. Not reported from interior lowlands of Missouri in recent times.

TABLE 6 (Cont)

AN ANNOTATED LIST OF RARE AND ENDANGERED FISH OF THE STUDY AREA

Sturgeon chub	Inhabits main channel in large silty rivers in areas of swift current with fine sand or gravel bottom. Scarce in Louisiana.
Sicklefin chub	Similar to sturgeon chub. Both appear to prefer gravel. Occasionally reported. Endemic to Missouri and Mississippi mainstream.
Pallid shiner	In upper study area only. Inhabits quiet pools in medium to large streams. Intolerant of siltation and turbidity. Common and widespread in Missouri 30 years ago, now with discontinuous distribution.
Pugnose minnow	Clear, lowland waters with abundant aquatic vegetation and no noticeable current. Quiet pools and slackwaters. Scarce south of Baton Rouge.
Steelcolor shiner	Relatively intolerant of turbidity. Uncommon in main stem.
Bluntnose minnow	Scarce in river.
Brown bullhead	Prefers quiet waters and heavily vegetated overflow pools. More abundant in sluggish streams and shallow portions of lakes over silt bottoms than in river. Omnivorous. Apparently never common in Missouri at western limit of its eastern distribution and scarce in southernmost reaches of study area.
Golden topminnow	Inhabits quiet, weedy slackwaters and oxbows, and lowland streams. Southeastern affinities.
Starhead topminnow	Quiet, weedy slackwaters and oxbows. Central Gulf States to Great Lakes. Depletion of stocks in Missouri may be due to destruction of preferred habitat by drainage.
Mississippi silverside	Apparent rarity throughout project area may be due to habit of coming near shore during darkness and returning to deeper water in daytime. Cairo is northern limit of range.

TABLE 6 (Cont)

AN ANNOTATED LIST OF RARE AND ENDANGERED FISH OF THE STUDY AREA

Banded pygmy sunfish	Inhabits quiet, clear, heavily vegetated lowland slackwaters. May be common in local situations. Apparently more widespread in Missouri and Illinois before swamp drainage. Near northern limit of range for both sunfishes.
Bantam sunfish	Clear, quiet water with submerged vegetation and standing timber in lowlands.
Harlequin darter	Slackwaters of large, lowland rivers.
Mud darter	Inhabits lakes, ponds, and sluggish areas of river. Rareness in Kentucky may be due to restricted suitable habitat. Scarce south of Baton Rouge. May be locally common elsewhere.
Slenderhead darter	Rare in river, avoids turbidity and high gradient streams. A northern species. Rareness in Kentucky may be due to lack of suitable habitat.
River darter	Found in wide variety of habitats, fast-moving and slow waters. Tolerant of continuous high turbidity. Scarce in lower reaches of project area.
Stargazing darter	Prefers lowland waters. Generally most abundant darter in river. Scarce south of Baton Rouge.
Sauger	Common to abundant in river. Predaceous. Prefers strong current. Tolerates turbidity. Highly migratory. Depleted in Kentucky only at present.
Walleye	Scarce. Upper river only. Generally replaces sauger in tributaries.

Source: R.E.T.A. (5) and G.S.R.I. (1) from the following:

a. Pflieger, W.L. 1971
b. Smith, P.W.; A.C. Lopinot; and W.L. Pflieger, 1971
c. Miller, R.R. 1972
d. Missouri Department of Conservation, 1973.

TABLE 7
AN ANNOTATED LIST OF KNOWN VECTORS OF THE STUDY AREA

Class Arachnida

Order Acarina (mites, ticks)

Family Ixodidae

Dermacentor variabilis (Say), wood tick. Transmits causative agent of Rocky Mountain spotted fever; causes tick paralysis. Field mice host immature stages. Most mammals except rabbits attacked by adults. Woodland and brushy habitat.

Amblyomma americanum (Linn), lone star tick. Bite extremely irritating to human skin. Possibly transmits Rocky Mountain spotted fever and tularemia. Attacks rabbits especially. Woodland and brushy habitat.

Ixodes scapularis (Say), black-legged tick. Causes dermatosis. Attacks mammals and birds.

Family Dermanyssidae

Dermanyssus gallinae (DeGeer), chicken mite. Bite in man results in dermatits. Transmits St. Louis and equine encephalitis. Primarily a chicken parasite.

Ornithonyssus sylvarium (Cane and Fan.), northern fowl mite. Transmits St. Louis and western equine encephalitis. Parasitizes domestic or wild fowl.

O. bursa (Berlese), fowl parasite. Bite in man causes dermatitis.

Echinolaelaps echidnus (Berlese), spiny rat mite. Reservoir of causative agent of tularemia.

Family Pyemotidae

Pyemotes ventricosus (Newport), hay itch mite. Causes severe dermatitis and secondary infections. Parasitizes insect larvae which are pests of grains and hay.

Family Demodicidae

Demodex spp., follicle mites. Implicated in skin disorders and dermatitis. Several different mammals attacked by species in this genus.

Family Trombiculidae

Trombicula alfreddugesi (Oudemans), chigger. Bites result in dermatitis and an allergic reaction. Many vertebrates parasitized; man is an accidental host.

Family Sarcoptidae

Sarcoptes scabei (DeGeer), itch mite. Burrows into skin and causes severe irritation which may lead to secondary infection. Man and domestic animals affected.

Class Insecta

Order Orthoptera (grasshoppers and allies)

Family Blattidae (cockroaches)

Parcoblatta spp., wood cockroaches. Six species recorded in the unprotected floodplain, younger stand. Roaches in general transmit viral, bacterial, fungal, and protozoan diseases.

Order Coleoptera (beetles)

Family Staphylinidae (rove beetles)

Occur around decaying plant and animal material. Some species found in the Mississippi floodplain may transmit anthrax.

Paederus spp. Cause painful blisters upon contact with human skin.

Family Silphidae (carrion beetles)

Silpha spp. and nicrophorus spp. Both collected in mammal can trap in the unprotected floodplain. Transmits anthrax.

TABLE 7 (Cont)

Family Dermestidae (skin beetles)

Various life stages transmit anthrax; invade the auditory canal of man; cause an allergic reaction, possibly asthma.

Family Scarabaeidae (scarab or lamellicorn beetles)

Implicated in disease transmission. Scavengers, some carrion and dung feeders.

Family Oedemeridae (false blister beetles)

Implicated in disease transmission. Larvae thrive in moist decaying wood, especially driftwood.

Family Ptinidae (spider beetles)

Implicated in disease transmission.

Family Melodidae (blister beetles)

Cause blisters upon contact with human skin.

Family Curculionidae (weevils)

Some species cause allergic reactions similar to that of the skin beetles.

Order Lepidoptera (moths and butterflies)

Family Noctuidae

With urticating hairs. Contact with skin causes inflammation and possible systemic disturbance.

Catocala spp., underwings. Taken in unprotected floodplain on levee and in younger stand.

Order Diptera (flies)

Family Culicidae (mosquitoes)

Lay eggs in soil which is seasonally flooded; eggs hatch under the stimulus of moisture. 55 species in Illinois, 51 in Missouri. Some of the most important species are listed.

Aedes spp. Eggs laid in woodland depressions, ditches, borrow pits, and artificial containers.

A. aegyptii (Linnaeus). Probably eastern, western, and St. Louis encephalitis. Prefers human blood to blood of other animals.

A. dorsalis (Meigen). Western equine encephalitis and St. Louis encephalitis.

A. thibaulti (Dyar and Knab). Painful biter. Locally abundant in southeast Missouri.

Aedes vexens, A. stricticus and A. triseriatus. Common in southern Tennessee. Throughout study area in appropriate moist habitat.

Anopheles spp. Transmit tularemia, malaria, and encephalitis. Eggs laid around pools and marshy areas with vegetation. Malaria has ceased to be a problem in the southeastern United States. The following species are commonly reported:

A. crucians (Wiederman). Transmits malaria.

A. quadrimaculatus (Say). Most important malarial vector in southern United States. Abundant around suitable breeding areas.

A. punctipennis. May be locally common.

Culex pipiens (Linnaeus). Northern house mosquito. Western equine and St. Louis encephalitis, possibly tularemia. Breeds in ditches and artificial containers. Persistent biter.

C. erraticus is commonly reported in the northern portion and may be common throughout the study area.

Psorophora spp. Mosquitoes of this genus may be locally troublesome.

P. confinnis and P. ciliata may be found at river mouths and other lowland stations as well as upstream stations. P. discolor and P. ferox appear to be common only at lower elevations.

Culiseta spp. All strains of equine and St. Louis encephalitis.

C. impatiens is commonly found in lowlands.

TABLE 7 (Cont)

Family Tendipedidae (midges)

Midges have painful bites and may be more of a nuisance than a vector problem. Due to their ability to reproduce and survive in periodically inundated areas, they may become serious pests, particularly during the summer months. Species tolerant of pollution as aquatic larvae may contribute as aerial adults to diseases commonly transmitted by biting, including some common enteric diseases.

Family Simuliidae (black flies, gnats)

Bite can be severe and serious, causing extreme pain, itching, and swelling. Larvae attach to rocks or vegetation in running water. Floods may wash in large numbers of eggs; with subsequent flooding they hatch, the larvae develop, and huge swarms of adults may result. Livestock, man, and presumably wild animals are attacked.

Family Chloropidae (fruit flies, eye gnats)

Hippelates spp., eye gnats. Involved in mechanical transmission of pinkeye. Eggs laid on freshly disturbed ground with high moisture content. Larvae found in decaying material.

Family Tabanidae (horse flies, deer flies)

Swarm annoyingly, cause painful bites, act as mechanical and cyclic disease vectors. Harrassment of livestock can lead to weakened condition. Eggs deposited on aquatic vegetation or vegetation overhanging water. Larvae found in moist soil, humus, and mud of floodplains and ditches.

Tabanus spp., horse flies. Transmit anthrax and causative agent of tularemia. Pests around sand areas.

Chrysops spp., deer flies. Transmit anthrax and causative agent of tularemia, and possibly other diseases. Swarm around the head persistently.

Family Muscidae (muscid flies)

Responsible in part for transmission of typhoid, paratyphoid, cholera, dysentery, salmonella enteritis, anthrax, conjunctivitis, poliomyelitis, and tuberculosis. Transmit eggs of several parasitic worms. Produce traumatic myiasis and psuedomyiasis. Larvae and adults feed on excreta and carrion, adults associate freely with man. Transmission is mechanical or due to regurgitation during feeding. Many species occur in the unprotected floodplain, including Musca domestica Linn., the common housefly.

TABLE 7 (Cont)

Family Hippoboscidae (louse flies)

Melanophagus ovinus (Linn.), sheep ked. Bite can cause allergic reaction. Possibly transmits disease as adults are blood-suckers of birds and mammals.

Pseudolynchia canariensis (Macq.) pigeon fly. Importance similar to that of previous species.

Family Nycteribiidae (bat flies)

Basilia boardmani Roy. Possibly aids in maintenance of rabies virus. Ectoparasite of bats.

Family Calliphoridae (blow flies)

Carry causative agent of dysentery, probably poliomyelitis and tuberculosis (Herms and James 1961). Larvae feed on ecrement, garbage, and carrion. Six species in the unprotected floodplain.

Callitraga americana (Cushing and Patten), primary screw worm. Produces traumatic myiasis in man by laying eggs in open wounds. Domestic and probably wild animals affected. Most serious myiasis-producing fly in the Midwest.

Family Sarcophagidae (flesh flies)

Disease transmission probably as in the blow flies. Larvae are scavengers.

Order Siphonaptera (fleas)

Connected with bubonic plague, tularemia, salmonellosis, typhus, and dermatitis. Most birds and mammals are hosts of fleas.

Source: Terpenning (13)
Nonconnah Basin Environmental Inventory (14)
R.E.T.A. (5)

TABLE 8
A CHECKLIST AND RELATIVE ABUNDANCE OF FRESHWATER FISH IN THE STUDY AREA

		Location						
Common Name	Scientific Name	Cairo	Hickman	Tunica	Vicksburg	Tarbert Landing	Luling	Head of Passes
Silver lamprey	*Ichthyomyzon unicuspis*	1	P	P	2	0	0	0
Chestnut lamprey	*Ichthyomyzon castaneus*	2	2	P	2	P	0	0
Southern brook lamprey	*Ichthyomyzon gagei*	0	0	0	0	P	P	P
Lake sturgeon	*Acipenser fulvescens*	P	P	P	P	0	0	0
Atlantic sturgeon	*Acipenser oxyrhynchus*	0	0	0	0	0	P	P
Pallid sturgeon	*Scaphirhynchus albus*	P	P	P	P	P	P	P
Shovelnose sturgeon	*Scaphirhynchus platorhynchus*	2	2	2	2	2	2	P
Paddlefish	*Polyodon spathula*	2	3	3	3	3	2	P
Bowfin	*Amia calva*	2	2	2	2	3	3	P
Alligator gar	*Lepisosteus spatula*	1	2	2	2	2	2	2
Longnose gar	*Lepisosteus osseus*	3	3	3	3	3	2	P
Spotted gar	*Lepisosteus oculatus*	P	1	1	2	3	3	3
Shortnose gar	*Lepisosteus platostomus*	4	4	4	4	4	3	1
American eel	*Anguilla rostrata*	2	2	2	2	2	2	P
Skipjack herring	*Alosa chrysochloris*	3	4	4	4	4	4	1
Alabama shad	*Alosa alabamae*	1	P	P	P	P	P	P
Gizzard shad	*Dorosoma cepedianum*	4	4	4	4	4	4	4
Threadfin shad	*Dorosoma petenense*	3	3	4	4	4	3	4
Goldeye	*Hiodon alosides*	3	4	3	3	3	1	1
Mooneye	*Hiodon tergisus*	2	2	2	2	2	2	P
Northern pike	*Esox lucius*	1	1	1	0	0	0	0
Chain Pickerel	*Esox niger*	0	1	1	1	1	1	P
Carp	*Cyprinus carpio*	4	4	4	4	4	4	P
Golden Shiner	*Notemigonus crysoleucas*	2	2	2	2	2	2	P
Speckled chub	*Hybopsis aestivalis*	P	P	P	3	P	P	P
Flathead chub	*Hybopsis gracilis*	4	4	P	P	P	0	0
Sturgeon chub	*Hybopsis gelida*	P	0	0	0	0	0	0
Gravel chub	*Hybopsis x-punctata*	P	P	P	P	0	0	0
Sicklefin chub	*Hybopsis meeki*	P	P	0	0	0	0	0
Silver chub	*Hybopsis storeriana*	3	3	P	3	P	0	0

TABLE 8
(CONTINUED)

Common Name	Scientific Name	Cairo	Hickman	Tunica	Vicksburg	Tarbert Landing	Luling	Head of Passes
		Location						
River Carpsucker	Carpiodes carpio	4	4	4	4	4	3	P
Highfin carpsucker	Carpiodes velifer	0	0	P	P	0	0	0
Golden redhorse	Moxostoma erythrurun	1	1	1	1	0	0	0
Northern redhorse	Moxostoma macrolepidotum	1	0	0	0	0	0	0
Spotted sucker	Minytrema melanops	1	1	1	1	1	1	P
Creek chubsucker	Erimyzon oblongus	0	P	P	P	P	P	P
Blue catfish	Ictalurus furcatus	3	4	4	4	4	4	4
Channel catfish	Ictalurus punctatus	4	4	4	4	4	4	1
Black bullhead	Ictalurus melas	2	2	2	2	2	2	P
Yellow bullhead	Ictalurus natalis	1	1	1	1	1	1	P
Brown bullhead	Ictalurus nebulosus	1	1	1	2	2	2	P
Flathead catfish	Pylodictis olivaris	3	3	3	3	3	2	P
Stonecat	Noturus flavus	1	0	0	P	0	0	0
Tadpole madtom	Noturus gyrinus	1	P	P	P	P	P	P
Freckled madtom	Noturus nocturnus	1	0	0	0	0	0	0
Pirate perch	Aphredoderus sayanus	P	P	1	1	P	P	P
Blackspotted topminnow	Fundulus olivaceous	P	P	P	P	P	P	P
Blackstripe topminnow	Fundulus notatus	P	P	P	P	P	P	P
Mosquitofish	Gambusia affinis	1	P	P	P	P	P	P
Brook silverside	Labidesthes sicculus	2	P	P	2	P	P	P
Mississippi silverside	Menidia audens	3	3	P	3	P	P	P
White bass	Morone chrysops	3	4	3	3	4	3	2
Yellow bass	Morone mississippiensis	2	3	2	2	3	3	3
Flier	Centrarchus macropterus	1	0	0	P	0	0	0
Green sunfish	Lepomis cyanellus	1	P	P	P	P	P	P
Warmouth	Lepomis gulosus	2	2	2	2	2	2	P
Orangespotted sunfish	Lepomis humilis	3	P	P	P	P	P	P
Bluegill	Lepomis macrochirus	3	3	3	3	3	3	P
Longear sunfish	Lepomis megalotis	2	2	2	1	1	0	0
Redear sunfish	Lepomis microlophus	1	1	1	1	1	1	P
Spotted bass	Micropterus punctalatus	1	1	1	1	0	0	0
Largemouth bass	Micropterus salmoides	2	2	2	2	2	2	P

TABLE 8
(CONTINUED)

Common Name	Scientific Name	Location: Cairo	Hickman	Tunica	Vicksburg	Tarbert Landing	Luling	Head of Passes
Pugnose minnow	Opsopoeodus emiliee	P	P	P	P	P	P	P
Emerald shiner	Notropis atherinoides	4	4	4	4	P	P	P
Spottail shiner	Notropis hudsonius	1	P	P	P	0	0	0
Silverband shiner	Notropis shumardi	3	3	P	P	0	0	0
Common Shiner	Notropis cornutus	P	P	P	P	0	0	0
Bigmouth shiner	Notropis dorsalis	1	0	0	0	0	0	0
Mimic shiner	Notropis volucellus	3	3	P	2	P	P	P
Spotfin shiner	Notropis spilopterus	1	1	0	0	0	0	0
Ghost shiner	Notropis buchanani	1	P	0	2	0	0	0
Taillight shiner	Notropis maculatus	P	P	P	P	P	P	P
Sand shiner	Notropis stramineus	1	P	P	P	P	P	P
Ribbon shiner	Notropis fumeus	P	P	P	P	0	0	0
River shiner	Notropis blennius	4	4	P	4	0	0	0
Chub shiner	Notropis potteri	0	0	0	P	0	0	0
Red shiner	Notropis lutrensis	3	3	P	2	P	P	P
Blacktail shiner	Notropis venustis	P	P	P	2	P	P	P
Weed shiner	Notropis texanus	P	P	P	2	P	2	0
Steelcolor shiner	Notropis shipplei						P	0
Silvery minnow	Hybognathus nuchalis	2	3	2	4	P	P	P
Plains minnow	Hybognathus placitus	3	3	P	P	P	P	P
Cypress minnow	Hybognathus hayi	P	P	P	P	P	P	P
Bullhead minnow	Pimephales vigilax	2	2	P	P	P	P	P
Bluntnose minnow	Pimephales notatus	2	P	P	P	P	P	P
Fathead minnow	Pimephales promelas	1	P	0	0	0	0	0
Suckermouth minnow	Phenacobius mirabilis	P	0	0	0	0	0	0
Blue sucker	Cycleptus elongatus	2	2	2	2	2	0	0
Bigmouth buffalo	Ictiobus cyprinellus	3	3	3	3	3	4	P
Smallmouth buffalo	Ictiobus bubalus	4	4	4	4	4	4	P
Black buffalo	Ictiobus niger	3	3	3	3	3	3	P
Quillback	Carpiodes cyprinus	1	2	2	2	0	0	0

TABLE 8

(CONTINUED)

Common Name	Scientific Name	Cairo	Hickman	Tunica	Vicksburg	Tarbert Landing	Luling	Head of Passes
		Location						
Bantam sunfish	Lepomis symmetricus							
Spotted sunfish	Lepomis punctatus							
Pygmy sunfish	Elassoma zonatus							
White crappie	Pomoxis annularis	3	4	4	4	4	3	P
Black crappie	Pomoxis nigromaculatus	3	3	3	3	3	3	P
Sauger	Stizostedion canadense	4	4	4	3	3	2	0
Walleye	Stizostedion vitreum	2	0	0	0	0	0	0
Dusky darter	Percina sciera	2	P	P	P	P	P	P
Logperch	Percina caprodes	2	P	P	P	P	P	P
River darter	Percina shumardi	2	P	P	P	P	P	P
Stargazing darter	Percina uranidea	P	P	P	P	P	P	P
Slenderhead darter	Percina phoxocephala	1	P	P	0	0	0	0
Bluntnose darter	Etheostoma chlorosomum	P	P	P	P	P	P	P
Crystal darter	Ammocrypta asprella							
Western sand darter	Ammocrypta clara							
Scaly sand darter	Ammocrypta virax							
Speckled darter	Etheostoma stigmatum							
Harlequin darter	Etheostoma histrio							
Mud darter	Etheostoma asprigene	P	P	P	P	P	P	P
Slough darter	Etheostoma gracile	P	P	P	P	P	P	P
Cypress darter	Etheostoma proelare	P	P	P	P	P	P	P
Freshwater drum	Aplodinotus grunniens	4	4	4	4	4	4	P

Source: R.E.T.A. (5) and G.S.R.I. (1)

TABLE 9

A CHECKLIST AND RELATIVE ABUNDANCE OF MARINE AND ESTUARINE FISH IN THE STUDY AREA

		Location						
Common Name	Scientific Name	Cairo	Hickman	Tunica	Vicksburg	Tarbert Landing	Luling	Head of Passes
Bull shark	Carcharhinas leucas	0	0	0	0	0	0	1
Atlantic stingray	Dasyatis sabina	0	0	0	0	0	0	2
Bluntnose stingray	Dasyatis sayi	0	0	0	0	0	1	2
Tarpon	Magalops atlantica	0	0	0	0	0	0	P
Ladyfish	Elops saurus	0	0	0	0	0	2	P
Gafftopsail catfish	Bagre marinus	0	0	0	0	0	1	P
Sea catfish	Galeichthys felis	0	0	0	0	0	0	4
Bay anchovy	Anchod mitchelli	0	0	0	0	0	0	4
Gulf menhaden	Brevoortia patronus	0	0	0	0	0	0	4
Atlantic needlefish	Strogylura marina	0	0	0	0	0	1	4
Gulf pipefish	Syngnathus scovelli	0	0	0	0	0	0	P
Sheepshead minnow	Cyprinodon variegatus	0	0	0	0	0	0	3
Tidewater silverside	Menidia berrylina	0	0	0	0	0	0	4
Gulf killifish	Fundulus grandis	0	0	0	0	0	0	4
Striped mullet	Mugil cephalus	0	0	0	1	2	4	P
White mullet	Mugil curema	0	0	0	0	0	1	P
Gray snapper	Lutjanus griseus	0	0	0	0	0	0	1
Gulf darter	Etheostoma swaini	0	0	0	0	0	0	1
Crevalle jack	Caranx hippos	0	0	0	0	0	1	2
Horse-eye jack	Caranx latus	0	0	0	0	0	1	P
Leatherjacket	Oligoplites saurus	0	0	0	0	0	0	2
Yellowfin majarra	Cerres cinerus	0	0	0	0	0	0	1
Silver perch	Bairdiella chrysura	0	0	0	0	0	0	3
Sand sea trout	Cynoscion arenarius	0	0	0	0	0	0	4
Spotted sea trout	Cynoscion nebulosus	0	0	0	0	0	0	3
Silver sea trout	Cynoscion nothus	0	0	0	0	0	1	P
Gulf kingfish	Menticirrhus littoralis	0	0	0	0	0	0	2
Atlantic croaker	Micropogon undulatus	0	0	0	0	0	1	4
Spot	Leiostomus xanthurus	0	0	0	0	0	1	4

TABLE 9

(CONTINUED)

Common Name	Scientific Name	Location: Cairo	Hickman	Tunica	Vicksburg	Tarbert Landing	Luling	Head of Passes
Black drum	Pogonias cromis	0	0	0	0	0	0	3
Red drum	Sciaenops ocellata	0	0	0	0	0	0	3
Sheepshead	Archosargus probatocephalus	0	0	0	0	0	0	3
Pinfish	Lagodon rhomboides	0	0	0	0	0	0	2
Fat sleeper	Dormitator maculatus	0	0	0	0	0	0	3
Spinycheek sleeper	Eleotris pisonis	0	0	0	0	0	0	3
Lyre goby	Evorthodus lyricus	0	0	0	0	0	0	3
Violet goby	Gobioides brossonnetti	0	0	0	0	0	0	3
Darter goby	Gobionellus boleosoma	0	0	0	0	0	0	P
Sharptail goby	Gobionellus hastatus	0	0	0	0	0	0	3
Freshwater goby	Gobionellus shufeldti	0	0	0	0	0	0	4
Spottail goby	Gobionellus stigmaturus	0	0	0	0	0	0	[illegible]
Naked goby	Gobiosoma bosci	0	0	0	0	0	0	3
Spanish mackerel	Scomberomorus maculatus	0	0	0	0	0	0	1
Bay whiff	Citharichthys spilopterus	0	0	0	0	0	0	3
Southern flounder	Paralichthys lethostigma	0	0	0	0	0	3	4
Lined sole	Achiurus lineatus	0	0	0	0	0	0	2
Hogchoker	Trinectes maculatus	0	0	0	0	0	3	3
Blackcheek tonguefish	Symphurus plagiusa	0	0	0	0	0	0	1

0 - Absent
1 - Rare
2 - Scarce
3 - Common
4 - Abundant
P - Probably occurs, no abundance data available

Source: R.E.T.A. (5) and G.S.R.I. (1)

TABLE 10
A CHECKLIST AND PROBABILITY OF OCCURRENCE OF THE SALAMANDERS IN THE STUDY AREA

Common Name	Scientific Name	Southern Illinois 978EW	Hickman, Kentucky 932EW	Memphis, Tennessee 735EW	Arkansas River 585EW	Vicksburg, Mississippi 437EW	Baton Rouge, Louisiana 203Ew	New Orleans Louisiana 100EW
Spotted salamander	Ambystoma maculatum	H	M	H	a	a	a	O
Marbled salamander	Ambystoma opacum	H	H	H	H	H	H	H
Mole salamander	Ambystoma talpoideum	H	a	H	a	H	H	O
Small-mouthed salamander	Ambystoma texanum	H	H	H	H	H	H	a
Tiger salamander	Ambystoma tigrinum	M	a	M	a	a	a	H[b]
Two-toed amphiuma	Amphiuma means	O	O	O	O	O	O	H
Three-toed amphiuma	Amphiuma tridactylum	O	H	H	H	H	H	H
Hellbender	Cryptobranchus alleganiensis	a	a	O	O	O	O	O
Southern dusky salamander	Desmognathus auriculatus	O	O	O	O	H	H	H
Dusky salamander	Desmognathus fuscus	H[c]	a	O	O	d	d	d
Two-lined salamander	Eurycea bislineata	L	H[e]	O	O	O	O	O
Long-tailed salamander	Eurycea longicauda	H[f]	a	O	O	H[f]	a	O
Cave salamander	Eurycea lucifuga	H[g]	O	O	O	O	O	O
Dwarf salamander	Manculus quadridigitus	O	C	O	O	M	H	H
Gulf Coast waterdog	Necturus beyeri	O	O	O	O	O	a	a
Water dog (mud puppy)	Necturus maculosus	H	H	a	h	O	O	O
Newt (Eft)	Notophthalmus viridescens	H	H	H	H	H	H	H
Zigzag salamander	Plethodon dorsalis	H	H	O	O	O	O	O
Slimy salamander	Plethodon glutinosus	H	H	M	a	M	L	O
Lesser siren	Siren intermedia	H	H	H	H	H	H	H

H = High

M = Medium

L = Low

O = Absent

[a]Unknown probability.

[b]High, but no recent records.

[c]If report of Smith, 1948 valid.

[d]Uncertain because of taxonomic problems involving specius fuscus and auriculatus.

[e]High in vicinity of Reelfoot Lake.

[f]Marginal, not in plain proper.

[g]Peripheral only.

[h]Records for upper river only; not mouth

Source: Gulf South Research Institute

TABLE 11
A CHECKLIST AND PROBABILITY OF OCCURRENCE OF THE FROGS AND TOADS IN THE STUDY AREA

Common Name	Scientific Name	Southern Illinois 978EW	Hickman, Kentucky 932EW	Memphis Tennessee 735EW	Arkansas River 585EW	Vicksburg, Mississippi 437EW	Baton Rouge, Louisiana 203EW	New Orleans Louisiana 100EW
Northern cricket frog	*Acris crepitans*	H	H	H	H	H	H	H
Southern cricket frog	*Acris gryllus*	O	O	L	L	L	L	H[a]
American toad	*Bufo americanus*	H	H	H	H	H	L	O
Oak toad	*Bufo quercicus*	O	O	O	O	O	O	O
Southern toad	*Bufo terrestris*	O	O	O	O	O	b	O
Gulf Coast toad	*Bufo valliceps*	O	O	O	O	O	H	H
Woodhouse's (Fowler's) toad	*Bufo woodhousii*	H	H	H	H	H	H	H
Eastern narrow-mouthed frog	*Gastrophryne carolinensis*	H	H	H	H	H	H	H
Bird-voiced treefrog	*Hyla avivoca*	H	H		H	H	H	b
Cope's gray treefrog	*Hyla chrysoscelis*	b	b	b	b	b	b	b
Green treefrog	*Hyla cinerea*	H	H	H	H	H	H	H
Spring peeper	*Hyla crucifer*	H	H	H	H	H	H	H
Pine woods treefrog	*Hyla femoralis*	O	O	O	O	O	L	O
Barking treefrog	*Hyla gratiosa*	O	O	O	O	O	L	O
Squirrel treefrog	*Hyla squirella*	O	O	O	O	H	H	H
Gray treefrog	*Hyla versicolor*	H	H	H	H	H	H	H
Ornate chorus frog	*Pseudacris ornata*	O	O	O	O	O	L	O
Strecker's chorus frog	*Pseudacris streckeri*	H	M[c]	O	O	O	O	O
Chorus frog	*Pseudacris triseriata*	H	H	H	H	H	H	H
Southern crawfish (Gopher frog)	*Rana areolata*	b	b	b	b	b	O	O
Bullfrog	*Rana catesbeiana*	H	H	H	H	H	H	H
Green (bronze) frog	*Rana clamitans*	H	H	H	H	H	H	H
Pig frog	*Rana grylio*	O	O	O	O	O	H	H
Pickerel frog	*Rana palustris*	H	H	H	M	M	M	O
Leopard frog	*Rana pipiens*	H	H	H	H	H	H	H
Eastern spadefoot	*Scaphiopus holbrooki*	H	H	H	L	b	O	O

H = High

M = Medium

L = Low

O = Absent

[a]Tinkle (1959).

[b]Not recorded as of yet.

[c]Unknown probability.

Source: Gulf South Research Institute (1)

TABLE 12
A CHECKLIST AND PROBABILITY OF OCCURRENCE OF THE CROCODILIANS, TURTLES, AND LIZARDS IN THE STUDY AREA

Common Name	Scientific Name	Southern Illinois 978EW	Hickman, Kentucky 932EW	Memphis, Tennessee 735EW	Arkansas River 585EW	Vicksburg, Mississippi 437EW	Baton Rouge, Louisiana 203EW	New Orleans, Louisiana 100EW
American alligator	Alligator Mississippiensis	O	OO	O	M	H	H	H
Snapping turtle	Chelydra serpentina	H	H	H	H	H	H	H
Mobile cooter or slider	Chrysemys concinna	H	H	H	H	H	H	H
Cooter (Missouri slider)	Chrysemys floridana	H	H	H	H	H	H	H
Painted turtle	Chrysemys picta	H	H	H	H	H	H	H
Pond Slider (red-eared turtle)	Chrysemys scripta	H	H	H	H	H	H	H
Chicken turtle	Deirochclys reticularia	L	M	M	M	H	H	H
Map turtle	Graptemys geographica	H	M	M	O	O	O	O
Mississippi map turtle	Graptemys kohni	H	H	H	H	H	H	H
False map turtle	Graptemys pseudogeographica	H	H	H	O	O	O	O
Mud turtle	Kinostermon subrubrum	H	H	H	H	H	H	H
Alligator snapping turtle	Macrochelys temmincki	H	H	H	H	H	H	H
Diamondback terrapin	Malaclemys terrapin	O	O	O	O	O	O	H
Keel-backed musk turtle	Sternotherus carinatus	O	O	O	H	H	H	H
Stinkpot	Sternotherus odoratus	H	H	H	H	H	H	H
Box turtle	Terrapene carolina	H	H	H	H	H	H	H
Ornate box turtle	Terrapene ornata	O	O	O	O	O	O*	O
Smooth softshell turtle	Trionyx muticus	H	H	H	H	H	H	H
Spiny softshell turtle	Trionyx spinifer	H	H	H	H	H	H	H
Green anole	Anolis carolinensis	O	O	O	H	H	H	H
Six-lined racerunner	Cnemidophorus sexlineatus	H	H	H	H	H	H[a]	a
Coal skink	Eumeces anthracinus	O	O	O	O	O	O	O
Five-lined skink	Eumeces fasciatus	H	H	H	H	H	H	H
Southeastern five-lined skink	Eumeces inexpectatus	O	O	O	b	H[c]	H[c]	H[c]
Broad-headed skink	Eumeces laticeps	H	H[d]	H	H	H	H	H
Mediterranean gecko	Hemidactylus turcicus	O	O	O	O	O	e	H
Slender glass lizard	Ophisaurus attenuatus	O	O	O	O	O	b	f
Eastern glass lizard	Ophisaurus ventralis	O	O	O	O	O	b	H
Eastern fence lizard	Sceloporous undulatus	H	H	H	H	M	L	O
Ground skink	Scincella laterale	H	H	H	H	H	H	H

H = High

M = Medium

L = Low

O = Absent

*Lafayette Parish only.

[a]Very restricted in southern part of alluvial plain.

[b]Unknown probability.

[c]According to range maps available

[d]No actual records according to Barbour and Ernst (1971).

[e]Lafayette; possibly Baton Rouge.

[f]Lafourche Parish Records.

SOURCE: Gulf South Research Institute (1)

TABLE 13
A CHECKLIST AND PROBABILITY OF OCCURRENCE OF THE SNAKES IN THE STUDY AREA

Common Name	Scientific Name	Southern Illinois 978EW	Hickman Kentucky 932EW	Memphis, Tennessee 735EW	Arkansas River 585EW	Vicksburg, Mississippi 437EW	Baton Rouge, Louisiana 203EW	New Orleans, Louisiana 100EW
Copperhead	Agkistrodon contortrix	H	H	H	H	H	H	H
Cottonmouth	Agkistrodon piscivorus	H	H	H	H	H	H	H
Worm snake	Carphophis amoenus	H[a]	H[a]	H	L	H[a]	L	O
Scarlet snake	Cemopnora coccinea	H[b]	H	H	H	H	H	H
Eastern diamondback rattlesnake	Crotalus adamanteus	O	O	O	O	O	L	O
Timber (canebrake) rattlesnake	Crotalus horridus	H	H	H	H	H	H	H
Ringneck snake	Diadophis punctatus	H	H	H	H	H	H	H
Corn snake	Elaphe guttata	O	O	O	O	H	H	H
Rat snake	Elaphe obsoleta	H	H	H	H	H	H	H
Mud snake	Farancia abacura	H	H	H	H	H	H	H
Rainbow snake	Farancia erythrogammus	O	O	O	O	e	e	e
Western hognose snake	Heterodon nasicus	L	M	O	O	O	O	O
Eastern hognose snake	Heterodon platyrhinos	H	H	H	H	H	H	H
Prairie kingsnake (mole snake)	Lampropeltis calligaster	L	L	L	L	L	O	O
Common kingsnake	Lampropeltis getulus	H	H	H	H	H	H	H
Milk snake	Lampropeltis triangulum	H	H	H	H	H	H	H
Coachwhip	Masticophis flagellum	O	O	O	O	L	O	O
Eastern coralsnake	Micrurus fulvius	O	O	O	M	M	M	M
Green watersnake	Natrix cyclopion	H	H	H	H	H	H	H
Plain-bellied watersnake	Natrix erythrogaster	H	H	H	H	H	H	H
Diamond-backed watersnake	Natrix rhombifera	H	H	H	H	H	H	H
Banded watersnake	Natrix fasciata	H	H	H	H	H	H	H
Common watersnake	Natrix sipedon	H	H	H	H	H	L	O
Rough greensnake	Opheodrys aestivus	H	H	H	H	H	H	H
Graham's water snake	Regina grahami	c	H[f]	H[g]	H	H	H	H
Glossy water snake	Regina rigida	O	O	O	O	H	H	H
Queen snake	Regina septemvittata	O	O	O	c	O	O	O
Pigmy rattlesnake	Sistrurus miliarius	O	O	H	H	H	H	H
Brown snake	Storeria dekayi	H	H	H	h	H	H	H
Red-bellied snake	Storeria occipitomaculata	H	M	M	M	M	M	M
Crowned snake	Tantilla coronata	O	O	O	O	e	e	O
Flat-headed snake	Tantilla gracilis	O	O	O	O	O	O	O
Western ribbonsnake	Thamnophis proximus	H	H	H	H	H	H	H
Eastern ribbonsnake	Thamnophis sauritus	c	H	O	O	H[h]	H[h]	O
Common gartersnake	Thamnophis sirtalis	H	H	H	H	H	H	H
Smooth earthsnake	Virginia valeriae	H	H	H	H	H	H	H
Rough earthsnake	Virginia striatula	O	O	O	O	O	O	O

[a]Peripheral.
[b]Known from one specimen only.
[c]Unknown probability.
[d]Parker (1939).
[e]Either low or absent.
[f]Missouri side of river.
[g]Arkansas side of river.
[h]In or near floodplain.

H = High
M = Medium
L = Low
O = Absent

SOURCE: Gulf South Research Institute (1)

TABLE 14
AVIFAUNA OF THE LOWER MISSISSIPPI ALLUVIAL PLAIN *

Common Name**	Scientific Name**	Status**
Common loon	*Gavia immer*	Transient
Red-throated loon	*Gavia stellata*	Accidental
Horned grebe	*Podiceps auritus*	Transient
Eared grebe	*Podiceps cospicus*	Accidental
Least grebe	*Colymbus dominicus*	Accidental
Western grebe	*Aechmophorus occidentalis*	Accidental
Pied-billed grebe	*Podilymbus podiceps*	Permanent resident
White pelican	*Pelecanus erythrorhynchos*	Transient
Brown pelican	*Pelecanus occidentalis*	Permanent resident
Brown booby	*Sula leucogaster*	Accidental
Red-footed booby	*Sula sula*	Accidental
Double-crested cormorant	*Phalacrocorax auritus*	Winter resident
Olivaceous cormorant	*Phalacrocorax olivaceus*	Accidental
Anhinga	*Anhinga anhinga*	Summer resident -south
Magnificient frigatebird	*Fregata magnificens*	Summer resident-coast only
Great blue heron	*Ardea herodias*	Permanent resident
Green heron	*Butorides virescens*	Summer resident
Little blue heron	*Florida caerula*	Summer resident
Cattle egret	*Bubulcus ibis*	Summer resident
Reddish egret	*Dichromanassa rufescens*	Summer resident-coast only
Common egret	*Casmerodius albus*	Summer resident
Snowy egret	*Leucophoyx thula*	Summer resident
Louisiana heron	*Hydranassa tricolor*	Permanent resident -coast only
Black-crowned night heron	*Nycticorax nycticorax*	Permanent resident
Yellow-crowned night heron	*Nyctanassa violacea*	Summer resident
Least bittern	*Ixobrychus exilis*	Summer resident
American bittern	*Botaurus lentiginosus*	Winter resident
Wood ibis	*Mycteria americana*	Summer resident -nonbreeding
Glossy ibis	*Plegadis fulcinellus*	Accidental
White-faced ibis	*Plegadis chihi*	Permanent resident
White ibis	*Eudocimus albus*	Permanent resident
Scarlet ibis	*Guara rubra*	Accidental
Roseate spoonbill	*Ajaia ajaja*	Accidental
Whistling swan	*Olor columbianus*	Accidental
Trumpeter swan	*Olor buccinator*	Accidental

TABLE 14 (Cont)
AVIFAUNA OF THE LOWER MISSISSIPPI ALLUVIAL PLAIN *

Common Name**	Scientific Name**	Status**
Canada goose	Branta canadensis	Winter resident
Brant goose	Branta bernicla	Accidental
White-fronted goose	Anser albifrons	Winter resident
Snow goose (blue goose)	Chen caerulescens	Transient
Fulvous tree duck	Deudrocygny bicolor	Accidental
Mallard	Anas platyrhynchos	Winter resident
Black duck	Anas rubripes	Winter resident
Mottled duck	Anas fulvigula	Permanent resident - coast only
Gadwall	Anas strepera	Winter resident
Pintail	Anas acuta	Winter resident
Green-winged teal	Anas carolinensis	Winter resident
Blue-winged teal	Anas discors	Transient
Cinnamon teal	Anas cyanoptera	Winter resident
Shoveler	Anas clypcata	Winter resident
American widgeon	Mareca americana	Winter resident
Wood duck	Aix sponsa	Permanent resident
Redhead	Aythya americana	Transient
Ring-necked duck	Aythya collaris	Winter resident
Canvasback	Aythya valisineria	Transient
Greater scaup	Aythya marila	Transient
Lesser scaup	Aythya affinis	Winter resident
Common goldeneye	Bucephala clangula	Winter resident
Bufflehead	Bucephala albeola	Winter resident
Oldsquaw	Clangula hycmalis	Winter resident
Harlequin duck	Histrionicus histrionicus	Accidental
Surf scoter	Melaritta perspicillata	Accidental
Common scoter	Oidemia nigra	Accidental
Ruddy duck	Oxyura jamaicensis	Winter resident
Hooded merganser	Lophodytes cucullatus	Permanent resident
Common merganser	Mergas merganser	Winter resident
Red-breasted	Mergas serrator	Winter resident
Turkey vulture	Cathartes aura	Permanent resident
Black vulture	Coragyps atratus	Permanent resident
White-tailed kite	Elanus leucurus	Accidental
Swallow-tailed kite	Elanoides forficatus	Summer resident
Mississippi kite	Ictinia misisippiensis	Summer resident
Sharp-shinned hawk	Accipiter striatus	Permanent resident

TABLE 14 (cont)
AVIFAUNA OF THE LOWER MISSISSIPPI ALLUVIAL PLAIN *

Common Name**	Scientific Name**	Status**
Cooper's hawk	Accipiter cooperii	Permanent resident
Red-tailed hawk	Buteo jamaicensis	Permanent resident
Red-shouldered hawk	Buteo lineatus	Permanent resident
Broad-winged hawk	Buteo platypterus	Summer resident
Rough-legged hawk	Buteo lagopus	Winter resident
Ferruginous hawk	Buteo regalis	Accidental
Harris' hawk	Parabuteo unicinctus	Accidental
Golden eagle	Aquila chrysaetos	Winter resident
Bald eagle	Haliaectus leucocephalus	Winter resident
Marsh hawk	Circus cyancus	Winter resident
Osprey	Pandion haliaetus	Transient
Peregrine falcon	Falco peregrinus	Winter resident
Pigeon hawk	Falco columbarius	Transient
Sparrow hawk	Falco sparrerius	Permanent resident
Ruffed grouse	Benasa umbellus	Permanent resident -north only
Bobwhite	Colinus virginianus	Permanent resident
Ring-necked pheasant	Phasianus colchicus	Accidental
Turkey	Meleagris gallopavo	Permanent resident
King rail	Rallus elegans	Permanent resident
Clapper rail	Rallus longirostris	Permanent resident -coast only
Virginia rail	Rallus limicola	Transient
Sora	Porzana carolina	Transient
Yellow rail	Coturnicops novaboracensis	Transient
Black rail	Laterallus jamaicensis	Transient
Purple gallinule	Porphyrula martinico	Summer resident
Common gallinule	Gallinula chloropus	Summer resident
American coot	Fulica americana	Permanent resident
Semipalmated plover	Charadrius semipalmatus	Transient
Piping plover	Charadrius melodus	Transient
Snowy plover	Charadrius alexandrinus	Winter resident -coast only
Wilson's plover	Charadrius wilsonia	Permanent resident -coast only
Killdeer	Charadrius vociferus	Permanent resident
American golden plover	Pluvialis dominica	Transient
Black-bellied plover	Squatarola squatarola	Transient

TABLE 14 (Cont)
AVIFAUNA OF THE LOWER MISSISSIPPI ALLUVIAL PLAIN *

Common Name**	Scientific Name**	Status**
Ruddy turnstone	*Arenaria interpres*	Transient
American woodcock	*Philohela minor*	Summer resident -north;permanent resident-south
Common snipe	*Capella gallinago*	Winter resident
Eskimo curlew	*Namenius horealis*	Formerly transient
Upland plover	*Bertramia longicande*	Transient
Spotted sandpiper	*Actitis macularia*	Summer resident
Solitary sandpiper	*Tringa solitaria*	Transient
Willet	*Catoptrophorus semipalmatus*	Permanent resident -coast;Transient-elsewhere
Greater yellowlegs	*Totonus melanoleucus*	Transient
Lesser yellowlegs	*Totonus flavipes*	Transient
Knot	*Calidris canutus*	Transient
Pectoral sandpiper	*Erolia melanotos*	Transient
White-rumped sandpiper	*Erolia fuscieollis*	Transient
Baird's sandpiper	*Erolia bairdii*	Transient
Least sandpiper	*Erolia minutilla*	Transient
Dunlin	*Erolia alpina*	Transient
Short-billed dowitcher	*Limnodromus griseus*	Transient
Long-billed dowitcher	*Limnodromus scolopaccus*	Transient
Stilt sandpiper	*Micropalama himantopus*	Transient
Semipalmated sandpiper	*Ereunetes pusillus*	Transient
Western sandpiper	*Ereunetes mauri*	Transient
Buff-breasted sandpiper	*Trynyites subruficollis*	Transient
Marbled godwit	*Limosa fedoa*	Transient
Sanderling	*Crocethia alba*	Transient
American avocet	*Recervirostra americana*	Transient
Black-necked stilt	*Himontopus mexicanus*	Permanent resident
Red phalarope	*Phalaropus fulicerius*	Accidental
Parasitic jaeger	*Stercorarius parasiticus*	Accidental
Glaucous gull	*Larus hyperhoreus*	Accidental
Herring gull	*Larus argentatus*	Winter resident
Ring-billed gull	*Larus delawarensis*	Winter resident -south;Transient -north
Laughing gull	*Larus atricilla*	Permanent resident -coast only

TABLE 14 (Cont)
AVIFAUNA OF THE LOWER MISSISSIPPI ALLUVIAL PLAIN *

Common Name**	Scientific Name**	Status**
Franklin's gull	*Larus pipixcan*	Accidental
Bonaparte's gull	*Larus philadelphia*	Transient
Gull-billed tern	*Gelochelidon nilotica*	Permanent resident -coast only
Forster's tern	*Sterna forsteri*	Transient
Common tern	*Sterna hirundo*	Transient
Sooty tern	*Sterna fuscata*	Summer resident -coast only
Bridled tern	*Sterna anaethetus*	Accidental
Least tern	*Sterna albifrons*	Summer resident
Royal tern	*Thalasseus maximus*	Permanent resident -coast only
Sandwich tern	*Thalasseus sandvicensis*	Permanent resident -coast only
Caspian tern	*Hydroprogne caspia*	Transient-permanent resident on coast
Black tern	*Chlidonias niger*	Transient
Black skimmer	*Rynchops nigra*	Permanent resident -coast only
Ancient murrelet	*Synthliboramphus antiquus*	Accidental
Rock dove	*Colymba ulivia*	Permanent resident
White-winged dove	*Zenaida asiatica*	Permanent resident -coast only
Mourning dove	*Zenaidara macreyra*	Permanent resident
Passenger pigeon	*Ectopistes migraterius*	Extinct
Ground dove	*Columbina passerina*	Permanent resident -southern Louisiana only
Carolina parakeet	*Conuropsis carolinensis*	Extinct
Yellow-billed cuckoo	*Coccyzus americanus*	Summer resident
Black-billed cuckoo	*Coccyzus crythropthalmus*	Transient
Smooth-billed ani	*Crotophaya ani*	Accidental
Groove-billed ani	*Crotophaya sulerestris*	Winter resident
Barn owl	*Tyto alba*	Permanent resident
Screech owl	*Otus asio*	Permanent resident
Flammulated owl		Accidental
Great horned owl	*Bubo virginianus*	Permanent resident
Snowy owl	*Nyctea scandiaca*	Winter resident
Hawk owl	*Surnia ulula*	Accidental?
Burrowing owl	*Speotyto cunicularia*	Winter resident

TABLE 14 (Cont)
AVIFAUNA OF THE LOWER MISSISSIPPI ALLUVIAL PLAIN *

Common Name**	Scientific Name**	Status**
Barred owl	*Strix varia*	Permanent resident
Long-eared owl	*Asio otus*	Winter resident
Short-eared owl	*Asio flammeus*	Winter resident
Saw-whet owl	*Aegolius acadicus*	Winter resident -north
Chuck-will's-widow	*Caprimulgus carolinensis*	Summer resident
Whip-poor-will	*Caprimulgus vociferus*	Summer resident -north; transient -south
Common nighthawk	*Chordeiles minor*	Summer resident
Lesser nighthawk		Accidental
Chimney swift	*Chaetura pelogica*	Summer resident
Vaux's swift	*Chaetura vauxi*	Winter resident -coast
Ruby-throated hummingbird	*Archilochus celubris*	Summer resident
Black-chinned hummingbird		Accidental
Broad-tailed hummingbird		Accidental
Rufous hummingbird	*Selasphorus rufus*	Winter resident -south
Buff-bellied hummingbird		Accidental
Belted kingfisher	*Megaceryle alcyon*	Permanent resident
Yellow-shafted flicker	*Colaptes auratus*	Permanent resident
Red-shafted flicker	*Colaptes cafer*	Winter resident -south
Pileated woodpecker	*Oryacopus pileatus*	Permanent resident
Red-bellied woodpecker	*Centurus carolinus*	Permanent resident
Red-headed woodpecker	*Melanerpes erythrocephalus*	Permanent resident
Yellow-bellied sapsucker	*Sphyrapicus varius*	Winter resident
Hairy woodpecker	*Dendrocopos villosus*	Permanent resident
Downy woodpecker	*Dendrocopos pubescens*	Permanent resident
Red-cockaded woodpecker	*Dendrocopos borealis*	Permanent resident
Ivory-billed woodpecker	*Campephilus principalis*	Permanent resident
Eastern kingbird	*Tyrannus tyrannus*	Summer resident
Gray kingbird	*Tyrannus dominieensis*	Accidental
Western kingbird	*Tyrannus verticalis*	Transient-south
Fork-tailed flycatcher	*Muscivera tyrannus*	Accidental
Scissor-tailed flycatcher	*Muscivera forticata*	Transient
Great crested flycatcher	*Myiarchus crinitus*	Summer resident
Wied's crested flycatcher	*Myiarchus tyrannulus*	Accidental
Ash-throated flycatcher	*Myiarchus cinerascens*	Accidental (winter resident, False River, Baton Rouge, New Orleans, and Venice, Louisiana)

TABLE 14 (Cont)
AVIFAUNA OF THE LOWER MISSISSIPPI ALLUVIAL PLAIN *

Common Name**	Scientific Name**	Status**
Eastern phoebe	*Sayornis phoebe*	Summer resident -north;Winter Resident-north
Say's phoebe	*Sayornis sayo*	Accidental
Yellow-bellied flycatcher	*Empidonax flaviventris*	Transient
Acadian flycatcher	*Empidonax virescens*	Summer resident
Traill's flycatcher	*Empidonax traillii*	Transient
Least flycatcher	*Empidonax minimus*	Transient
Eastern wood pewee	*Contopus virens*	Summer resident
Olive-sided flycatcher	*Nuttallornis borealis*	Transient
Vermilion flycatcher	*Pyroccphalus rubinus*	Winter resident -south
Horned lark	*Eremophila alpestris*	Permanent resident -north; winter resident-south
Tree swallow	*Iridoprocae bicolor*	Transient
Bank swallow	*Riparia riparia*	Summer resident -north; transient -south
Rough-winged swallow	*Stelgidopteryx ruficoilis*	Summer resident
Barn swallow	*Hirundo rustica*	Summer resident -north; transient -south
Cliff swallow	*Petrochelidon pyrrhonota*	Transient
Purple martin	*Progne subis*	Summer resident
Blue jay	*Cyanocitta cristata*	Permanent resident
Common crow	*Corvus brachyrhychos*	Permanent resident
Fish crow	*Corvus ossifragus*	Permanent resident
Carolina chickadee	*Parus carolinensis*	Permanent resident
Tufted titmouse	*Parus bicolor*	Permanent resident
White-breasted nuthatch	*Sitta carolinensis*	Permanent resident
Red-breasted nuthatch	*Sitta canadensis*	Winter resident
Brown-headed nuthatch	*Sitta pusilla*	Permanent resident -south
Brown creeper	*Certhia familiaris*	Winter resident
House wren	*Troglodytes aedon*	Winter resident
Winter wren	*Troglodytes troglodytes*	Winter resident
Bewick's wren	*Thryomanes bewickii*	Permanent resident -north; Winter resident-south

TABLE 14 (Cont)
AVIFAUNA OF THE LOWER MISSISSIPPI ALLUVIAL PLAIN *

Common Name**	Scientific Name**	Status**
Carolina wren	Thryothorus ludovicianus	Permanent resident
Long-billed marsh wren	Telmatodytes palustris	Winter resident -south; transient -north
Short-billed marsh wren	Cistethorus platensis	Summer resident -north; transient -south
Mockingbird	Mimus polyglottos	Permanent resident
Catbird	Pymetella carolinensis	Summer resident -north; winter resident-south
Brown thrasher	Toxostema rufum	Permanent resident
Sage thrasher	Oreoscoptes montanus	Accidental
Robin	Turdus migratorius	Permanent resident
Wood thrush	Hylocichla mustelina	Summer resident
Hermit thrush	Hylocichla gattata	Winter resident
Swainson's thrush	Hylocichla ustulata	Transient
Gray-cheeked thrush	Hylocichla minima	Transient
Veery	Hylocichla fuscescens	Transient
Eastern bluebird	Sialia sialis	Permanent resident
Mountain bluebird	Sialia carrucoides	Accidental
Wheatear	Oenanthe ocnanthe	Accidental
Blue-gray gnatcatcher	Polioptila cacrulea	Summer resident
Golden-crowned kinglet	Regulus sutrapa	Winter resident
Buby-crowned kinglet	Regulus calendula	Winter resident
Water pipit	Anthus spinoletta	Winter resident -south;Transient -north
Sprague's pipit	Anthus spragueii	Winter resident -south; transient -north
Bohemian waxwing	Bombycilla garrulus	Accidental
Cedar waxwing	Bombycilla cedrorum	Winter resident
Loggerhead shrike	Lanius ludoricianus	Permanent resident
Starling	Sturnus vulgaris	Permanent resident
White-eyed vireo	Vireo griscus	Summer resident
Bell's vireo	Vireo bellii	Summer resident -north; transient -south

TABLE 14 (Cont)
AVIFAUNA OF THE LOWER MISSISSIPPI ALLUVIAL PLAIN *

Common Name**	Scientific Name**	Status**
Yellow-throated vireo	*Vireo flavifrons*	Summer resident
Solitary vireo	*Vireo solitarius*	Winter resident -south; transient -north
Red-eyed vireo	*Vireo olivaceus*	Summer resident
Philadelphia vireo	*Vireo philadelphicus*	Transient
Warbling vireo	*Vireo gilvas*	Summer resident
Black-and-white warbler	*Mniotilta varis*	Summer resident
Prothonotary warbler	*Protenotaria citrea*	Summer resident
Swainson's warbler	*Limnothlypis swainsonii*	Summer resident
Work-eating warbler	*Helmitheros vermirerus*	Summer resident -north; transient -south
Golden-winged warbler	*Vermivora chrysoptera*	Transient
Blue-winged warbler	*Vermivora pinus*	Transient
Bachman's warbler	*Vermivora bachmanii*	Summer resident
Tennessee warbler	*Vermivora peregrina*	Transient
Orange-crowned warbler	*Vermivora celata*	Transient
Nashville warbler	*Vermivora ruficapilla*	Transient
Lucy's warbler	*Vermivora luciae*	Accidental
Parula warbler	*Parula americana*	Summer resident
Yellow warbler	*Dendroica petechia*	Summer residenr
Magnolia warbler	*Dendroica magnolia*	Transient
Cape May warbler	*Dendroica tigrina*	Transient
Black-throated blue warbler	*Dendroica caerulescens*	Transient-casual; winter resident Venice;December 1964
Myrtle warbler	*Dendroica ceronata*	Winter resident
Audubon's warbler	*Dendroica auduboni*	Accidental
Black-throated gray warbler	*Dendroica nigrescens*	Accidental
Black-throated green warbler	*Dendroica virens*	Transient
Cerulean warbler	*Dendroica cerulea*	Summer resident-north; transient-south
Blackburnian warbler	*Dendroica fusca*	Transient
Yellow-throated warbler	*Dendroica dominica*	Summer resident
Chestnut-sided warbler	*Dendroica pensylvanica*	Transient

TABLE 14 (Cont)
AVIFAUNA OF THE LOWER MISSISSIPPI ALLUVIAL PLAIN *

Common Name**	Scientific Name**	Status**
Bay-breasted warbler	*Dendroica castanca*	Transient
Blackpoll warbler	*Dendroica striata*	Transient
Pine warbler	*Dendroica pinus*	Summer resident -north; permanent resident-south
Prairie warbler	*Dendroica discolor*	Summer resident
Palm warbler	*Dendroica palmarum*	Transient-north; winter resident-south
Ovenbird	*Sciurus aurocapillus*	Summer resident -north; transient -south
Northern waterthrush	*Sciurus noveboracensis*	Transient
Louisiana waterthrush	*Sciurus motacilla*	Summer resident -north; transient -south
Kentucky warbler	*Oporornis formosus*	Summer resident
Connecticut warbler	*Oporornis agilis*	Transient
Mourning warbler	*Oporornis philadelphia*	Transient
MacGillivray's warbler	*Oporornis tolmici*	Accidental
Yellowthroat	*Gcothlypis trichas*	Summer resident
Yellow-breasted chat	*Icteria virens*	Summer resident
Hooded warbler	*Wilsonia citrina*	Transient
Canada warbler	*Wilsonia canadensis*	Transient
American redstart	*Setophaga ruticilla*	Summer resident
Painted redstart		Accidental
House sparrow	*Passer domesticus*	Permanent resident
Bobolink	*Dolichonyx oryzivorus*	Transient
Eastern meadowlark	*Sturnella magna*	Permanent resident
Western meadowlark	*Sturnella neglecta*	Winter resi
Yellow-headed blackbird	*Xanthocephalus xanthocephalus*	Accidental
Red-winged blackbird	*Agelaius phoeniceus*	Permanent resident
Orchard oriole	*Icterus spurius*	Summer resident
Baltimore oriole	*Icterus galbala*	Summer resident -north; transient -south
Bullock's oriole	*Icterus bullockii*	Winter resident -south
Rusty blackbird	*Euphagus carolinus*	Winter resident
Brewer's blackbird	*Euphagus cyanocephalus*	Winter resident -south

TABLE 14 (Cont)
AVIFAUNA OF THE LOWER MISSISSIPPI ALLUVIAL PLAIN *

Common Name**	Scientific Name**	Status**
Boat-tailed grackle	Cassidix mexicanus	Permanent resident -south
Great-tailed grackle		Permanent resident -south
Common grackle	Quisculus quiscula	Permanent resident
Brown-headed cowbird	Molothrus ater	Permanent resident
Bronzed cowbird		Accidental
Western tanager	Piranga ludoriciana	Accidental
Scarlet tanager	Piranga olivacea	Summer resident -north; transient -south
Summer tanager	Piranga rubra	Summer resident
Cardinal	Richmendeno cardinalis	Permanent resident
Rose-breasted grosbeak	Pheucticus ludovicianus	Transient
Black-headed grosbeak	Pheucticus melanocephalus	Winter resident -south
Blue grosbeak	Guiraca cacrulea	Summer resident -north; transient -south
Indigo bunting	Passerina cyanca	Summer resident
Painted bunting	Passerina ciris	Summer resident
Dickcissel	Spiza americana	Summer resident
Evening grosbeak	Hesperiphonn vespertina	Winter resident
Purple finch	Carpedacus purpureus	Winter resident
Pine grosbeak	Pinicola enucleator	Accidental
Pine siskin	Spinus opinus	Winter resident
American goldfinch	Spinus tristis	Permanent resident -north;Winter resident-south
Red crossbill	Loxia curvirostra	Winter visitant
White-winged crossbill	Loxia leucoptera	Accidental
Green-tailed towhee	Chlorura chlorura	Accidental
Rufous-sided towhee	Pipile erythrophthalmus	Permanent resident
Savannah sparrow	Passerculus sandwinchensis	Winter resident
Grasshopper sparrow	Ammodramus savannaram	Summer resident -north, winter resident-south
Le Conte's sparrow	Passerherbulus caudacutus	Winter resident
Henslow's sparrow	Passerherbulus henslowii	Transient

TABLE 14 (Cont)
AVIFAUNA OF THE LOWER MISSISSIPPI ALLUVIAL PLAIN *

Common Name**	Scientific Name**	Status**
Sharp-tailed sparrow	*Ammospiza caudacuta*	Transient-north; Winter resident--south
Seaside sparrow	*Ammospiza maritima*	Permanent resident -south
Vesper sparrow	*Pooecetes gramineus*	Winter resident
Lark sparrow	*Chondestes grammacus*	Summer resident -north; transient -south
Bachman's sparrow	*Aimophila aestivalis*	Summer resident
Slate-colored junco	*Junco hyemalis*	Winter resident
Oregon junco	*Junco oreganus*	Accidental
Tree sparrow	*Spizella arborea*	Winter resident -north
Chipping sparrow	*Spizella passerina*	Permanent resident
Clay-colored sparrow	*Spizella pallida*	Accidental
Field sparrow	*Spizella pusilla*	Permanent resident
Harris' sparrow	*Zonotrichia querula*	Accidental
White-crowned sparrow	*Zonotrichia leucophrys*	Winter resident
White-throated sparrow	*Zonotrichia albicollis*	Winter resident
Fox sparrow	*Passerella iliaca*	Winter resident
Lincoln's sparrow	*Melospiza lincolnii*	Transient-north; winter resident -south
Swamp sparrow	*Melospiza georgiana*	Winter resident
Song sparrow	*Melospiza melodia*	Winter resident -south; summer resident-north
Lapland longspur	*Calcarius lapponicus*	Winter resident
Smith's longspur	*Calcarius pictus*	Accidental

Permanent resident: A fair number present year-around, not necessarily the same individuals.
Winter resident: Mainly present only in winter months.
Summer resident: Mainly present only in summer months, but not necessarily breeding.
Transient: Move through area only during spring and/or fall migration.
Accidental: Out of normal range.

* Source: modified from GSRI inventory.

** Nomenclature is from A.O.U. checklist of N.A. birds, 5th Ed. 1957, with no attempt to update following the many supplements to that edition.

*** Abbreviated from GSRI inventory.

TABLE 15
A CHECKLIST AND RELATIVE ABUNDANCE OF THE MAMMALS IN THE STUDY AREA

Common Name	Scientific Name	Southern Illinois	Hickman, Kentucky	Memphis, Tennessee	Arkansas River	Vicksburg, Mississippi	Baton Rouge, Louisiana	New Orleans, Louisiana
Opossum	Didelphis virginiana	3	3	3	3	3	3	P
Shorttail shrew	Blarina brevicauda	3	3	3	3	3	P	0
Least shrew	Cryptotia parpa	2	1	2	2	2	1	P
Southeastern longtail shrew	Sarex longirontria	1	1[a]	1[a]	0	0	1	0
Eastern mole	Scalopua aquaticus	3	3	3	3	3	3	0
Little brown myotis	Myotis lucifugus	3	2	0	0	0	0	0
Southeastern myotis	Myotis austroriparius	2	3	0	0	P	P	P
Gray myotis	Myotis grisescens	1	1	0	0	0	0	0
Keen's myotis	Myotis keenii	1	0	0	0	0	0	0
Indiana myotis	Myotis sodalis	2	0	0	0	0	0	0
Least myotis	Myotis leibii	1	1	0	0	0	0	0
Silver-haired bat	Lasionycteris noctivagans	2	1[b]	0	P	P	0	0
Eastern pipistrelle	Pipistrellus subflavus	3	3	3	3	3	P	P
Big brown bat	Eptesicus fuscus	2	2	2	2	2	P	P
Red bat	Lasiurus borealis	3	4	4	4	4	P	P
Seminole bat	Lasiurus seminolus	0	0	0	1	P	P	P
Hoary bat	Lasiurus cinereus	1	1[b]	1	1	P	P	0
Florida (northern) yellow bat	Lasiurus intermedius	0	0	0	0	0	P	P
Evening bat	Nycticeius humeralis	4	2	2	3	3	P	P
Rafinesques big-eared bat	Plecotus rafinesquii	1	1	1	2	P	P	P
Free-tailed bat	Tadarida cynocephala	0	0	0	P	P	P	P
Nine-banded armadillo	Dasypus novemcinctus	0	0	2	3	4	3	2
Eastern cottontail rabbit	Sylvilagus floridanus	3	3	4	4	4	3	P
Swamp rabbit	Sylvilagus aquaticus	2	2	3	3	3	2	P
Woodchuck	Marmota monax	1	3	1	0	0	0	0
Eastern chipmunk	Tamias striatus	1	1	1	1	1	1	0
Gray squirrel	Sciurus carolinensis	2	3	3	3	3	3	1
Fox squirrel	Sciurus niger	3	2	3	4	4	3	1
Southern flying squirrel	Glaucomys volans	2	2	2	2	2	2	P
Plains pocket gopher	Geomys bursarius	0	0	0	1[c]	0	0	0
Beaver	Castor canadensis	2	2	3	3	3	2	0
Eastern harvest mouse	Reithrodontomys humilis	P	2	0	0	0	P	0
Western harvest mouse	Reithrodontomys megalotis	0	0	2[d]	0	0	0	0
Fulvous harvest mouse	Reithrodontomys fulvescens	0	0	0	0	P	P	P
Deer mouse	Peromyscus maniculatus	3	3	2	2	0	0	0
White-footed mouse	Peromyscus leucopus	3	3	3	3	3	P	P
Cotton mouse	Peromyscus gossypinus	1	2	3	3	2	P	P
Golden mouse	Ochrotomys nuttallii	2	2	2	3	3	P	0
Rice rat	Oryzomys palustris	2	3	3	3	3	P	P
Cotton rat	Sigmodon hispidus	0	3	3	4	3	P	P

TABLE 15 (Cont)
A CHECKLIST AND RELATIVE ABUNDANCE OF THE MAMMALS IN THE STUDY AREA

Common Name	Scientific Name	Southern Illinois	Hickman, Kentucky	Memphis, Tennessee	Arkansas River	Vicksburg, Mississippi	Baton Rouge, Louisiana	New Orleans, Louisiana
Eastern woodrat	Neotoma floridana	2	2	2	2	2	P	P
Southern bog lemming	Synaptomys cooperi	1	1	1	1[e]	0	0	0
Prairie vole	Microtus ochrogaster	3	3	3	P	P	0	0
Woodland vole	Microtus pinetorum	3	3	3	3	3	P	0
Muskrat	Onadatra zibethicus	2	3	3	3	3	2	P
Nutria *	Myocaster coypus	0	0	0	2	1	2	P
Norway rat *	Rattus norvegicus	4	3	3	3	3	3	P
Black rat *	Rattus rattus	1	1	1	1	2	1	P
House mouse *	Mus musculus	4	4	4	4	4	4	P
Jumping mouse	Zapus hudsonius	2	f	0	0	0	0	0
Coyote	Canis latrans	2	1	2	2	2	0	0
Red wolf	Canis rufus	1	0	0	0	1	0	0
Red fox	Vulpes fulva	3	3	3	3	3	2	0
Gray fox	Urocyon cinereoargentatus	3	3	3	3	3	2	0
Black bear	Ursus americanus	g	0	0	2[h]	1	0	0
Raccoon	Procyon lotor	3	3	3	4	3	3	3
Long-tailed weasel	Mustela frenata	2	1	2	2	2	2	0
Mink	Mustela vison	3	3	3	3	3	2	P
Otter	Lutra canadensis	1	1	2	2	2	1	P
Spotted skunk	Spilogale putorius	P	1	2	2	1	1	0
Striped skunk	Mephitis mephitis	3	3	3	3	3	3	0
Puma (cougar) (panther)	Felis concolor	0	0	0	1	1	0	0
Bobcat	Lynx rufus	1	2	2	3	2	2	P
White-tailed deer	Odocoileus virginianus	1	2	3	4	4	2	P
Bottle-nosed dolphin	Tarsiops truncatus	0	0	0	0	0	0	P

*Introduced species.

[a]East side of river only.

[b]Present in migration.

[c]Phillips County, Arkansas only.

[d]Crittenden County and Mississippi County, Arkansas only.

[e]Phillips County, Arkansas only.

[f]May occur in Lake County, Tennessee

[g]Rare intruder.

[h]West side of river only.

[p]Probably present--no data available.

0 = Absent
1 = Rare
2 = Scarce
3 = Common
4 = Abundant

SOURCE: Gulf South Research Institute and R.E.T.A.

TABLE 16
CHARACTERISTIC WOODY SPECIES OF LOWER MISSISSIPPI RIVER VALLEY

Common Name	Scientific Name		Braun					Steyermark		Shelford							Hosner &	Mohlenbrock		
		Kuchler	D	M	S	H rank	R	mark	#	B	F	H	O	T	A	Shanks	Minckler	C	P	S
Box elder	Acer negundo		X					X		X		X	X				X			X
Red maple	Acer rubrum				X	2	X	X		X		X	X				X	X	X	X
Drummond's maple	Acer rubrum var. drummondii	X			X			W	2							X		X		
Silver maple, soft maple	Acer saccharinum		X		X			X						X			X			X
Pepper-vine, raccoon grape	Ampelopsis arborea	X						X		X		X	X		X	R				
Pawpaw	Asimina triloba					11	X	X				X								
Rattan vine, supple jack	Berchemia scandens	X						X					X			L				
River birch, red birch	Betula nigra		X					X												X
Buckwheat-vine, Ladies' eardrops	Brunnichia cirrhosa							X		X						X				
Trumpet vine, trumpet creeper	Campsis radicans	X						X		X		X	X							
Hornbeam, blue beech, ironwood	Carpinus caroliniana					13	X	X	2			X		X						
Bitter pecan, water hickory	Carya aquatica	X						W	1			X	X			R	X	O		
Pecan	C. illinoensis	X	X	X	X		X	X		X	X	X				X	?			
Shagbark hickory	C. ovata						X	X									?			
Hackberry (southern), sugarberry	Celtis laevigata	X	X	X		10	X	X		X	X	X	X	X			X	X	X	X
Buttonbush	Cephalanthus occidentalis							W	2								X	X	X	X
Dogwood	Cornus sp.					12		X		X		X								
Ashe haw (hawthorn)	Crataegus ashei							-	O							X				
Parsley haw (hawthorn)	C. marshalli							-	o							X				
Green haw (hawthorn)	C. viridis							X	2							X				
Persimmon	Diospyros virginiana							X			X	X	X			R	X			
Swamp privet	Forestiera acuminata	X						X									X			
Water ash	Fraxinus caroliniana	X			X			-	O											
Pumpkin ash	F. tomentosa [profunda]	X			X			W								X	X	X		
Water locust	Gleditsia aquatica	X						W							X	R		X		
Possumhaw, deciduous holly	Ilex decidua	X						X								X	X			X
Virginia willow	Itea virginica							W	1									X	X	X
Sweetgum, gum, red gum	Liquidambar styraciflua	X				1	D	X		X	X	X	X		?		X			X
Tulip poplar	Liriodendron tulipifera																			
Climbing hempweed	Mikania scandens							V	2											
Tupelo, tupelo gum, water tupelo, swamp tupelo	Nyssa aquatica	D			X	X	X	W							?	R	X	O		
Black gum, sour gum, black tupelo, tupelo	N. sylvatica	X						X			X									
Swamp blackgum	N. sylvatica var. biflora	X						-	O							X				
	Personia borbonia	X						-	O											
Water elm, planer elm	Planera aquatica	X			X			W								R		O		
Sycamore, plane tree, buttonwood	Platanus occidentalis	X		X				X		X	X	X					X			
Cottonwood	Populus deltoides	X	X	X				X		X							X			
Swamp cottonwood	P. heterophylla	X						W					X		X	X	X	X	X	X
Big-tree plum, wild plum	Prunus mexicana							X	1							R				
White oak	Quercus alba						X	X			X			X						X
Southern red oak, Spanish oak	Q. falcata					? 4	X	X			X	X	?							

TABLE 16 (Cont)
CHARACTERISTIC WOODY SPECIES OF LOWER MISSISSIPPI RIVER VALLEY

Common Name	Scientific Name	Kuchler	Braun D	Braun M	Braun S	Braun H rank	Braun R	Steyer-mark		Shelford B	Shelford F	Shelford H	Shelford O	Shelford T	Shelford A	Shanks	Hosner & Minckler	Mohlenbrock C	Mohlenbrock P	Mohlenbrock S
Cherrybark oak	Q. falcata var. pagodaefolia	D						X	2		X	X		X		X	X			
Shingle oak, laurel oak	Q. imbricaria					5	X	X	1		X									
Overcup oak	Q. lyrata	D				6	X	W			X	X	X			X	X			
Swamp chestnut oak, cow oak, basket oak	Q. michauxii	D				3	X	X	2		X	X				X	X			
Water oak	Q. nigra	D						W	1				X			X	X			
Willow oak	Q. phellos					7	X	W					X					O		
Shumard's oak	Q. shumardii	D						X	2		X	X	X	X			X			
Black willow	Salix nigra		X	X				X		X					X		X	X	X	
Sassafras	Sassafras albidum					9	X	X	X											
Star anise	Schisandra glabra							-	O							R				
Laurel leaf greenbrier	Smilax laurifolia							-	O							X				
Storax, snow-bells	Styrax americana							W								R		O		
Bald cypress, cypress	Taxodium distichum	D			X	X	X	W							X	R	X	X		
Climbing dogbane	Trachelospermum difforme							V	2							R				
American elm, elm	Ulmus americana	X				8	X	X	2	X	X	X	X	X			X			
Cedar elm	U. crassifolia							-	O							R				
Possumhaw viburnum	Viburnum nudum							-	O							X				
Grayback grape	Vitis cinerea var. canescens							X								R				
Red grape, wild grape	V. palmata							V								R				
	V. sp.	X								X		X								
Wisteria	Wisteria frutescens var. macrostachya							V												

SOURCE: Compiled by R.E.T.A. (5) from the following:

Key to each section:

Kuchler (regional)
X = present & characteristic of southern floodplain forest
D = dominant

Braun (regional)
X = present
D = disturbed stream margins
M = stream margins
S = swamp forest
H = hardwood bottoms, abundance rank (most = 1)
R = ridgewood bottoms, D = dominant

Steyermark (southeastern Missouri)
W = woody & characteristic of swampy areas
V = vine & characteristic of swampy areas
X = present
# = number of study area counties of occurrence if less than 3
O = absent in Missouri flora
o = absent in study area flora

Shelford (southeastern Missouri and Kentucky)
X = present
B = black willow - cottonwood
F = floodplain oak - hickory
H - hackberry - sweetgum
O = overcup oak - white oak
T = tulip - deer - oak
A = aquatic series

Shanks (Tennessee), 1958
X = present & characteristic of bottomland
R = present, characteristic, & restricted to Mississippi Alluvial Plain, Mississippi Embayment, & counties along the Tennessee River
L = Shelby County (southern-most) is northern limit of Tennessee range

Hosner & Minckler, 1963
X = present in southern Illinois bottomland hardwoods

Mohlenbrock, 1959
X = present in Union County swampy areas
O = present in swamps other than those studied
C = constant inundation
P = part-time inundation
S = seldom inundation

TABLE 17
COMMON AQUATIC VEGETATION

Rooted or Sedentary:	
Pickerelweed	Pontederia cordata
Mud plantain	Heterantheria dubia
Pondweeds	Potomogeton sp.
Water-lilly	Nelumbo lutea
Cow-lilly	Nymphaea advena
Cattail	Typha latifolia
Coontail	Ceratophyllum sp.
Waterweed	Elodea canadensis
Bladderwort	Utricularia biflora
Fanwort	Cabomba caroliniana
Water crowfoot	Ranunculus delphinifolius
Featherfoil	Hottonia inflata
Parrot feather	Myriophyllum brasiliense
Black rush	Juncus roemerianus
Floating:	
Water hyacinth	Eichornia crassipes
	Lemna valdiviana
Duckweed	Lemna minor
	Spirodela polyrhiza
	Azolla caroliniana
	Wolffia columbiana
	Ricciocarpus natans
Alligator weed	Alternanthera philoxeroides
Coastal Marsh:	
Coontail	Ceratophyllum demersum
Saltgrass	Distichlis spicata
Black rush	Juncus roemerianus
Roseau	Phragmites communis
Fresh water three-square	Scirpus americanus
Oystergrass	Spartina alterniflora
Cattail	Typha latifolia

TABLE 18
AQUATIC AND SEMI-AQUATIC BOTTOMLAND MACROPHYTES

Senecio glabellus	Butterweed
Polygonum lapathifolium	Smartweed
Ranunculus pusillus	Bulbed bitter cress
Juncus effusus var. solutus	Rush
Saururus cernuus	Lizard tail
Polygonum punctatum	Smartweed
Echinochloa crusgalli	Barnyard grass
Eleocharis obtusa	Spike rush
Mimulus alatus	Monkey flower
Bochmeria cylindrica	False nettle
Rorippa sessiliflora	Marsh grass
Sagittaria latifolia	Arrowhead
Carex cherokeensis	Sedge
Cyperus erithrorhizos	Sedge
Elephantopus carolinianus	Elephant's foot
Equisetum hyemale	Horsetail
Sabatia angularis	Marsh pink
Onoclea sensibilis	Sensitive fern
Leersia oryzoides	Cut grass
Cypernus pseudovegetus	Sedge
Samolus florabunda	Water pimpernel
Scirpus cyperinus	Sedge
Penthorum sedoides	Ditch stonecrop
Lippia lanceolata	Frog fruit
Eelipta alba	
Gratiola neglecta	Hedge hyssop
Ludwigia palustris	
Hydrolea uniflora	
Tripsacum datyloides	Gama grass
Scutellaria laterifolia	Scullcap
Spermococe glabra	Buttonweed
Polygonum hydropiperoides	Smartweed
Equisetum arvense	Horsetail
Carex grayii	Sedge
Cicuta maculata	Water hemlock
Callitriche heterophylla	Water starwort
Gratiola virginiana	Hedge hyssop
Cardamine pensylvanica	Bittercress
Rorippa islandica var fernaldiana	Yellow cress

SOURCE: Nonconnah Creek Environmental Inventory (14)
GSRI (1)
RETA (5)

TABLE 19
MACRO-INVERTEBRATE BENTHIC FORMS
FROM MAINSTEM MISSISSIPPI AND ADJACENT WATERS

PHYLUM ARTHROPODA

Class Crustacea

Order Isopoda
Family Asellidae
Lirceus louisinae
Family Bopyridae
Probopyrus sp.
Family Asellidae
Lirceus sp.

Order Amphipoda
Family Talitridae
Hyalella azeteca
Family Gammaridae
Gammarus fasciatus

Order Decapoda
Family Palaemonidae
Macrobrachium ohione
Palaemonetes kadiakensis
Family Astacidae
Procambarus clarki
Procambarus blandingi acutus
Procambarus vioscai
Cambarellus schufeldi
Cambarus diogenes diogenes
Orconectes lancifer
Orconectes palmeri palmeri
Orconectes virilis

Class Insecta

Order Collembola
Family Isotomidae
Isotoma sp.
Family Sminthuridae
Sminthurides sp.

Order Ephemeroptera
Family Ephemeridae
Tortopus primus
Oreianthus sp.
Pentagenia vittigera
Hexagenia limbata
Family Heptageniidae
Stenonema frontale
Heptagenia sp.
Rhithrogenia sp.
Family Baetidae
Paraleptophlebia sp.
Tricorythodes sp.
Caenis sp.
Callibactis sp.
Centroptilum sp.
Pseudoelucon sp.
Bactis sp.
Ameletus sp.
Baetisca obesa
Isonychia sp.
Family Caenidae
Caenis sp. (nymphs)

Order Odonata
Family Gomphidae
Ophiogomphus sp.
Gomphus sp.
Dromogomphus spoliatus
Dromogomphus spinosus
Dromogomphus armatus
Progomphus sp.
Gomphus viilosipes
Family Aeschnidae
Boyeria sp.
Coryphaeschna ingens
Aeschna sp.
Epiaeschna heros

Family Libellulidae
- *Dythemis* sp.
- *Libellula* sp.
- *Epicordulia* sp.
- *Somatochlora* sp.
- *Macromia* sp.
- *Neurocordulia* sp.
- *Holocordulia* sp.
- *Pachydiplax longipennis*
- *Plathemis lydia*
- *Tetragoneuria* sp.
- *Perithemis domitia*

Family Agrionidae
- *Agrion* sp.

Family Coenagrionidae
- *Enallagma* sp.
- *Ischnura* sp.
- *Argia* sp.
- *Nehallenia* sp.
- *Lestes* sp.
- *Amphiagrion* sp.

Order Hemiptera

Family Pleidae
- *Plea* sp.

Family Hydrometridae
- *Hydrometra* sp.

Family Mesoveliidae
- *Mesovelia* sp.

Family Gerridae
- *Gerris* sp.
- *Trepobates* sp.
- *Rheumatobates* sp.

Family Notonectidae
- *Notonecta* sp.

Family Naucoridae
- *Pelocoris* sp.

Family Nepidae
- *Ranatra* sp.

Family Belostomatidae
- *Belostoma* sp.
- *Lethocerus* sp.

Family Corixidae
- *Trichorixa* sp.
- *Graptocorixa* sp.

Order Coleoptera

Family Elmidae
- *Macronychus glabratus*
- *Cylloepus* sp.

Family Dytiscidae
- *Hydroporus* sp.
- *Graphoderus* sp.
- *Coptotomus* sp.
- *Cybister* sp.
- *Dytiscus* sp.
- *Laccophilus* sp.

Family Gyrinidae
- *Dineutus* sp.

Family Haliplidae
- *Peltodytes* sp.

Family Hydrophilidae
- *Tropisternus* sp.
- *Laccoblus* sp.
- *Berosus* sp.

Family Dryopidae
- *Dryops* sp.

Family Curculionidae
- unidentified adults

Order Plecoptera

Family Perlodidae
- *Isoperla* sp.

Order Trichoptera

Family Helicopsychidae
- *Helicopsyche* sp.

Family Hydroptilidae
- *Ochrotitchia* sp.

Family Hydropsychidae
- *Hydropsyche orris*
- *Triaenodes* sp.
- *Cheumatopsyche* sp.

Family Psychomyidae
- *Neuroclipsis* sp.
- Unident. psychomviids

Order Megaloptera

Family Sialidae
- *Sialis* sp.

Family Corydalidae
- *Chauloides* sp.
- *Corydalus cornutus*

TABLE 19 (Cont)

Order Diptera
- Family Tipulidae
  - Helius sp. ?
  - Tipula sp.
- Family Culicidae
  - Aedes sp.
  - Chaoborus sp.
  - Anopheles sp.
  - Culex quinquefasciatus
  - Chaoborus punctipennis
  - Machlonyx sp.
- Family Simuliidae
  - Simulium sp.
- Family Chironomidae
  - Demicrytochironomus sp.
  - Tendipes (Cryptochironomus) fulvus
  - Tendipes (C.) Sp. b
  - T. (Dicrotendipes) nemodestus
  - T. (Endochironomus) nigricans
  - T. (Limnochironomus) modestus
  - T. (Tendipes) attenuatus
  - T. (Stichtochironomus) flavicingula
  - Coelotanypus concinnus
  - Coryneura sp.
  - Diamesa sp.
  - Pentapedilum sp.
  - Polypedilum (P.) flavus
  - Metriocnemus sp.
  - Chironomus spp. (larvae and pupae)
  - Spaniotoma sp. (larvae)
  - Cricoptopus spp. (larvae and pupae)
  - Pentaneura monilis
  - Pentaneura sp. (cf. carnea)(pupae)
  - Pentaneura sp. (cf. flavifrons) (pupae)
  - Procladius sp. (cf. culiciformis) (pupae)
  - Tanytarsus sp. (pupa)
  - diamesine pupa
  - unidentified chironomid larvae
- Family Stratiomyiidae
  - Stratiomyia sp.
- Family Tabanidae
  - Chrysops sp.
  - Tabanus sp.
- Family Ceratopogonidae
  - Unidentified ceratopogonid larva

Class Arachnida

Order Acarina
- Unidentified water mites, several species

PHYLUM MOLLUSCA

Class Gastropoda

- Family Physidae
  - Physa sp. (adult)
  - Physa pomilia
- Family Planorbidae
  - Helisoma trivolvis lentum
  - Gyraulus sp.
- Family Lymnaeidae
  - Lymnaea sp.
- Family Ancylidae
  - Ferrisia sp.
- Family Viviparidae
  - Campeloma sp.
  - Viviparus sp.
- Family Pleuroceridae
  - Gonoiobasis sp.
  - Pleurocera sp.
- Family Amnicolidae
  - Somotogyrus sp.

Class Pelecypoda

- Family Sphaeriidae
  - Musculium sp.
  - Sphaerium
  - Eupera sp.
  - Pisidium sp.

TABLE 19 (Cont)

Family Cyrenidae
- *Corbicula leana*
- *Corbicula manilensis*

Family Unionidae
- *Lampsilis anodontoides*
- *Margaritifera hembeli*
- *Fusconia missouriense*
- *Arkansia wheeleri*
- *Ptychobranchus occidentalis*
- *Lampsilis streckeri*
- *Dysonomia florentina curtisi*
- *Dysnomia lefevrei*
- *Toxolasma lividumglans*
- *Fusconaia ebenus*
- *Fusconaia undata*
- *Megalonaias gigantea*
- *Amblema peruviana*
- *Quadruia refulgens*
- *Quadrula pustulosa*
- *Quadrula quadrula*
- *Quadrula nodulata*
- *Quadrula metanevra*
- *Tritogonia verrucosa*
- *Lasmigona complanata*
- *Anodonto corpulenta*
- *Anodonta imbecillis*
- *Obliquaria reflexa*
- *Obovaria divaria*
- *Obovaria olivaria*
- *Truncilla truncata*
- *Truncilla donaciformis*
- *Plagiola lincolata*
- *Leptodea fragilis*
- *Leptodea laevissima*
- *Proptera alata*
- *Ligumia recta latissima*
- *Cyclonaias tuberculata granifera*
- *Plethobasus cyphyus*
- *Arcidens confragosus*
- *Alasmidonta marginata*
- *Actinonaias ellipsiformis*
- *Elliptio crassidens*
- *Pleurobema cordatum coccineum*

NOTE: This list has been compiled from the literature. However, many genera have been inadequately studied and this list should not be taken as a complete fauna.

TABLE 20
PHYTOPLANKTON REPORTED FROM
MAINSTEM MISSISSIPPI AND ADJACENT WATERS

CHLOROPHYTA

Class Chlorophyceae

Order Volvocales
Family Chlamydomonadaceae
<u>Chlamydomonas</u> sp.
Family Phacotaceae
<u>Phacotus</u> sp.
Family Volvocaceae
<u>Volvox</u> sp.
<u>Pandorina</u> sp.
Family Carteridae
<u>Pelytoma</u> sp.
<u>Carteria</u> sp.

Order Tetrasporales
Family Palmellaceae
<u>Sphaerocystis</u> sp.
<u>Gloeocystis</u> sp.
Family Coccomyxaceae
<u>Chlorosarcina</u> sp.
<u>Dactylothece</u> sp.
<u>Nannochloris</u> sp.
<u>Dispora</u> sp.

Order Ulotrichales
Family Microsporaceae
<u>Microspora</u> sp.

Order Chaetophorales
Family Chaetopheraceae
<u>Chaetophora</u> sp.

Order Chloroccales
Family Chlorococcaceae
<u>Chlorococcum</u> sp.
Family Micractiniaceae
<u>Golenkinia</u> sp.
<u>Micractinium</u> sp.
Family Dictyosphaeriaceae
<u>Dictyosphaerium</u> sp.
Family Characiaceae
<u>Schroederia</u> sp.
Family Hydrodictyaceae
<u>Pediastrum</u> sp.
Family Coelastraceae
<u>Coelastrum</u> sp.
Family Oocystaceae
<u>Chlorella</u> sp.
<u>Planktosphaeria</u> sp.
<u>Oocystis</u> sp.
<u>Lagerheimia</u> sp.
<u>Franceia</u> sp.
<u>Ankistrodesmus</u> sp.
<u>Closteriopsis</u> sp.
<u>Selenastrum</u> sp.
<u>Kirchneriella</u> sp.
<u>Quadrigula</u> sp.
<u>Tetraedron</u> sp.
<u>Cerasteria</u> sp.
Family Scenedesmaceae
<u>Scenedesmus</u> spp.
<u>Tetradesmus</u> sp.
<u>Crucigenia</u> spp.
<u>Tetrastrum</u> sp.
<u>Actinastrum</u> spp.
Family Desmidiaceae
<u>Spondylosium</u> sp.
<u>Closterium</u> sp.
<u>Penium</u> sp.
<u>Cosmarium</u> spp.
<u>Hyalotheca</u> sp.
<u>Staurastrum</u> sp.
<u>Pleurotaenium</u> sp.
<u>Spirogyra</u> sp.

CHRYSOPHYTA

Class Xanthophyceae

Order Herterotrichales
Family Tribonemataceae
<u>Tribonema</u> sp.

Order Mischocaccales
Family Sciadaceae
<u>Ophiocytium</u> sp.
<u>Centritractus</u> sp.
<u>Pseudotetraedron</u> sp.

TABLE 20 (Cont)

Class Chrysophyceae

Order Chromulinales
Family Chrysococcaceae
Chrysococcus sp.

Order Ochroinonadales
Family Synuraceae
Mallomonas sp.
Family Dinobyaceae
Dinobyton sp.

Class Bacillariophyceae

Order Centrales
Family Coscinodiscaceae
Melosira spp.
Cyclotella sp.
Stephanodiscus sp.
Coscinodiscus sp.

Order Pennales
Family Tabellariaceae
Tabellaria sp.
Family Meridionaceae
Meridion sp.
Family Fragilariaceae
Fragilaria spp.
Synedra spp.
Asterionella sp.
Diatoma sp.
Family Achnanthaceae
Achnanthes sp.
Coconeis sp.
Family Scenedesmaceae
Scenedesmus spp.
Tetradesmus sp.
Crucigenia spp.
Tetrastrum sp.
Actinastrum spp.

Family Desmidiaceae
Spondylosium sp.
Closterium sp.
Penium sp.
Cosmarium spp.
Hyalotheca sp.
Staurastrum sp.
Pleurotaenium sp.
Spirogyra sp.

CHRYSOPHYTA

Class Xanthophyceae

Order Herterotrichales
Family Tribonemataceae
Tribonema sp.

Order Mischocaccales
Family Sciadaceae
Ophiocytium sp.
Centritractus sp.
Pseudotetraedron sp.

Class Chrysophyceae

Order Chromulinales
Family Chrysococcaceae
Chrysoccocus sp.

Order Ochroinonadales
Family Synuraceae
Mallomonas sp.
Family Dinobyaceae
Dinobyton sp.

Class Bacillariophyceae

Order Centrales
Family Coscinodiscaceae
Melosira spp.
Cyclotella spp.
Stephanodiscus sp.
Coscinodiscus sp.

TABLE 20 (Cont)

Order Pennales
Family Tabellariaceae
Tabellaria sp.
Family Meridionaceae
Meridion sp.
Family Fragilariaceae
Fragilaria spp.
Synedra spp.
Asterionella sp.
Diatoma sp.
Family Achnanthaceae
Achnanthes sp.
Coconeis sp.
Family Naviculaceae
Navicula spp.
Pinnularia sp.
Gyrosigma sp.
Pleurosigma sp.
Family Gomphonemataceae
Gomphonema sp.
Family Cymbellaceae
Cymbella sp.
Family Nitzschiaceae
Hantzschia sp.
Nitzschia spp.
Family Surirellaceae
Surirella sp.

CYANOPHYTA

*Order Chroococcales

Family Chroococcaceae
*Chroococcus sp.
*Aphanocapsa sp.
**Aphanothece sp.
Agmenellum sp.
Gomphosphaeria sp.
*Microcystis sp.
*Anacystis sp.
Family Oscillatoriaceae
Oscillatoria sp.

Order Hormogonales

Family Oscillatoriaceae
Spirulina sp.
Oscillatoria spp.
Phormidium spp.
Lyngbya sp.
Family Nostocaceae
Cylindrospermium
Anabaena spp.
Apnanizomenon sp.
Nostoc sp.

EUGLENOPHYTA

Class Euglenophyceae

Order Euglenales
Family Eugleneaceae
Euglena spp.
Lepocinclis spp.
Phacus spp.
Trachelomonas sp.
Peranema sp.

PYRROPHYTA

Class Dinophyceae

Order Dinokontae
Peridinium sp.

* Presently regarded as Anacystis (APHA, 1971).
** Presently regarded as Coccochloris (APHA, 1971)

NOTE: This list has been compiled from the literature. However, many genera have been inadequately studied and this list should not be taken as a complete flora.

TABLE 21
ZOOPLANKTON REPORTED
FROM MAINSTEM MISSISSIPPI AND ADJACENT WATERS

PHYLUM PORIFERA

Family Spongillidae
Unident. spongillids

PHYLUM COELENTERATE (CNIDARIA)

Class Hydrozoa - Hydroids

Order Hydroida
Family Clavidae
Cordylophora lacustris
Family Hydridae
Hydra americana

PHYLUM PLATYHELMINTHES

Class Turbellaria

Order Tricladida
Family Planariidae
Dugesia tigrina
Unident. planariids

PHYLUM ENTOPROCTA - entoproct "bryozoans"

Family Urnatellidae
Urnatella gracilis
Family Plumatellidae
Plumatella repens
Hyalinella punctata
Family Lophopodidae
Pectinatella magnifica

PHYLUM ANNELIDAE - segmented works

Class Oligochaeta - oligochaetes

Family Naididae
Stylaria lacustris
Unident. naidid (adults)
Family Tubificidae
Limnodrilus cervix
Potamothrix vejdovskyi
Peloscolex multisetosus
Tubifex tubifex
Branchiura sowerbyi
Family Glossoscolecidae
Sparganophilus eiseni
Family Naididae
Dero digitata
Pristina sp.
Family Lumbriculidae
Unident. lumbriculids

Class Hirudinea - leeches

Family Piscicolidae
Lumbriculus sp.
Family Erpobdellidae
Mooreobdella microstoma
Family Hirudidae
Macrobdella ditetra
Philobdella grasile
Haemopts grandis
Family Glossiphoniidae
Placobdella parasitica
Helobdella stagnalis
Placobdella rugoaa
Glossophonia sp.

PHYLUM NEMATA - nematodes
Unident. nematode (adult)

Class Aphasmidia

Order Enoplida
Family Dorylaimidae
Dorylaimus sp.

PHYLUM ROTIFERA

Class Digononta

Order Belloidea
Family Philodinidae
Rotaria sp.
Philodina sp.

Class Monogononta

Family Filiniidae
Filinia sp.
Hexarthra sp.

Order Ploima
Family Notommatidae
Notommata sp.
Family Synchaetidae
Polyarthra sp.
Synchaeta sp.
Family Ploesomatidae
Ploesoma sp.
Family Gastropodidae
Ascomorpha sp.
Family Trichocercidae
Trichocerca sp.
Family Asplanchnidae
Asplanchna sp.
Family Brachionidae
Anuraeopsis sp.
Brachionus sp.
Euchlanis sp.
Kellicottia sp.
Keratella sp.
Nothoica sp.
Family Lecaninae
Lecane sp.
Monostyla sp.

PHYLUM ARTHROPODA

Class Crustacea
Subclass Brachiopoda

Order Cladocera
Family Leptodoridae
Leptodora kindtii
Family Holopedidae
Holopedium amazonicum
Family Sididae
Sida crystallina
Diaphanosoma brachyurum
Latonopsis occidentalis
Family Daphnidae
Daphnia similis
Daphnia pulex
Daphnia parvula
Daphnia laevis
Daphnia sp.
Simocephalus exspinosus
Scapholeberis kingi
Ceriodaphnia reticulata
Moina brachiata
Family Bosminidae
Bosmina longirostris
Family Chydoridae
Eurycercus lamellatus
Family Macrothricidae
Grimaldina brazzai
Ilyocryptus sordidus
Family Chydorinae
Camptocercus sp.

Subclass Ostracoda
Cypridae
Cadona sp.

Subclass Copepoda

Order Calanoida

Family Temoridae
Eurytemora sp.
Family Centropagidae
Osphranticum labronectum
Family diaptomidae
Diaptomus clavipes
Diaptomus clavipoides
Diaptomus louisianensis
Diaptomus sp.

Subclass Branchiura
Family Argulidae
Argulus sp.

TABLE 21 (Cont)

Subclass Malacostraca

Order Mysidacea

Family Mysidae

Taphromysis louisianae

Order Cyclopoida

Family Cyclopidae

Cyclops vernalis

Cyclops bicuspidatus

Cyclops varicans rubellus

Mesocyclops edax

Macrocyclops albidus

NOTE: This list has been compiled from the literature. However, many genera have been inadequately studied and this list should not be taken as a complete fauna.

TABLE 22
THREATENED OR ENDANGERED WILDLIFE POSSIBLY
IN THE OBION-FORKED DEER RIVERS BASIN OF TENNESSEE

Common Name	Scientific Name	Status
Fish		
none	--	--
Amphibians		
none	--	--
Birds		
Southern bald eagle	Haliaeetus leucocephalus	E
White pelican	Pelecanus erythrorhynchos	BL
Double-crested cormorant	Plalacrocorax auritus	BL
Yellow-crowned night heron	Nyctanassas violacea	BL
Turkey vulture	Cathartes aura	BL
Black vulture	Coragyps atratus	BL
Sharp-skinned hawk	Accipiter striatus	BL
Cooper's hawk	Accipter cooperii	BL
Red-shouldered hawk	Buteo lineatus	BL
Marsh hawk	Circus cyaneus	BL
Least tern	Sterna albinfrons	BL
Barn owl	Tyto alba	BL
Red-headed woodpecker	Melanerpes erythrocephalus	BL
Berwick's wren	Thryomanes berwickii	BL
Eastern bluebird	Sialia sialis	BL
Loggerhead shrike	Lanius ludovicianus	BL
Mammals		
Indiana bat	Myotis sodalis	E

E = On the official "United States List of Endangered Fauna," May 1974.

BL = Blue listed by the National Audubon Society.

Source: MRI, 1973.

APPENDIX D*

SOCIAL/CULTURAL DETAILS

* The National Registry of Natural Landmarks has been consulted in the compilation of this list; no sites listed lie within the project area.

HISTORICAL SITES IN THE PROJECT AREA

Missouri

Norfolk - mile 949.0

At the beginning of the War Between the States, Norfolk was the northernmost Confederate post on the Mississippi River. It was set up as a tax collecting station, apparently during the brief period when there was some hope that war could be averted. Before the War, Norfolk did not amount to much more than a woodyard and a warehouse, and its Confederate government function did not last long, due to the Federal blockade at Cairo and to the early conquest of that part of the river by Union troops. While it functioned, however, all ships going down river were required to stop at Norfolk (Gould, 1889;144).

Belmont - mile 938

Belmont was the site of one of General Grant's first Civil War engagements, in which an amphibious Union force attacked the Confederate encampment there on November 7, 1861. After the War, a small town grew up at Belmont around the river terminus of the St. Louis, Illinois, Missouri and Southwestern Railroad. Apparently the town was totally dependent on the railroad for its livelihood, for it disappeared shortly after the line was abandoned.

Island #10 - mile 901

This was the site of an important Civil War battle fought in April, 1862, which left several boat wrecks in its wake. See also steamboat site list.

New Madrid - mile 889

In 1783 two Canadian fur traders established a trading post on the present site of New Madrid, called by the Americans across the river Greasy Cave or Fertile Bend. A town was later laid out by a Revolutionary War officer named Morgan, who hoped to interest Spain, which controlled the territory, in establishing a buffer colony. The plan was not successful, but the town held on, and became an important center after the Louisiana purchase transferred the territory around it to the United States. The town's development was largely halted, however, by the great earthquake which centered there in the winter of 1811-1812, and growth did not really begin again until after the Civil War (Carter, 1942). See also steamboat site list.

Kentucky

Fort Jefferson - mile 950
This was the site of a short-lived stockade built by George Rogers Clark in 1782 and abandoned in 1784. The exact location of the outpost is now known, and might yet be discovered.

Iron Banks - mile 938
The Iron Banks, bluffs which got their name from their unusual color, were an important navigational landmark during the steamboat era.

Columbus - mile 937
Columbus was the site of major Confederate river defenses, including a huge iron chain across the Mississippi, during the Civil War. It was these defenses which led to Grant's defeat in his attack on Belmont across the river. See also steamboat site list.

Chalk Bluff - mile 934
Chalk Bluff was another important nineteenth century navigational landmark.

Tennessee

Confederate Batteries - mile 902
The batteries near mile 902 were Confederate bases for the defense of the river. They controlled the Mississippi until the Battle of Island #10, April, 1862.

Plum Point - mile 786
LaSalle is believed to have camped on Plum Point in 1682, and the area may have been the site of his Fort Prudhomme. An important naval engagement was fought here during the Civil War. See also steamboat site list.

Fort Pillow - mile 780
Fort Pillow was an important Confederate defensive position during the battle of Plum Point Bend, May, 1862. The fort was finally captured by the Union in June 1862, and recaptured by Confederate forces in April, 1864. It was abandoned shortly thereafter. The battle site is being restored by the Tennessee Department of Conservation as a state park. See also steamboat site list.

Fulton - mile 778
Fulton was an early river town established in 1827. Its importance faded in the late 1830's. Hopes for revival as a railroad terminus were never realized. The town site is now an open field.

Randolph - mile 771

Randolph was established in 1828, and as late as 1837 it was larger than Memphis and had great hopes as a commercial center. Plans for Randolph were finally crushed when Memphis became the terminus of the Memphis and Charleston Railroad. Most of the town was on top of the bluff, but there was some development along the river front, where traces of streets can still be seen. See also steamboat site list.

Fort Harris and Fort Wright - mile 736

These forts were minor earthwork fortifications built during the Civil War for the defense of Memphis. Both were bandoned in June 1862, and their exact locations are not known.

Memphis Steamboat Landing - mile 736

The main landing during the years of heavy steamboat traffic in the mid-nineteenth century is still in use by pleasure craft. See also steamboat site list.

Fort Pickering and the Confederate Naval Yard - mile 734

The Fort and the Naval Yard once stood under what is now the approach to the Memphis-Arkansas bridge.

Arkansas

Tomato - mile 806

Tomato possesses one of the smallest post offices in the United States, and the establishment is considered an historic site by the State of Arkansas (mis 24). The post office was originally a smokehouse belonging to a Mr. Jones. When Mr. Jones' house burned down, he moved into the post office, and the post office moved into the smokehouse. The entire community is outside the levee system.

Pecan Point - mile 762

Pecan Point had one of the first post offices in Mississippi County, the other being Plum Point (modern Osceola). The oldest boat landing in the county was also located there, as well as a large archaeological dig conducted during the nineteenth century by the Smithsonian Institution. The archaeological site and much of the town have since disappeared into the river.

Hopefield - mile 737

Hopefield was a nineteenth century town built on the site of an early Spanish outpost called Cantonment Esperanza. Hopefield was a stop on the Memphis to Little Rock railroad line, and the railroad facilities were used as an armory during the Civil War. Hopefield never really recovered after being burned by Union forces in 1863. Nothing remains of the town above ground today, and most of the remains are probably under the Interstate 40 bridge to Memphis.

Utica - mile 672

Utica was a very early Arkansas settlement, a boom town in 1817, when many people were attracted to the area after the New Madrid earthquake of 1811-1812. It was laid out as a town at the mouth of the St. Francis River, but disappeared, presumably into the water, in 1820 or 1821. See also steamboat site list.

Helena - mile 663

Helena became the Phillips County seat in 1820, although the town did not really begin to grow until the 1850's. The area may have been the site of a large Indian village visited by DeSoto, but this has not been substantiated archaeologically. See also steamboat site list.

Montgomery Point - mile 598

Located at the mouth of the White River, this was a steamboat port where freight and passengers for central Arkansas were transferred.

Napoleon - mile 582

Napoleon was quite a notorious river port during the mid-nineteenth century. Founded in about 1830, it slide into the river by 1882. During its heyday it was a haven for gamblers and other wicked souls, as well as the site of a United States Marine Hospital established to care for the victims of steamboat accidents. The ruins of Napoleon were accessible during the drought in 1954. See also steamboat site list.

Arkansas City - mile 554

Arkansas City was once the major steamboat landing between Memphis and Vicksburg, and was the site of the first telegraph connection across the river. It became an important rail connection, but gradually lost its commercial importance during the twentieth century. Located outside the levee is an old lumber mill and the first cotton mill built west of the Mississippi, both considered historical sites by the State of Arkansas (De 28, De 30). See also steamboat site list.

Point Chicot - mile 544

Point Chicot, cutoff by the river in the 1930's, was the site of an early settlement called Villemont, after the former commandant of Arkansas Post, who owned the land. It became the county seat and a bustling little river port, but it slipped into the Mississippi in 1847.

Mississippi

Commerce - mile 698

Commerce was the oldest town in Tunica County, and the first county seat, but in spite of having the first levees in the area, most of the town was washed into the river in 1841 (Federal Writers Project, 1938). Commerce was one of several possible sites for DeSoto's historic crossing of the Mississippi. See also steamboat site list.

Mhoon - mile 688

Mhoon Landing was established in 1859, and was one of the last landings in use in the area, serving as Red Cross headquarters during the disastrous flood of 1927.

Austin - mile 674

Austin was an important shipping point and county seat prior to the Civil War. It was burned by Union troops in 1863, lost its standing as county seat in 1868, was cut off by the river in 1884, and was finally bypassed by the railroad. See also steamboat site list.

Delta - mile 655

Delta became county seat in 1842. The town was forced to move to escape the encroachment of the river, and much of the original town went into the river in 1890 (W.P.A., n.d.).

Friars Point - mile 651

Friars Point, named for an early settler in the area and founded in the 1830's, succeeded Delta as Coahoma County seat. It is the only river town in the area of its age which has not been eaten away by the Mississippi (Federal Writers Project, 1938).

Port Royal - mile 648

Port Royal was Coahoma County's first seat, settled in 1820. It was cut off from the river in 1848 and was eventually abandoned. Several plantations in the immediate area also had to be abandoned after the cut off (W.P.A., n.d.).

Sunflower Landing - mile 627

Sunflower Landing, now located on DeSoto Lake, was settled in 1838, and was the terminus of a trail known as Charlie's Trace. It is one of the most widely accepted locations for DeSoto's crossing of the Mississippi (W.P.A., n.d.).

Pushmataha Landing - mile 625

This landing is also now on DeSoto Lake. It was a plantation landing which had to be moved due to changes in the river.

Rosedale - mile 589

The Rosedale area was originally called Able's Point, and was the site of an early plantation. The landing had to be moved several times because of the formation of sand bars. Under the name Floreyville, it served as a nineteenth century county seat.

Riverton - 585

Riverton was settled in 1848, and boasted an unusual communication link: a mule-powered railway to Bogue Phalia. The town was abandoned in the 1880's because of caving banks, and its remains are outside the present levee system (W.P.A., n.d.).

Prentiss - mile 583

Prentiss, located on Indian Point, was founded in 1856 and intended as a county seat. It was burned, however, by Federal troops in 1863, and the ruins disappeared into the river a few years later. The Indian Point area was settled as early as 1819 and was a crossing point during the gold rush. Several plantations on the Point had to be abandoned after a levee break in 1865 (W.P.A., n.d.).

Carter Point - mile 542

Carter Point, cut off in the 1930's, was the site of several plantations, including Woodstock, Salona, and Tarpley. Buildings belonging to these plantations were reported standing well into the present century (Federal Writers Project, 1938).

Greenville - mile 541

The town of Greenville is now in its third location. The first, five miles south of the present city, slipped into the river prior to the Civil War. The second, about one mile north of the first, was heavily damaged by Union shelling in 1863. Even part of the present town was destroyed by the river during the flood of 1927. See also steamboat site list.

Longwood - mile 520

The town of Longwood is named for a plantation house nearby which has been moved twice to save it from the river. Also in danger from the river is the county's oldest cemetery, located three miles north of Longwood.

Princeton and New Mexico - mile 510

These two early county seats have disappeared into the river. The first, New Mexico, held the position from 1827 to 1830. It appeared on maps as late as 1840, but Princeton, slightly to the south, became county seat in 1830. Princeton was abandoned in 1846. See also steamboat site list.

Duncansby - mile 500

Established in 1833, Duncansby was destroyed by the river in the late nineteenth century.

Shiloh Landing - mile 473

Shiloh Landing was established in 1837 and was once an important cotton shipping point. It has gone into the river (W.P.A., n.d.).

Vicksburg - mile 437

Vicksburg, like Natchez, sits high on the bluff line (the English settlers named it Walnut Hill, and it began as a small Spanish outpost in 1790), and like Natchez its seamier side was largely concentrated at the foot of the bluffs, where archaeological work might prove fruitful. The Vicksburg harbor area was cut off from the river after the Civil War (a delayed result of one of Grant's canal schemes), but through rechannellization of the Yazoo, Vicksburg has retained its connection with the Mississippi. See also steamboat site list.

Warrenton - mile 430

Prior to 1836 Warrenton was the seat of Warren County, but it was cut off from the river in the 1840's and never regained its former prominence (Rowland, 1907).

Palmyra - mile 424

Palmyra, a settlement on the island of the same name (Island #106), was established about 1800 by immigrants from New England (Rowland, 1907). This island was also the site of Jefferson Davis' plantation, Brierfield, built in 1847. See also steamboat site list.

Grand Gulf - mile 405

Grand Gulf was settled by the British before the Revolutionary War, and although the town had to be moved back from the river twice, it became an important shipping point. Three serious fires swept through the town, the last set by Federal troops during the Civil War, and then the river swung away from the landing. Finally, the railroad to Port Gibson was discontinued and removed (Lowry and McCardle, 1891). Grand Gulf was a supply base for Grant's campaign against Vicksburg, and no doubt there are archaeological remains in the area dating from colonial times through the Civil War. See also steamboat site list.

Bruinsburg and Bayou Pierre - mile 397

Bruinsburg plantation was built in 1796 by a Revolutionary War officer. The town which grew nearby, in which Andrew Jackson once ran a trading post, declined after the Civil War. Bayou Pierre was an important route for flatboat commerce.

Rodney - mile 389

Rodney was the chief shipping point for its area, and was settled as early as 1772. The original name of the town was Petit Gulf, and the new species of Mexican cotton introduced into the area in 1806, which gave a tremendous boost to the cotton industry, was named for it (Federal Writers Project, 1938). Disastrous fires in 1852 and 1969 and a shift in the river in 1864 decreased Rodney's importance considerably (Rowland, 1907). See also steamboat site list.

Natchez - mile 364

There were French land grants in the Natchez area as early as 1702, and a fort in 1716. Its growth continued steadily through the Spanish, English, and American periods. From an archaeological and historical point of view, the area at the foot of the bluff, called Natchez-under-the-Hill, would be of great interest. This was the section devoted to flatboats, gambling, brothels, taverns, and general lawlessness. It was effectively destroyed by a tornado in May, 1840. See also steamboat site list.

Hutchins Landing - mile 347

Hutchins Landing, originally called Second Creek, was settled by British Loyalists prior to the American Revolution. It may have been the site of the White Apple Village of the Natchez Indians, the bone of contention which touched off the Natchez War of 1729 (W.P.A., n.d.).

Fort Adams - mile 312

Fort Adams was established in 1797 or 1798, and was intended to be the terminus of the Natchez Trace. The site had been known previously as Davion's Bluff, after the French priest who founded a mission there in 1698. See also steamboat site list.

Louisiana

Bunch's Bend - mile 504

Bunch's Bend was a notorious river pirate hangout in the early nineteenth century, and was named for the outlaw captain who controlled it.

Stack Island - mile 488

At first a haven for river travelers, Stack Island also became notorious for piracy.

Yucatan Point - mile 410

At least one plantation has been abandoned outside the levee system on Yucatan Point.

Winter Quarters - mile 400

Winter Quarters was an area of Confederate billets which has been largely destroyed by levee construction.

St. Joseph - mile 396

Part of the older section of St. Joseph has been abandoned outside the levee system. See also steamboat site list.

Hedgeland - mile 382

The older section of Hedgeland has been abandoned outside the levee system.

Waterproof - mile 381

The town of Waterproof has been forced to move away from the river four times by caving banks. There may well be early material from the old town remaining outside the levee. See also steamboat site list.

Vidalia - mile 363

The first settlement at Vidalia was a Spanish fort called Concord Post, built as a defense against the English Fort Rosalie across the river at Natchez. There was a ferry at Vidalia as early as 1797, serving the road from Natchez to Natchitoches. Six blocks of the old town had to be abandoned outside the levee in 1933 (Hansen, 1971). Also outside the levee are Waverly Plantation, above Vidalia, and an old shanty boat town below the city.

St. Catherine Towhead - mile 352

There were several old plantations in this area which are now outside the levee system.

Bayou Sara - mile 266

Bayou Sara, now largely washed away or absorbed by its neighboring town of St. Francisville, was a very important nineteenth century shipping point and steamboat landing. There was also a shortlived French fort, Fort St. Reine, at this site (Hansen, 1971). See also steamboat site list.

Port Hudson - mile 256

Port Hudson is the best remembered of four river ports which rose and fell at the mouth of Thompson's Creek, depending on the whims of the Mississippi. The towns were called Thompson's Creek (1765-1832), Port Hudson (1832-1862), Alto (1863-1880), and Port Hickey (1880-1905). Port Hudson is famous as an important Civil War battle site. See also steamboat site list.

St. Michel - mile 230

St. Michel was the original seat of West Baton Rouge Parish, located east of the modern town of Port Allen. It has long since disappeared into the river.

Fort Bute - mile 215

Fort Bute was built in 1765 by the British at the mouth of Bayou Manchac. It marked the boundary between British West Florida and Spanish Louisiana.

Plaquemine Lock - mile 209 1/

Bayou Goula - mile 196

Bayou Goula began as a French concession in 1718. It was an important steamboat landing and built an early levee system. See also steamboat site list.

White Castle - mile 194

White Castle plantation has been gradually eaten away by the river. The house has been moved back four times, leaving sections behind each time.

Uncle Sam Plantation - mile 160

Uncle Sam was a complete working plantation from its building in 1841 until its destruction by levee construction in 1941. It was one of the last such complete plantations left in the state (Hansen, 1971). Parts of the old plantation outside the levee may still be accessible to archaeological investigation.

Edgaard - mile 138

Edgaard is an old settlement on what is still referred to as the German Coast, and a former steamboat landing. Cultural material may exist outside the levee, as most of the town has been forced to move back by the encroachment of the river.

Fort St. Leon - mile 79

Fort St. Leon was built by the Spanish and later occupied by the French, British, and Americans at various times. It is accessible only at low water.

Fort St. Philip - mile 20 1/

Fort St. Philip was built in 1795 by the Spanish on the site of an earlier French outpost, and was not abandoned until 1923. It was an unsuccessful defender of New Orleans in 1862, when Farragut attacked the city from the river. See also steamboat site list.

Fort Jackson - mile 20 1/

Fort Jackson was built in 1815 by the Americans as a companion fort to St. Philip across the river, and was enlarged by the Confederate Army in 1861. It was abandoned as a military base in 1920, and a levee was later built through it. Today it is a national historic monument (Hansen, 1971). See also steamboat site list.

1/ Listed on National Register of Historic Places.

STEAMBOAT WRECK EVENTS IN THE PROJECT AREA

Boat	Date	Cause	Dead	Tons	Built
Cairo, Ill. - mile 954.5					
Columbus	11 11 1828	snagged	0	450	1819
Neptune	10 30 1830	snagged	0	180	1828
Lafayette	8 30 1833	burned	0	84	1833
La Fourche	9 29 1833	stranded	0	186	1930
Napoleon	3 2 1834	snagged	0	167	1831
Louisiana	7 4 1837	snagged	0	306	1830
Knickerbocker	12 11 1839	snagged	0	169	1838
Tchula	8 24 1841	snagged	0	203	1840
Iatan	1844	stranded	0	172	1840
Star of the West	1 17 1844	collided	3	122	1842
Edwin Hickman	10 13 1844	burned	0	328	1842
White Rose	7 24 1848	burned	0	194	1847
Boston (below Cairo)	1 9 1850	ice	0	163	1849
Shelby (below Cairo)	10 1 1852	foundered	0	225	1850
Farmer	9 19 1853	snagged	3	198	1848
Pacific	11 23 1854	snagged	0	572	1850
Grand Tower	11 25 1854	stranded	0	569	1853
Chancellor	12 7 1854	snagged	0	372	1850
New Orleans	1 28 1855	stranded	0	299	1848
Glendy Burke (Bird Island)	5 24 1855	snagged	0	425	1851
White Bluff	3 27 1857	collided with George Albree	0	142	1856
C.Bealer (Carroll Island)	3 7 1858	snagged	0	262	1854
Martha Jewett	1 3 1858	burned	0	408	1852
Martha Putnam	12 29 1959	burned	0	225	1857
Oakland	12 29 1859	burned	0	141	1853
B.W. Lewis	6 24 1860	exploded	40	472	1858
Ellen Gray	11 5 1860	collided with Arkansas	0	118	1859
John Gault	3 15 1862	foundered	0	198	1857
U.S.S. Glide	2 7 1863	burned			
Grey Fox	9 1863	snagged	0	70	1857
Dan Pollard	8 3 1864	snagged	0	77	1857
Fannie Fisk	7 16 1865	burned	0	97	1856
Paragon (Devils Island)	2 28 1868	snagged	0	495	1863
David Watts	1870	unknown	0	293	1865

Boat	Date	Cause	Dead	Tons	Built
Norfolk, Mo. - mile 949.0					
Ruth	8 1863	burned (apparently by Confederate sympathizers)	35		
Columbus, Ky. - mile 937.2					
Admiral	4 5 1862	burned	0	244	1853
Henry Choteau	9 26 1863	burned	0	623	1853
Odd Fellow	1 1 1865	ice	0	70	1862
Island #5, Ky. - mile 933.0 (Wolf Island)					
Empire	1 6 1869	collided	0	70	1864
Hickman, Ky. - mile 922.0					
Prince	2 27 1862	snagged	74	223	1859
Island #8, Ky. - mile 914.0					
Commodore Perry	4 1950	stranded	0	293	1846
Island #10, Mo. - mile 901.0					
H. D. Bacon	2 18 1855	stranded	0	576	1851
Fred Tron	10 22 1860	snagged	0	278	1856
John Simmonds	4 6 1862	foundered (battle)	0	1024	1852
Kanawha Valley No. 2	4 6 1862	burned (battle)	0	147	1860
Winchester	4 7 1862	foundered (battle)	0	180	1851
Mohawk	4 7 1862	snagged (battle)	0	100	1860
Yazoo	4 7 1862	foundered (battle)	0	371	1860
C.S.S. Grampus	4 7 1862	sunk in battle			
James White	11 5 1864	snagged	18	662	1864
New Madrid, Mo. - mile 888.8					
St. Louis	12 28 1820	burned	0	199	1819
General Robertson	4 17 1823	snagged	0	237	1819
Caldonia	4 21 1833	snagged	0	371	1824
Samson	6 28 1836	burned	0	198	1832
Talma	1848	snagged	0	306	1843
General Scott	5 13 1853	burned	0	293	1847
Dresden	2 15 1855	snagged	0	548	1852
Colonel Grossman	2 4 1858	exploded	14	415	1857
Michigan	12 9 1859	exploded	2	482	1853
John J. Roe	9 12 1864	snagged	0	691	1856
Brilliant	10 16 1865	burned	0	440	1863

Boat	Date	Cause	Dead	Tons	Built
Island #14, Mo. - mile 858.5					
John Perry	8 4 1842	snagged	0	395	1842
Caruthersville, Mo. - mile 846.0					
Coosa	5 14 1831	collided with Huntress	13	173	1826
Orb	5 9 1860	snagged	0	226	1854
Island #16, Mo. - mile 840.5					
Linwood	3 19 1847	snagged	0	316	1843
Alfred T. Lacy	4 26 1860	burned	16	670	1857
Island #18, Mo. - mile 834.5					
Colonel Dickinson	9 13 1853	snagged	0	198	1850
Pawnee	10 8 1853	stranded	0	477	1950
Ben Stickney	11 16 1865	snagged	0	889	1864
Island #21, Tenn. - mile 825.0					
H. D. Newcomb	10 25 1858	snagged	0	549	1856
Island #25, Ark. - mile 801.5					
Caspian	12 11 1845	snagged	0	318	1842
Belle Gould	3 3 1854	snagged	0	207	1852
Island #26, Tenn. - mile 798.0					
Mary E. Poe	10 17 1873	burned		296	1871
Osceola, Ark. - mile 786.0					
Telegraph No. 3	11 25 1863	exploded	3	747	1853
Virginia	10 7 1871	snagged	0	890	1865
Plum Point, Tenn. - mile 786.0					
America	11 12 1827	snagged	0	263	1827
President	2 7 1829	stranded	0	288	1824
New York	1 1832	snagged	0	298	1827
Caroline	8 6 1841	snagged	37	407	1841
Neptune	12 12 1845	snagged	0	227	1841
Tom Corwin	10 9 1846	stranded	0	194	1846

Boat	Date	Cause	Dead	Tons	Built
Plum Point, Tenn.- mile 786.0 (cont)					
Magic	10 26 1846	snagged	0	122	1845
Eliza	1 25 1855	snagged	0	349	1852
Eugene	11 1 1862	snagged	15	298	1860
Belle Creole	2 1 1864	snagged	1	205	1856
Universe	10 30 1864	snagged	17	399	1857
Saint Cloud	1 24 1867	snagged	0	291	1859
Yankee	11 28 1867	snagged	0	205	1857
Island #31, Tenn. - mile 784.0					
Smithland	11 1 1841	snagged	0	234	1839
Island #33, Tenn. - mile 781.5		(Flour Island)			
Banner of Attakapas	6 10 1852	snagged	0	208	1848
Fort Pillow, Tenn. - mile 779.5					
Garden Grant	6 5 1862	burned	0	40	1855
Island #34, Tenn. - mile 774.0					
Queen of the South	8 3 1842	snagged	0	208	1841
Fanny McBurney	12 6 1863	stranded	0	207	1860
Empress	10 28 1864	snagged	0	854	1861
Celeste	12 24 1872	ice	0	292	1865
Randolph, Tenn. - mile 771.0					
Henry Clay	1843	snagged	0	310	1841
Niagara	1 1956	stranded	0	213	1847
Island #35, Tenn. - mile 764.5					
Superior	2 21 1866	stranded	0	417	1856
Vulcan	7 19 1866	snagged	0	179	1858
Emma No. 3	2 19 1870	burned	40	495	1866
Silver Spray	8 1 1870	exploded	21	406	1864
Island #37, Tenn. - mile 760.0					
Empire	8 15 1856	snagged	0	152	1854
Rattler	12 13 1866	snagged	0	33	1863

Boat	Date	Cause	Dead	Tons	Built
Island #39, Ark.-Tenn. - mile 750.0					
Jennie Sutton	3 6 1870	collided with Gallatin	0	10	1865
Island #40, Tenn. - mile 746.0		(Beef Island)			
James Raymond	4 24 1866	exploded	1	274	1853
W. P. Arthur	1 6 1871	exploded	45	763	1864
Fannie Brandeis	12 8 1871	snagged	0	170	1864
Island #31, Tenn. - mile 746.0		(Beef Island)			
George Campbell	12 27 1853	stranded	0	159	1852
Mound City, Ark. - mile 739.2					
Sultana	4 27 1865	exploded	1547	660	1863
Memphis, Tenn. - mile 735.0					
Helen M'Gregor	2 24 1830	exploded	30-60		
Thomas Yeatman	10 24 1833	exploded	7	113	1830
General Pratte	11 25 1842	burned	0	342	1840
Belle of Clarksdale	12 14 1844	collided	31	250	1843
Sam Walker	6 5 1849	burned	0	125	1846
Constitution	5 20 1850	burned	0	536	1848
A. B. Shaw	5 20 1850	burned	0	67	1847
Colorado	6 18 1850	stranded	0	172	1846
Gayoso	11 30 1850	burned	0	236	1850
Swallow	11 30 1850	burned	0	82	1847
E.P. McNeil	8 30 1851	burned	0	203	1850
DeWitt Clinton	1 25 1852	snagged	36	265	1847
Tuscumbia	10 10 1852	snagged	0	291	1846
Mary Agnes	3 1 1854	burned		374	1853
Mayflower	12 3 1855	burned	0	100	1841
Brilliant	12 3 1855	burned	0	398	1850
George Collier	12 3 1855	burned	0	539	1851
May Flower	12 3 1855	burned	3	890	1855
James Laughlin	9 13 1856	foundered	6	187	1853
A. L. Shotwell	3 24 1857	snagged	0	583	1853
Comet (18 miles below Memphis)	2 19 1859	foundered		100	1857

Boat	Date	Cause	Dead	Tons	Built
Memphis, Tenn. - mile 735.0 (cont)					
Persia	3 23 1860	burned	0	255	1852
St. Francis No. 2	9 16 1860	foundered	0	162	1853
St. Louis	12 9 1860	foundered	0	937	1850
Flying Cloud	12 9 1860	burned	0	537	1854
U.S.S. Swallow	8 19 1862	ran aground and burned			
Jacob Musselman	1 8 1863	burned	0	144	1860
Grampus	1 11 1863	burned	0	100	1857
Hercules	2 18 1863	burned	0	151	1854
Champion	8 21 1863	burned	1	676	1858
Thomas J. Paten	1 25 1864	burned	0	118	1860
Evansville	1 28 1864	snagged	0	155	1854
Columbia	3 30 1864	burned	0	44	1863
Stephen Bayard	3 6 1865	burned	0	155	1851
General Halleck	2 5 1866	burned	0	66	1862
St. Patrick	4 18 1868	burned	0	414	1862
Annie Jacobs	5 10 1868	burned	0	148	1863
Victor No. 2 (20 miles above Memphis)	10 27 1868	snagged	0	67	1860
Nettie Jones	3 7 1870	foundered	2	43	1865
T. L. McGill	1 16 1871	burned	40	598	1857
Belle of Pike	12 1872	ice	0	614	1866
Helen Brooke	12 26 1872	ice	0	26	1863
Mattie Cabler	12 26 1872	ice	0	128	1864
Excelsior	12 30 1872	ice	0	155	1864
Warner	1875	exploded			
Legal Tender	6 30 1876	snagged		539	1867
Liberty No. 3	12 17 1876	snagged	0	54	1860
Golden City	4 30 1884	burned			
Island #45, Tenn. - mile 728.0		(President Island)			
Henry Bry	1845	snagged	0	347	1843
Connecticut	10 29 1852	stranded	0	248	1848
Plane Valley	1 17 1867	snagged	3	394	1858
Island # 46, Tenn. - mile 728.0		(Vice President Island)			
Favorite	11 22 1831	snagged	0	155	1831
Island #53, Ark. - mile 702.0		(Buck Island)			
City of Memphis	5 31 1866	exploded	5	865	1857

Boat	Date	Cause	Dead	Tons	Built
Commerce, Miss. - mile 698.0					
Yazoo City	9 3 1848	snagged	0	229	1843
Hardin Point, Ark. - mile 675.0					
U.S.S. Paw Paw	8 6 1863	snagged			
Austin, Miss. - mile 674.0					
Monongahela Belle	3 8 1859	snagged	0	74	1854
Mouth of the St. Francis River, Ark. - mile 672.3					
General Lane	12 30 1851	snagged	0	240	1849
Pennsylvania	6 13 1858	exploded	20	486	1854
St. Nicholas	4 24 1859	exploded	60	666	1853
Mariner	7 4 1864	burned	0	193	1856
Niagara	10 20 1865	collided with Post Boy	75	797	1864
Helena, Ark. - mile 663.3					
Thomas Jefferson	10 4 1824	snagged	0	224	1819
Montezuma	2 28 1829	snagged	0	175	1828
Milnare	9 8 1844	collided with Westwood	3	276	1840
Lucy Holcombe	11 11 1859	burned	0	440	1858
Dilligent	1 10 1865	snagged	0	140	1859
Market Boy	5 25 1866	foundered	0	70	1862
Clermont	3 8 1867	snagged	1	79	1863
Maid of Peru	10 6 1867	stranded	0	37	1865
Pilgrim (30 miles below Helena)	12 6 1867	snagged	0	139	1864
Kenton	6 10 1870	snagged	0	215	1860
Webster	12 28 1872	ice	0	78	1860
Island #65, Miss. - mile 628.0					
Chief Magistrate	9 4 1841	snagged	0	149	1841
Martha Washington	1 14 1852	burned	9	299	1847

Boat	Date	Cause	Dead	Tons	Built
Island #66, Ark. Mile 625.0					
Decatur	3 20 1844	burned	1	282	1843
Countess	6 22 1851	snagged	0	98	1847
Maggie Hays	2 10 1870	exploded	6	301	1864
Morning Star	2 17 1874	snagged	0	65	1866
Belle of Shreveport	1883	sank			1872
Island #67, Miss. - mile 621.0					
Dunleith	10 31 1864	snagged	0	155	1856
, Miss. - mile 616.0					
Pelican	2 24 1858	burned	0	362	1856
Australia, Miss. - mile 615.0					
Die Vernon	2 10 1967	snagged	0	378	1859
Island #70, Ark.-Miss. - mile 608.0					
Memphis	5 15 1866	snagged	0	645	1860
Island #74, Ark. - mile 584.5					
Rector	11 10 1842	burned	1	246	1841
Lancet	6 10 1845	burned	0	184	1843
Belle Zane	12 20 1847	snagged	40	128	1844
Rainbow	11 21 1857	burned	30	486	1854
Lake Beulah, Miss. mile 584.0					
Wilmington	11 8 1889	exploded	8	206	1837
Napoleon, Ark. - mile 582.0					
Clarksville	5 27 1848	burned	21	484	1845
St. Joseph	1 12 1850	exploded	8	217	1846
Cotton Plant	5 22 1852	burned	0	295	1846
Forest Rose	3 25 1857	exploded	6	205	1852
Rough and Ready	1858	collided with Monongahela	0	126	1856
Bridge City	11 29 1860	burned	0	199	1854
Frontier City	1 4 1861	snagged	0	144	1860
Blue Wing No. 2	12 28 1862	burned	0	170	1850
Fanny Bullitt	3 15 1864	snagged	0	438	1854
Miami	1 28 1966	exploded	many	175	1863

Boat	Date	Cause	Dead	Tons	Built
Island #75, Miss. - mile 579.0		(Ozark Island)			
Humboldt	2 21 1857	collided with Belfast	15	512	1855
Judge Torrence	2 19 1868	snagged	0	419	1857
Island #75, Miss. - mile 575.0					
Amaranth	6 21 1852	snagged	0	293	1846
James Watson	2 25 1865	burned	34	200	1863
Island #78, Ark. - mile 561.5		(Choctaw Island)			
optas	4 16 1852	burned	10	397	1849
Choctaw Bend, Miss. - mile 559.0					
Chieftain	11 9 1844	snagged	0	322	1840
Arkansas City, Ark. - mile 554.0					
Keystone	6 24 1841	burned	0	69	1839
Island #80, Ark. - mile 551.5					
Ruth	3 31 1869	burned	0	1681	1865
Island #82, Ark. - mile 546.0					
John Adams	1 28 1851	snagged	123	298	1848
Gregon	3 2 1851	exploded	25	181	1844
Garden City	1 14 1855	burned	0	409	1853
U.S.S. Sallie Wood	7 30 1862	CSA artillery	0	256	1860
Kate Kearney	12 25 1871	unknown		445	1864
Greenville, Miss. - mile 541.0					
Peter Tellen	12 22 1858	stranded	0	738	1853
Minnesota	5 3 1863	burned	0	142	1857
Lebanon	5 27 1864	burned	0	225	1855
John Raine	1 17 1868	burned	59	541	1858
Island #84, Ark.-Miss. - mile 533.0					
General Pike	2 26 1843	snagged	3	237	1840
California	4 4 1853	snagged	0	269	1850

Boat	Date	Cause	Dead	Tons	Built
Island #86, Ark. - mile 521.0					
Webster	5 2 1851	burned	0	324	1848
Princeton, Miss. - mile 510.0					
Daniel O'Connell	3 11 1838	snagged	0	193	1833
Gronoko	4 21 1838	exploded	100		
Tarquin	11 4 1841	snagged	0	165	1837
Western World	12 14 1852	collided with H.R.W. Hill	12	338	1848
Caroline Landing, Miss. - mile 507.6					
Clarabell	7 24 1864	burned	0	200	1860
Island #92, La. - mile 503.0					
John McKee	2 7 1859	collided with Cherokee	0	140	1850
Lake Providence, La. - mile 487.2					
Nicholas Biddle	7 15 1837	snagged	10	139	1836
Belfast	11 19 1860	stranded	0	780	1854
Cora Anderson	1 18 1861	snagged	0	658	1856
Marmora	2 15 1867	burned	0	177	1857
Island #96, La. - mile 471.0					
Bulletin No. 2	3 27 1855	burned	23	692	1850
Albermarle, Miss. - mile 464.0					
Phoenix	7 16 1832	burned	0	205	1829
Milliken's Bend, La. - mile 456.0					
Brunette	1 28 1847	snagged	0	207	1842
Rober Campbell, Jr.	9 28 1863	burned	0	116	1860

Boat	Date	Cause	Dead	Tons	Built
Vicksburg, Miss. - mile 437.0					
Mandan	11 20 1824	stranded	0	127	1819
New Brunswick	10 28 1833	burned	0	178	1832
Ganges	5 17 1841	burned	0	155	1836
Wyandotte	11 21 1848	snagged	30	314	1847
Magnolia	6 12 1856	stranded	3	160	1850
Daniel Boone	12 13 1859	snagged	0	381	1854
U.S.S. Lancaster	3 25 1863	CSA artillery			
U.S.S. Vicksburg	3 25 1863	burned	0	635	1857
U.S.S. Henry Clay	4 22 1863	burned	0	257	1857
U.S.S. Tigress	4 22 1863	CSA artillery	0		
U.S.S. Cincinnati	5 27 1863	CSA artillery	40		
Cotton Plant	7 23 1863	burned	0	247	1859
City of Madison	9 1863	ammunition explosion	156	419	1860
Keoto	7 29 1868	foundered			1863
belle of Alton	11 18 1873	burned			1868
ton, Miss. - mile 430.0					
Florence Miller No. 3	3 3 1869	snagged	0	236	1864
Diamond Island, Miss. - mile 425.0					
Odd Fellow	12 20 1848	stranded	0	97	1845
Island #106, Miss. - mile 424.0 (Palmyra Island)					
Amazon	11 21 1831	snagged	0	296	1827
Telegraph	12 27 1833	collided with New Orleans	0	188	1829
Joseph Pierce	7 31 1865	exploded	12	533	1864
Grand Gulf, Miss. - mile 405.3					
Napoleon	5 17 1822	snagged	0	315	1818
George Washington	1 14 1852	exploded	17	303	1845
North Star	3 11 1858	foundered	0	82	1857
U.S.S. Indianola	2 24 1863	snagged		146	1859
John C. Fremont	5 1863	collided with Moderator		315	1854

Boat	Date	Cause	Dead	Tons	Built
St. Joseph, La. - mile 396.4					
Mediator	1 4 1856	burned	0	421	1852
Ceres	10 9 1862	exploded	12	217	1853
U.S.S. Conestoga	3 8 1864	rammed by U.S.S. General Price	2		
Rodney, Miss. - mile 389.0					
Huron	9 20 1833	snagged	0	183	1829
Pathfinder	2 8 1845	burned	7	137	1841
Waterproof, La. - mile 381.0					
Mississippi	2 28 1870	snagged	0	856	1864
Henry Ames	8 1874	snagged	2	777	1864
Lotus No. 3	1877	burned		232	1866
Natchez, Miss. - mile 363.8					
Tennessee	2 8 1823	snagged	30	416	1819
Teche	4 14 1825	exploded	20	295	1820
Peruvian	6 7 1833	exploded	50	226	1831
Walk in the Water	12 8 1835	burned	0	290	1826
Lady Washington	1 9 1836	snagged	0	96	1832
Saint Lawrence	5 7 1840	stranded		111	1835
Hinds	5 7 1840	foundered	51	130	1836
Charleston	3 17 1842	snagged	0	84	1835
North Alabama	10 30 1842	stranded	0	341	1832
Queen City	5 24 1846	exploded	12	318	1843
Maria	11 21 1846	collided with Sultan	30	692	1844
Convoy	3 8 1849	burned	2	749	1846
Duroc	3 10 1854	sank		220	1847
Monroe	3 20 1854	capsized	30	183	1848
Unicorn	12 11 1855	burned	0	185	1853
Jennie Hubbs	12 27 1868	foundered	0	220	1863
Carthage, Miss. - mile 360.5					
Montgomery	11 7 1851	burned	2	407	1843
Ranger	2 15 1859	burned	0	86	1856
Black Hawk, La. - mile 320.1					
Eclipse	8 20 1826	snagged	0	168	1823
Ben Sherrod	5 8 1837	burned	72	393	1836

Boat	Date	Cause	Dead	Tons	Built
Fort Adams, Miss. - mile 311.9					
Baltic	4 1 1842	collided with Maid of Kentucky	0	407	1832
John L. Avery	3 9 1854	snagged	40	323	1853
Planter	12 30 1857	snagged	0	182	1852
Torras, La. - mile 302.2					
William Tell	3 16 1830	exploded	5	80	1826
Creole	2 22 1841	burned	34	192	1839
W.A. Violette	1 24 1853	burned	0	162	1848
Gipsy	12 7 1854	burned	5	298	1848
Moro Castle	2 1863	burned by Union forces			
May A. Bruner	2 3 1866	burned	0	172	1865
Red River Landing, La. - mile 301.4					
Echo	1853	burned			
Angola, La. - mile 300.4					
Swan	5 22 1837	snagged	0	26	1831
General Quitman	10 21 1868	snagged	0	615	1859
Raccourei Cutoff, La. - mile 299.4					
Ridgely	6 28 1849	burned	0	97	1847
Point Coupee, La. - mile 268.7					
Constitution	5 4 1817	exploded	many		
General Pike	4 18 1849	burned	1	308	1843
Majestic	10 22 1865	burned	0	201	1864
Bayou Sara, La. - mile 266.0					
Hope	1825	snagged	0	75	1822
Fort Adams	12 9 1836	stranded	0	137	1825
Pearl	1 1 1854	collided with Natchez	7	184	1851
Rockaway No. 2	4 29 1854	burned	0	324	1850
Alice W. Glaze	3 1857	burned	0	161	1853
Arkansas	2 19 1859	snagged	0	154	1856
Messenger	8 30 1859	burned	0	389	1852
Bonita	5 7 1860	burned	0	211	1857
Converse	1 11 1872	sank			1870

Boat	Date	Cause	Dead	Tons	Built
St. Francisville, La. - mile 265.4					
Fancy	3 23 1837	burned	0	20	1832
Waterloo, La. - mile 260.4					
Thomas Jefferson	11 8 1849	stranded	0	279	1846
Savanna	11 24 1849	snagged	1	337	1848
Alto Landing, La. - mile 256.9					
J. E. Trudeau	4 20 1898	snagged			1889
Port Hudson, La. - mile 256.0					
Wing	3 17 1845	burned	1	133	1844
Madora	2 12 1847	exploded		198	1845
U.S.S. Mississippi	3 14 1863	exploded			
Profit Island, La. - mile 249.5					
Monmouth	10 23 1837	collided with Trenton and Warren	300		
Memphis	11 7 1847	snagged	0	462	1843
Esperenza	1874	burned			1871
Baton Rouge, La. - mile 229.0					
New Orleans	7 14 1814	snagged	0	371	1811
Carrollton	10 11 1836	exploded	15	185	1831
Pittsburgh	1 14 1838	snagged	0	144	1836
Star Spangled Banner	6 29 1847	snagged	20	275	1845
Magnolia Banner	7 3 1855	burned	8	151	1855
Magnolia	7 8 1855	burned	8	596	1845
Afton Jr.	12 8 1858	snagged	0	155	1856
H.R.W. Hill	10 31 1860	exploded	39	602	1852
Uncle Ike	12 2 1860	stranded	0	68	1859
C.S.S. Arkansas	8 6 1862	destroyed to avoid capture	0		
Tecumseh	12 1 1863	burned	0	418	1852
Keokuk	1866	sank			1858
Fashion	12 27 1866	burned	43	1194	1865

Boat	Date	Cause	Dead	Tons	Built
Conrad Point, La. - mile 222.5					
Princess	2 28 1859	exploded	70	715	1855
Laura Lee	1888	sank			1875
Plaquemine, La. - mile 208.6					
Caroline	3 12 1834	snagged	0	78	1828
Joe Davis	12 10 1843	snagged	0	218	1842
Luda	1 8 1846	collided		244	1841
Texan	3 27 1849	burned	0	96	1848
Melodeon	12 14 1850	collided with George W. Kendall	3	244	1849
Sylvester Webb	8 17 1854	capsized	4	48	1853
R. W. Powell	8 20 1861	snagged	0	349	1855
Ingomar	8 10 1867	snagged	0	110	1858
Rapides	2 28 1876	sank		415	1859
Willie Camage	10 11 1876	burned	8	187	1864
Point Pleasant, La. - mile 200.3					
Reindeer	1 5 1837	burned	0	104	1834
Tippah	1 13 1852	burned	1	107	1851
Nina Simms	6 17 1869	snagged	0	327	1860
Bayou Goula, La. - mile 195.6					
Tribune	11 2 1849	burned	0	251	1849
Talleyrand	12 20 1850	stranded	0	593	1848
Autocrat	2 10 1851	collided with Magnolia	10	846	1847
Silver Moon	3 7 1858	burned		171	1857
Donaldsonville, La. - mile 175.3					
Saint Martin	10 31 1833	burned	31	143	1832
Osage	3 22 1844	burned	0	129	1841
Yalobusha	1 18 1848	burned	35	80	1837
Harkaway	1 1 1849	stranded	0	288	1843
Transport	5 6 1849	stranded	0	91	1848
Viola	10 27 1849	collided with America	0	299	1846
Luna	5 17 1850	collided with Duchess	5	321	1846
Cotton Valley	12 1 1878	collided with Morgan		401	1876

Boat	Date	Cause	Dead	Tons	Built
Burnside, La. - mile 170.3					
Henry von Phul	11 13 1866	burned	6	709	1860
Lauderdale, La. - mile 166.6					
Charmer	2 10 1861	burned	5	667	1859
Cantrelle, La. - mile 159.0					
Mars	12 6 1822	stranded	0	61	1820
Providence	11 27 1824	snagged	0	375	1819
St. James, L.a - mile 156.5					
Nashville	2 22 1826	snagged	0	194	1822
Choctaw	8 5 1836	snagged	0	107	1833
Wave	3 7 1849	stranded	0	78	1844
College Point, La. - mile 155.4					
Daniel Boone	9 10 1853	collided with Southern Belle	0	169	1844
Southerner	7 21 1862	collided	0	393	1853
Planet	2 1 1864	stranded	0	604	1856
Gertrude	9 21 1864	foundered	6	70	1864
Grandview Reach, La. - mile 148.0					
S.F. Vinton	8 27 1851	burned	0	284	1850
Meteor No. 3	10 11 1856	burned		162	1847
DeSoto	4 1 1867	burned	0	390	1860
Alab	4 4 1867	burned		412	1860
Glide No. 3	1 13 1869	exploded			1863
Laplace, La. - mile 134.0					
Hope	2 27 1850	exploded	5	32	1849
Bonnet Carre, La. - mile 128.0					
Alexandria	2 1 1823	stranded	0	94	1820
Alexandria and Natchez Packet	2 1 1827	snagged	0	26	1825
William Penn	12 17 1827	snagged	0	160	1825
Clinton	3 31 1847	burned	6	267	1844
Swallow	1 26 1853	collided with E. Howard	1	337	1851

Boat	Date	Cause	Dead	Tons	Built
Hahnville Landing, La. - mile 123.8					
Gem	2 14 1914	burned		97	1898
St. Rose, La. - mile 118.4					
Columbia	10 11 1833	snagged	0	131	1826
Kenner, La. - mile 113.0					
Missouri Belle	10 24 1834	collided with Boons Lick	15	165	1834
Boons Lick	10 24 1834	collided with Missouri Belle		295	1833
Waggaman, La. - mile 109.0					
Ravenswood	7 16 1859	burned	1	159	1852
Carrollton, La. - mile 102.8					
Randolph	3 2 1841	snagged	1	549	1833
Maid of Arkansas	11 3 1842	burned	0	213	1840
Yazoo	4 3 1848	snagged	1	304	1842
Saline	6 5 1848	foundered	0	53	1845
Piota	6 4 1859	burned	2	293	1858
William S. Nelson	11 1859	burned	0	324	1856
Silver Heels	10 2 1860	foundered	0	267	1857
John D. Scully	8 20 1895	burned			
Harvey, La. - mile 98.0					
Reub White	2 3 1861	stranded	0	110	1856
Gretna, La. - mile 97.2					
Wanderer	11 24 1865	stranded	0	36	1860
Science	6 1866	burned	0	116	1860
Madison	8 6 1866	burned	0	399	1853
Scioto	1867	snagged	0	54	1863
Starlight	4 25 1868	burned	0	214	1862
Gladiator	2 10 1900	burned	0	146	1863
McDonoghville, La. - mile 96.0					
Corinne	2 28 1851	exploded	15	183	1844

Boat	Date	Cause	Dead	Tons	Built
New Orleans, La. - mile 95.0					
Comet	1815	burned	0	24	1813
New Orleans	12 1 1818	snagged	0	324	1815
Comet	1823	snagged	0	154	1819
Rapide	1 21 1823	burned	0	188	1819
Alabama	1824	collided with Natchez		218	1818
United States	9 3 1824	stranded	0	645	1819
Venture	12 9 1824	burned	0	27	1823
Grecian	5 24 1825	burned	0	156	1824
Eagle	11 25 1825	snagged	0	118	1818
George Washington	1831	burned	0	355	1825
Shamrock	2 8 1832	collided with Baltic	0	218	1832
Saratoga	12 4 1832	burned	0	105	1829
Cotton Plant	12 4 1832	burned	0	260	1831
Natchez	9 4 1835	burned	0	206	1823
Marion	12 9 1835	collided	0	139	1835
Storm	7 2 1836	burned	0		1835
Rob Roy	3 7 1837	burned	0	236	1823
Amite	3 24 1838	snagged	0	34	1836
Tangipahoa	3 2 1838	burned	3	65	1837
Columbia	11 17 1838	stranded	0	140	1835
Mohican	2 19 1842	exploded	12	371	1830
Post Boy	3 31 1842	snagged	0	258	1825
George Washington	4 21 1842	burned	0	309	1836
Oronoko	10 6 1842	burned	0	367	1837
Phoenix	5 20 1843	exploded	3	42	1841
Governor Yell	10 12 1843	unknown	0	104	1841
Glide	8 15 1844	exploded		52	1843
Lucy Walker	10 25 1844	exploded	18	182	1843
John Linton	4 19 1845	snagged	0	307	1836
Marquette	7 1 1845	exploded	13	126	1842
Doctor Franklin	3 8 1846	burned	0	280	1843
Rob Roy	5 9 1846	burned	0	110	1845
Live Oak	6 4 1846	snagged	0	64	1845
Swallow	7 15 1846	stranded	0	159	1844
Doctor Watson	10 26 1846	foundered	0	141	1844
Hempstead	7 21 1848	snagged	0	75	1844
Rodolph	1 14 1849	snagged	0	150	1836
Mathilda Jane	3 1849	snagged	0	87	1845
Champion	4 7 1849	exploded	3	148	1843

Boat	Date	Cause	Dead	Tons	Built
Marshal Ney	10 8 1849	burned	0	486	1847
Illinois	10 8 1849	burned	0	579	1847
Falcon	10 8 1849	burned	0	295	1849
Aaron Hart	10 8 1849	burned	0	261	1848
Louisiana	11 15 1849	exploded	86	376	1848
General Herran	1 9 1850	capsized	0	65	1849
Diana	1 23 1850	collided with Ohio	0	296	1845
Belle of Arkansas	8 6 1850	unknown	0	224	1842
Nimrod	8 6 1850	unknown	0	210	1844
Creole	12 27 1850	burned	0	122	1846
Southerner	5 21 1851	snagged	0	298	1836
Caddo	2 15 1852	foundered	0	188	1848
Texas	2 15 1853	burned			1850
Post Boy	2 15 1853	burned		157	1851
John Swasey	2 15 1853	burned	3	274	1851
Mohican	2 4 1854	burned	0	398	1848
Crescent	2 4 1854	burned	0	547	1850
Saxon	2 4 1854	burned	0	479	1850
Charles Belcher	2 4 1854	burned	2	823	1852
Liah Tuna	2 4 1854	burned	0	646	1853
Natchez	2 4 1854	burned	3	698	1853
Anglo-Celt	5 21 1855	collided with Louisiana	1	367	1853
Knoxville	7 3 1855	burned	4	349	1848
Summit	12 5 1855	burned	0	180	1855
Post Boy	1 10 1858	exploded	3	157	1851
Eclipse	2 21 1860	foundered	0	1117	1852
Duncan F. Kenner	5 20 1860	burned	0	493	1859
Peerless	5 27 1860	burned	0	349	1858
William Campbell	5 27 1860	burned	0	322	1856
B. E. Clark	5 30 1860	burned	0	199	1853
Conqueror	5 16 1861	burned	0	398	1847
William M. Morrison	8 1861	burned	0	662	1856
Galveston	4 2 1862	burned	0	945	1857
Jackson	4 2 1862	burned	0	84	1860
Anglo-Norman	4 7 1862	burned	0	558	1850
C.S.S. Mississippi	4 25 1862	burned to avoid capture			
Bio Bio	3 22 1863	burned	0	822	1859
Empire Parish	5 28 1864	burned	0	279	1859
Antelope	9 27 1864	snagged	0	587	1853
Minnehaha	5 15 1865	burned	0	531	1857

Boat	Date	Cause	Dead	Tons	Built
Victoria	11 29 1865	unknown	0	23	1863
Dick Fulton No. 2	2 2 1866	exploded	4	98	1860
B. J. Adams	8 9 1866	burned	0	497	1860
Saratoga	8 9 1866	burned	0	339	1864
Doubloon	6 24 1867	burned	0	293	1859
Planter	7 25 1867	unknown	0	23	1867
Idaho	11 26 1867	exploded	2	62	1863
Minnie	1868	burned		445	1865
Starlight	4 28 1868	burned		386	1862
Crescent	12 11 1868	burned	0	678	1863
Glide	1 13 1869	exploded	15	232	1863
New York	3 21 1870	burned	0	199	1862
Jennie Gibbons	4 1870	snagged		42	1867
Bossier	11 16 1870	burned			1869
Grand Era	1 21 1871	burned		857	1869
Kankakee	6 11 1871	foundered	1	84	1865
Welcome	8 1871	burned	0	449	1863
Pioneer	1872	burned		63	1867
City of Cairo	9 1 1873	burned	0	894	1864
P. W. Strader	3 9 1874	burned			1866
Lotawanna	6 30 1874	unknown		479	1867
Selma	1 25 1875	unknown		600	1867
Jessie	7 3 1875	unknown	0	187	1866
W. S. Pike	12 17 1875	burned		616	1869
Garry Owen	2 4 1876	sunk by tug			
Bill Henderson	2 18 1876	stranded	0	104	1861
Mary Lowery	2 20 1876	burned		198	1871
Ashland	7 14 1882	burned		591	1872
J. S. Rumsey	12 1 1884	burned	0	47	1863
Meteor	7 27 1886	burned	0	220	1863
Sentinel	5 11 1896	foundered	0	297	1863
Columbia	9 20 1909	burned			1894

Algiers, La. - mile 94.0

Boat	Date	Cause	Dead	Tons	Built
Attakapas	9 29 1831	burned	0	123	1827
Bayou Sara	4 2 1840	burned	0	244	1833
Saint Helena	11 10 1849	foundered	0	124	1846
Patrick Henry	2 18 1850	foundered	0	161	1840
Lelia No. 2	5 4 1853	burned	0	134	1851
Falcon	4 24 1855	burned	0	177	1852
J. S. Chenoweth	9 17 1855	foundered	0	309	1851
S. S. Prentiss	2 20 1858	burned	0	272	1853

Boat	Date	Cause	Dead	Tons	Built
Montgomery	2 20 1858	burned	0	314	1854
William N. Sherman	2 20 1858	burned	0	194	1855
Empress	6 29 1858	burned	0	304	1850
Dollie Webb	5 5 1861	burned	0	139	1859
Editor	5 6 1861	burned	0	246	1851
Grenada	5 6 1861	burned	0	217	1851
General Pike	5 6 1861	burned	0	248	1856
Telegram	5 6 1861	burned	0	205	1858
Baltic	5 6 1861	burned	0	604	1860
Maria Denning	5 11 1866	burned	0	691	1856
Lady Franklin	1 31 1867	burned	0	207	1860
General Ransom	4 10 1868	burned	0	115	1865
Autocrat	4 10 1868	burned	0	662	1860
Starlight	4 23 1868	burned	0	280	1858
U.S.S. Lexington	2 3 1869	burned		448	1858
Victoria	2 3 1869	burned	0	405	1858
Carrie Poole	7 27 1870	burned	0	154	1865
Cornelia	11 16 1870	burned	0	647	1865
Belle Ida No. 2	1 9 1873	burned			1861
Below New Orleans, La.					
Grampus	8 12 1828	unknown	9		
(lost 9 miles below New Orleans, along with brig in tow)					
DeSoto	12 31 1870	burned	0	1000	1859
Ella Hughes	3 17 1880	sank	0	212	1867
Poydras, La. - mile 82.2					
Tomochichi	4 22 1843	snagged		236	1835
English Turn Bend, La. - mile 78.0					
Post Boy	3 28 1842	snagged	0	140	1836
Invincible	3 12 1844	snagged	0	210	1836
Thomas McDaniel	2 26 1855	exploded	7	539	1853
C.S.S. William H. Webb	4 24 1865	destroyed to avoid capture	0	655	1856
Er	5 11 1877	unknown	7	385	1856
Davant, La. - mile 53.0					
Courier	3 9 1849	snagged	0	140	1846
A.G. Brown	12 30 1868	collided with Teutonic	0	150	1858

Boat	Date	Cause	Dead	Tons	Built
Forts St. Philip and Jackson, La. - mile 20.0					
U.S.S. Maria J. Carlton	4 19 1862	sunk by CSA artillery fire			
U.S.S. Varona	4 24 1862	sunk in battle			
C.S.S. Warrior	4 24 1862	sunk in battle			
C.S.S. Stonewall Jackson	4 24 1862	sunk in battle			
C.S.S. General Lovell	4 24 1862	sunk in battle			
C.S.S. General Breckinridge	4 24 1862	sunk in battle			
C.S.S. Phoenix	4 24 1862	sunk in battle			
C.S.S. Star	4 24 1862	sunk in battle			
C.S.S. Belle Algerine	4 24 1862	sunk in battle			
C.S.S. Manassas	4 24 1862	run aground			
C.S.S. Resolute	4 24 1862	desteoyed to avoid capture			
C.S.S. Governor Moore	4 24 1862	destroyed to avoid capture			
Louisiana Gunboat General Quitman	4 24 1862	sunk in battle			
C.S.S. Defiance	4 28 1862	destroyed to avoid capture			
C.S.S. Louisiana	4 28 1862	destroyed to avoid capture			
C.S.S. McRae	4 28 1862	destroyed to avoid capture			

ARCHAEOLOGICAL SITES IN THE PROJECT AREA

MISSOURI

New Madrid County

23 Nm 25

This is a small Woodland burial mound.

23 NM 27

This is a low Coles Creek Mound of the Black Bayou phase.

23 NM 205

This was apparently a Baytown village, but it has been badly scattered.

23 NM 234

Very little is known about this apparent Mississippian village site.

23 Nm 523

This site was destroyed by the construction of an aluminum plant.

KENTUCKY

Ballard County

15 Ba 3

This was a late Woodland village with two low mounds. It has been destroyed by excavation and the construction of a paper mill.

15 Ba 10

This was a similar site, also destroyed by excavation in the 1930's and the construction of a paper mill.

Fulton County

15 Fu 4 - Adams Mounds

This is a large Mississippian mound and village area, with three pyramidal and four conical mounds. The site is on a rise now used for agriculture and is not known to have ever been excavated. It is an extremely important site and is being well protected by its owner.

TENNESSEE

Lake County

40 Lk 7

This is a late Woodland to early Mississippian village site.

Dyer County

40 Dy 2

No archaeological materials have been recovered from this large Mississippian mound. It is an important site and should be investigated.

Lauderdale County

40 La 2

This is a Nodena phase Mississippian village site with a temple mound and a small mound. There is some evidence that the village burned, and otherwise perishable materials may be preserved in charcoal.

40 La 4

This is a late Mississippian village site of the Jones Bayous phases, with a temple mound.

40 La 6

This late Woodland to early Mississippian village site has nine small mounds arranged in a U shape. The site has a high potential for the study of the Woodland/Mississippian transition and is in danger of being plowed away.

40 La 7

A major Mississippian village site is situated on the edge of the bluff top. The site is being destroyed by flood associated erosion.

40 La 11

Chert gravels were heat treated for the manufacture of lithic tools, at this unique site. According to Gerald Smith, it is the only known Mississippian site of its kind.

40 La 12

This is a small Woodland camp site at the base of the bluff.

40 La 17

This is a Jones Bayou phase village with a mound. House patterns are visible after a good rain.

40 La 18

This is a Woodland and Mississippian village site currently covered by a tree farm. A test excavation has been conducted at the site by Memphis State University.

40 La 19

This late Mississippian mound and village is probably the least disturbed site in the area.

40 La 20

This is a late Woodland to early Mississippian village site with a mound.

40 La 25

This is a large, deep, and relatively undisturbed village site of the Jones Bayou phase with three mounds.

40 La 26

Several very interesting artifacts, such as effigy bowls, water bottles, and burial urns, have been found in this Mississippian village site by pothunters.

40 La 31

Situated on the bluff on the edge of a road, this is a small archaic site.

40 La 32

This is a small archaic site. It is near the edge of the bluff near a road.

40 La 33

A late Paleo-Indian occupation may be associated with this site.

40 La 34

Both early and middle Woodland materials have been recovered from this site.

40 La 36

This is a late Woodland village site in a soybean field.

40 La 37

This Woodland village is forested and extremely difficult to locate.

40 La 38

This is a late Woodland to early Mississippian village site with two mounds. It is in good condition but is difficult to reach.

40 La 39

This is a Woodland camp site which may have a Poverty Point component. The site appears to be largely silted over.

40 La 40

This is a late Woodland through Mississippian village site which floods periodically.

Tipton County

40 Tp 1

This is a late Mississippian village of the Tipton phase. It has been partially excavated by Memphis State University, but needs more attention soon as it is eroding.

40 Tp 12

This early to late Mississippian site has a very deep and stratified midden and is the best source for cultural sequences in the area.

40 Tp 13 - Richardson's Landing

Most of this Tipton phase village site is presently under a Corps of Engineers casting field.

40 Tp 14

Very little is known about this small site.

40 Tp 15

This camp site is not well described and should be investigated further.

40 Tp 16

Little information about this site is available.

40 Tp 26

This is another Tipton phase late Mississippian village. It formerly included a platform mound which has been destroyed.

40 Tp 34

This is a small early Woodland camp site.

40 Tp 35

This is a small late Woodland camp site.

40 Tp 36

This site is the best preserved Woodland burial mound in the area.

Shelby County

40 Sy 9

This early Mississippian village site may have been destroyed by airport construction.

40 Sy 10

This site, situated on a flood plain ridge, floods frequently. It is an early Mississippian village on the Ensley phase.

40 Sy 12

This is an early Mississippian site which has been partially destroyed by construction.

40 Sy 27

Located at the base of the bluff, the site is covered with trees and brush. It is the remains of an early to middle Mississippian village.

40 Sy 28

This is a large Mississippian period site located on the bluff. It is being destroyed by erosion.

40 Sy 75

Preliminary excavations at this important site have been conducted by Memphis State University. It is a Mississippian village with a large mound at the western end.

40 Sy 205

This is an important site located at the base of the bluffs. It is the only surviving village site of the Ensley phase in bottom land context. It should be investigated further.

40 Sy 284

This late Archaic - early Woodland site is being destroyed by erosion.

40 Sy 285

This site is also late Archaic and early Woodland. It is being destroyed by gully erosion.

ARKANSAS

Mississippi County

3 Ms 3

This is part of one of the most important site complexes in the area. The University of Arkansas Museum and the Museum of Natural History conducted excavations at the site during the 1930's. Morse (1973) edited a report on skeletal remains and artifacts recovered from 3 Ms 3.

3 Ms 4 (10 Q 1)

This large village site with a large mound is part of the Nodena site complex described above (3 Ms 3).

3 Ms 17 (10 Q 3)

The Turnage site includes Mississippian village remains and a mound.

3 Ms 18

The Crosskno site includes village and cemetery remains.

3 Ms 23

This site is known locally as the Armorel site.

3 Ms 53

Knappenberger is the local name for this site.

3 Ms 60 (10 P 14)

Golden Lake is a Mississippian Period site.

3 Ms 61

The Wilson site is a Nodena phase farmstead.

3 Ms 64

This Woodland site is known locally as the Terry #1 site.

3 Ms 65

Both Woodland and Mississippian materials have been recovered from this site. It is located west of the levee.

3 Ms 68

This is a Woodland site. A knoll on the site may be a mound.

3 Ms 69 (11 P 11)

This is a small Woodland site.

3 Ms 70 (11 P 11)

This is also a small Woodland site.

3 Ms 71 (11 P 1)

The Shawnee Village #2 site is a Nodena phase site of the Mississippian Period.

3 Ms 72

This Woodland site is small and dispersed.

3 Ms 73

This is a possible Mississippian mound.

Crittenden County

3 Ct 3

This is a large village site with a rectangular mound. Part of the site was destroyed by levee construction.

3 Ct 7 (11 P 2)

This village site with platform mounds was excavated in 1932. It is a Mississippian site (Nodena phase) with some European contact material (Phillips, 1970).

3 Ct 9

The Waponacca site includes a large mound and village remains. It was excavated in 1932 and burials were recovered.

Lee County

3 Le 51

This is an extensive Mississippian village site with no mounds. It may have a late Woodland component.

Phillips County

3 Ph 8 (14 N 2)

This is a badly eroded Mississippian village site.

3 Ph 20 (15 N 3)

This is a Mississippian village site with burials. It has been disturbed by pot hunters and part of the site was used as borrow material for the levee. If any of the site remains it should be investigated. (McClukan, personal communication, 1974).

3 Ph 21

This is a Baytown and Mississippian village site. It is partially covered by a levee and has been cut by a drainage ditch.

Desha County

3 De 5 (17 K 5)

This large mound abuts on the west side of the levee. It appears to have Coles Creek and Mississippian components.

3 De 9

Pottery is scattered on the surface of this site on the north end of Big Island.

3 De 15

Although this mound is located on the west side of the levee, midden materials probably extend under and on the east side of the levee. A post Civil War cemetery is located on the mound.

3 De 17

This flat topped mound has been incorporated into the levee. There may be an historic cemetery on top of it.

3 DE 19

This site is on the bank of the Mississippi River. No artifacts have been recovered.

3 De 21

This mound is on the west side of the levee. Associated midden material may extend to the east side of the levee.

3 De 28

This low mound is located on the east bank of Fishing Bayou.

3 De 31

This is a small conical mound on the east bank of Bear Brake.

3 De 32

There are two low mounds, one conical and one flat topped, on this site.

3 De 33

There are four low mounds on this site.

3 De 34

The three mounds on this site were used as borrow material during levee construction. Part of the site may remain.

3 De 52

This site consists of the remains of Avenue Landing. It appears to be a mid-nineteenth century steamboat landing site.

3 De (18 L 7)

Historic artifacts have been recovered from Fort Desha (McClurkan, 1971).

Chicot County

3 Ch 43 (20 L 13)

There is a large square mound on this site.

MISSISSIPPI

DeSoto County

22 Ds 500

The Wall site is a Mississippian village with mounds. It is a state archaeological landmark and is owned by the levee board.

Tunica County

22 Tu 503

This site is known as the Wilson mound. A modern house has been built on the top. There is an unconfirmed report of a mound two miles south of 22 Tu 503 on the west side of the levee (Connaway, personal communication, 1974).

22 Tu 504 (13 O 11)

This site is adjacent to the levee and near Commerce Landing. Some scholars believe that De Soto may have crossed the Mississippi River here.

Coahoma County

22 Co 605

The Gilbert site is a Mississippian village. It has been partially destroyed by pot hunters and levee construction. Nearby there is a large mound above the water line in a borrow pit. It has no site number (Connaway, personal communication, 1974).

22 Co 655

Only one large mound remains at this site. It appears that several other mounds were used for borrow material.

Bolivar County

22 Bo 512 (17 L 5)

There are two rectangular and one conical mound on this site. It is near the Mississippi River bank.

22 Bo 566 (18 L 6)

This site is known as Huntington Camp.

22 Bo 567 (18 L 7)

There are two mounds located on this site.

22 Bo (18 L 2)

This is known as the Perkins site.

Washington County

22 Ws 503 (18 L 3)

There are mounds at the Shadyside Landing site.

Issaquena County

22 Is 520 (22 L 1)

Artifacts from this site are from the Deer Creek phase of the Mississippian Period. There is a large mound and a semi-circular embankment. There are historic building foundations on the mound. Part of the site may be buried under silt (Phillips, 1970).

22 Is 522 (23 M 6)

This is the Duck Lake site.

Warren County

22 Wr 512 (22 L 5)

Although the Brunswick site is on the dry side of the levee, it might be disturbed by construction or levee modification.

22 Wr (22 M 4)

This site is known as the Johnson mound.

22 Wr (24 L 16)

This is the Davis site.

Claiborne County

22 Cb 509

There is a pyramidal mound, possibly Coles Creek, at the Bruinsburg site.

Jefferson County

22 Je 504

There are several mounds on the Villa Gayosa site.

Adams County

22 Ad 500 (26 K 1)

This is a village site with six mounds, covering twenty acres. It is on the bluff, but cultural material can probably be found on the flood plain below. Tunica pottery, as well as Mississippian pottery of the Gordon and Natchez phases, has been recovered (Phillips, 1970).

22 Ad 516

This site is known as the Stowers mound.

Wilkinson County

22 Wk 505

This is a large village site, located in a pasture, with a small mound at the east end. It contains Coles Creek and Deasonville sherds, as well as nineteenth century porcelain, and may be the remains of the historic Houma/Tunica village of 1706.

22 Wk 510

There are seven mounds on this site.

22 Wk 511 (28 J 3)

This is a very fine Coles Creek village site, with rectangular platform mounds, as well as a Mississippian component (Phillips, 1970).

16 Ec (22 L 4)

This is the Henderson site.

16 Ec (22 L 6)

There are several mounds on the Hagaman site.

Tensas Parish

16 Te (24 L 8)

Several mounds are situated on the west bank of Palmyra Lake.

16 Te (24 L 15)

This site is located between two segments of the levee.

East Baton Rouge Parish

16 Ebr 24

The site of Fort Baton Rouge is owned by the State of Louisiana. Louisiana State University has done limited excavation there, but found no structural remains. Gunflints, china, a Mexico City coin, and other artifacts were recovered. The fort was occupied by the British (1779), Spanish (1779-1810), and the Republic of West Florida (1810).

West Baton Rouge Parish

16 WBR 1 (31 L 6)

This site is located on Maçhac Point. It may be a Medora phase site of the Mississippian Period (Phillips,1970).

Iberville Parish

16 Iv 11 (32 L 1)

The Bayou Goula mounds appear to be historic late Mississippian. The site may extend to the edge of the Mississippi River.

Plaquemines Parish

16 Pl 12 (34 Q 7)

The Pointe a la Hache site appears to be Mississippian.

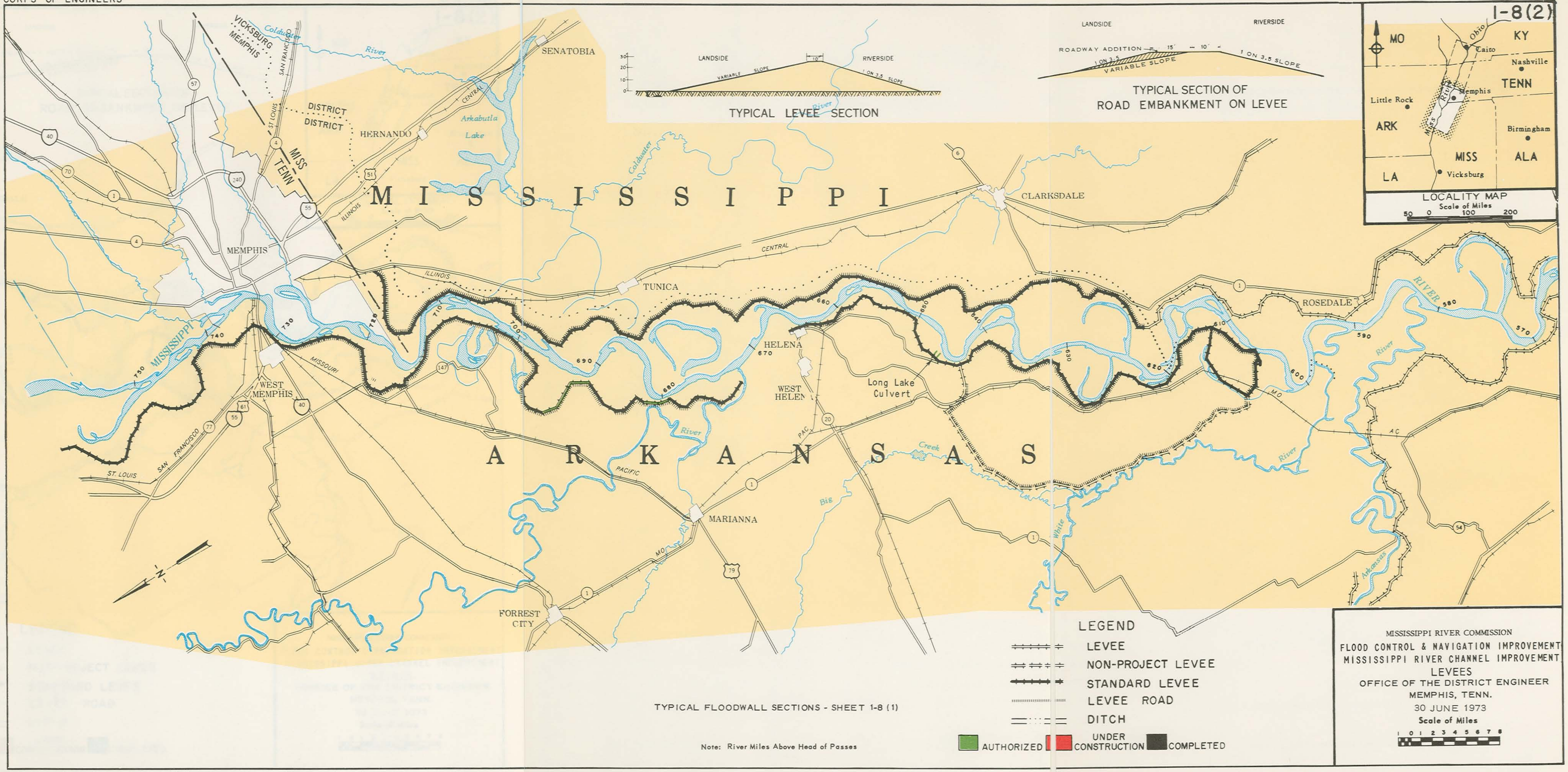
16 Pl 35

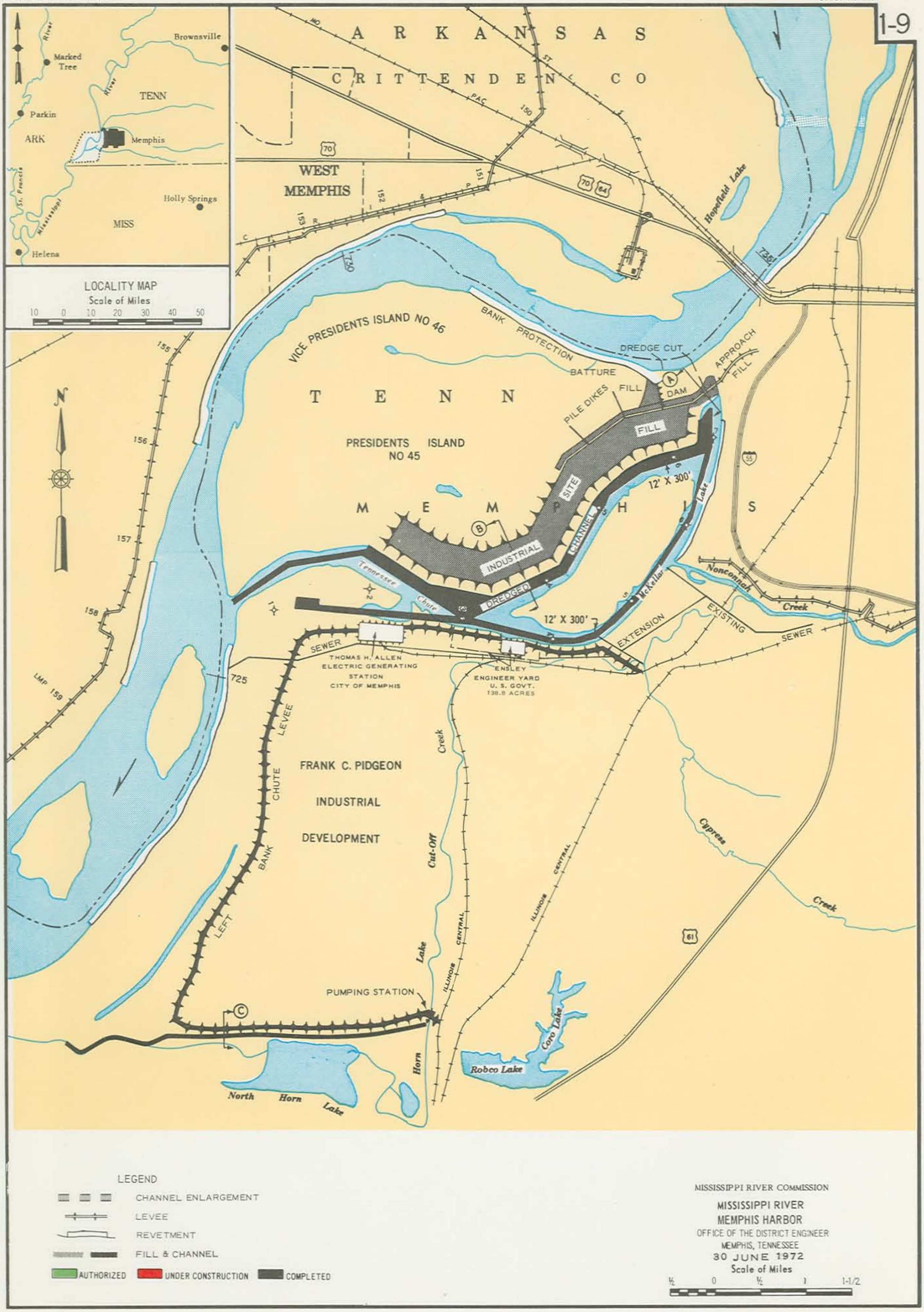
This site is on the west bank of English Turn Bend and is accessible at low water. It is the site of Fort St. Leon, and has been tested by Louisiana State University. The artifact assemblage confirms Spanish, French, British and American occupations. It is being eroded by the Mississippi River.

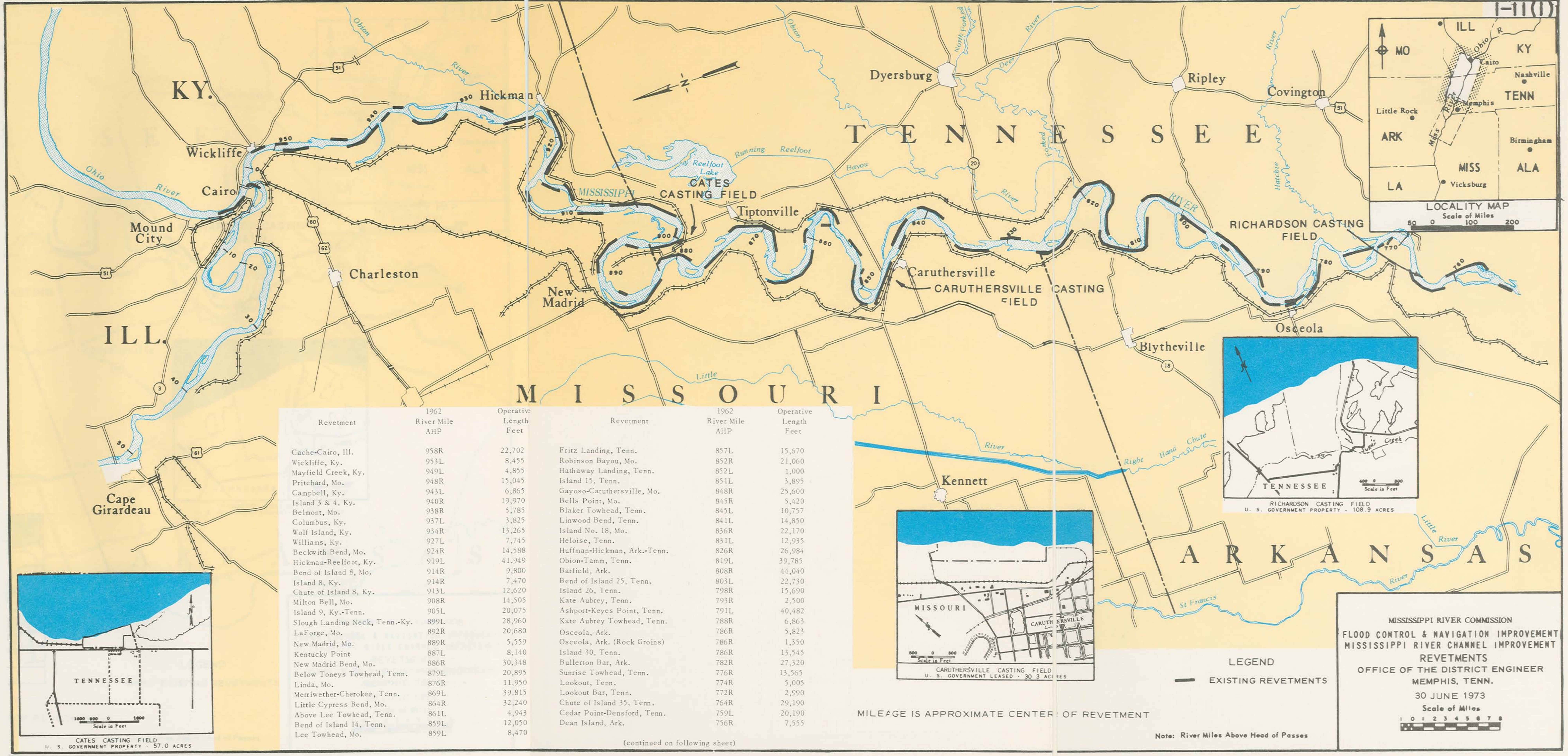
APPENDIX E

PROJECT MAPS


1-8(1)
TYPICAL FLOODWALL SECTION AT CAIRO
RIVERSIDE
LANDSIDE
GROUND LINE
WOOD PILES
STEEL SHEET PILING
KY
ILL
MISSOURI
TENNESSEE
ARKANSAS
WICKLIFFE
PUMPING STATIONS
CAIRO
MOUND CITY
CULVERT
FUSE PLUG
BIRD POINT NEW MADRID FLOODWAY
United States Flowage Easement
114,069.13 Ac.
LEVEE CLOSURE AND CULVERT
ST. JOHNS BAYOU OUTLET STRUCTURE
NEW MADRID
SEE INSERT
HICKMAN
TIPTONVILLE
Reelfoot Lake
DYERSBURG
RIPLEY
COVINGTON
Tiptonville-Obion Levee Extension
Obion River Diversion Channel
CARUTHERSVILLE
BLYTHEVILLE
OSCEOLA
KENNETT
CHARLESTON
SIKESTON
CAPE GIRARDEAU
MISSISSIPPI
Ohio River
RIVER
LOCALITY MAP
St Louis
ILL
MO
KY
Cairo
Nashville
TENN
Little Rock
ARK
Memphis
Birmingham
MISS
ALA
LA
Vicksburg
Scale of Miles
50 0 100 200
INSERT
NEW MADRID
St. John's Bayou
PLAN OF ST. JOHNS BAYOU OUTLET STRUCTURE
Elevations Referred to MGL
BERM EL. 270.0
6-10' X 10' CONCRETE BARRELS
OUTLET
INLET
EL. 259.0
EL. 285.0
EL. 258.0
1 on 3
1 on 3.5
1 on 6
BERM
TYPICAL FLOODWALL SECTION AT CARUTHERSVILLE HELENA & HICKMAN
RIVERSIDE
LANDSIDE
GROUND LINE
STEEL SHEET PILING
TYPICAL LEVEE SECTIONS - SHEET 1 - 8(2)
Note: River mileage on Miss. River below Cairo is above Head of Passes (1962).
River mileage on Miss. River above Cairo are miles above Cairo (1942).
LEGEND
LEVEE
NON-PROJECT LEVEE
STANDARD LEVEE
LEVEE ROAD
DITCH
AUTHORIZED
UNDER CONSTRUCTION
COMPLETED
Note: River Miles Above Head of Passes
MISSISSIPPI RIVER COMMISSION
FLOOD CONTROL & NAVIGATION IMPROVEMENT
MISSISSIPPI RIVER CHANNEL IMPROVEMENT
LEVEES
OFFICE OF THE DISTRICT ENGINEER
MEMPHIS, TENN.
30 JUNE 1973
Scale of Miles


1-8(2)
TYPICAL LEVEE SECTION
LANDSIDE
RIVERSIDE
VARIABLE SLOPE
1 ON 3.5 SLOPE
TYPICAL SECTION OF
ROAD EMBANKMENT ON LEVEE
ROADWAY ADDITION
VARIABLE SLOPE
1 ON 3.5 SLOPE
LOCALITY MAP
Scale of Miles
50 0 100 200
MO
KY
Ohio
Cairo
Nashville
TENN
Memphis
Little Rock
ARK
Birmingham
MISS
ALA
LA
Vicksburg
MISSISSIPPI
ARKANSAS
MEMPHIS
WEST MEMPHIS
SENATOBIA
HERNANDO
TUNICA
CLARKSDALE
HELENA
WEST HELENA
ROSEDALE
MARIANNA
FORREST CITY
Long Lake Culvert
VICKSBURG
MEMPHIS
DISTRICT
DISTRICT
MISS
TENN
Arkabutla Lake
Coldwater River
Big Creek
White River
Arkansas
MISSISSIPPI RIVER
ILLINOIS CENTRAL
MISSOURI PACIFIC
ST. LOUIS SAN FRANCISCO
750
740
730
720
710
700
690
680
670
660
650
640
630
620
610
600
590
580
570
LEGEND
LEVEE
NON-PROJECT LEVEE
STANDARD LEVEE
LEVEE ROAD
DITCH
AUTHORIZED
UNDER CONSTRUCTION
COMPLETED
TYPICAL FLOODWALL SECTIONS - SHEET 1-8 (1)
Note: River Miles Above Head of Passes
MISSISSIPPI RIVER COMMISSION
FLOOD CONTROL & NAVIGATION IMPROVEMENT
MISSISSIPPI RIVER CHANNEL IMPROVEMENT
LEVEES
OFFICE OF THE DISTRICT ENGINEER
MEMPHIS, TENN.
30 JUNE 1973
Scale of Miles
1 0 1 2 3 4 5 6 7 8


1-9
ARKANSAS
CRITTENDEN CO
WEST MEMPHIS
LOCALITY MAP
Scale of Miles
Marked Tree
Brownsville
TENN
Parkin
ARK
Memphis
Holly Springs
MISS
Helena
VICE PRESIDENTS ISLAND NO 46
BANK PROTECTION
DREDGE CUT
APPROACH FILL
BATTURE
FILL
DAM
PILE DIKES
TENN
PRESIDENTS ISLAND NO 45
FILL
12' X 300'
INDUSTRIAL SITE
CHANNEL
DREDGED
MEMPHIS
Hopefield Lake
Tennessee Chute
McKellar Lake
Nonconnah Creek
12' X 300'
EXTENSION
EXISTING SEWER
SEWER
THOMAS H. ALLEN ELECTRIC GENERATING STATION CITY OF MEMPHIS
ENSLEY ENGINEER YARD U. S. GOVT. 138.8 ACRES
FRANK C. PIDGEON INDUSTRIAL DEVELOPMENT
LEFT BANK CHUTE LEVEE
Cut-Off Creek
Cypress Creek
ILLINOIS CENTRAL
PUMPING STATION
Horn Lake
North Horn Lake
Robco Lake
Coro Lake
LMP 159
LEGEND
CHANNEL ENLARGEMENT
LEVEE
REVETMENT
FILL & CHANNEL
AUTHORIZED
UNDER CONSTRUCTION
COMPLETED
MISSISSIPPI RIVER COMMISSION
MISSISSIPPI RIVER
MEMPHIS HARBOR
OFFICE OF THE DISTRICT ENGINEER
MEMPHIS, TENNESSEE
30 JUNE 1972
Scale of Miles



Revetment	1962 River Mile AHP	Operative Length Feet
Cache-Cairo, Ill.	958R	22,702
Wickliffe, Ky.	953L	8,455
Mayfield Creek, Ky.	949L	4,855
Pritchard, Mo.	948R	15,045
Campbell, Ky.	943L	6,865
Island 3 & 4, Ky.	940R	19,970
Belmont, Mo.	938R	5,785
Columbus, Ky.	937L	3,825
Wolf Island, Ky.	934R	13,265
Williams, Ky.	927L	7,745
Beckwith Bend, Mo.	924R	14,588
Hickman-Reelfoot, Ky.	919L	41,949
Bend of Island 8, Mo.	914R	9,800
Island 8, Ky.	914R	7,470
Chute of Island 8, Ky.	913L	12,620
Milton Bell, Mo.	908R	14,505
Island 9, Ky.-Tenn.	905L	20,075
Slough Landing Neck, Tenn.-Ky.	899L	28,960
LaForge, Mo.	892R	20,680
New Madrid, Mo.	889R	5,559
Kentucky Point	887L	8,140
New Madrid Bend, Mo.	886R	30,348
Below Toneys Towhead, Tenn.	879L	20,895
Linda, Mo.	876R	11,950
Merriwether-Cherokee, Tenn.	869L	39,815
Little Cypress Bend, Mo.	864R	32,240
Above Lee Towhead, Tenn.	861L	4,943
Bend of Island 14, Tenn.	859L	12,050
Lee Towhead, Mo.	859L	8,470
Fritz Landing, Tenn.	857L	15,670
Robinson Bayou, Mo.	852R	21,060
Hathaway Landing, Tenn.	852L	1,000
Island 15, Tenn.	851L	3,895
Gayoso-Caruthersville, Mo.	848R	25,600
Bells Point, Mo.	845R	5,420
Blaker Towhead, Tenn.	845L	10,757
Linwood Bend, Tenn.	841L	14,850
Island No. 18, Mo.	836R	22,170
Heloise, Tenn.	831L	12,935
Huffman-Hickman, Ark.-Tenn.	826R	26,984
Obion-Tamm, Tenn.	819L	39,785
Barfield, Ark.	808R	44,040
Bend of Island 25, Tenn.	803L	22,730
Island 26, Tenn.	798R	15,690
Kate Aubrey, Tenn.	793R	2,500
Ashport-Keyes Point, Tenn.	791L	40,482
Kate Aubrey Towhead, Tenn.	788R	6,863
Osceola, Ark.	786R	5,823
Osceola, Ark. (Rock Groins)	786R	1,350
Island 30, Tenn.	786R	13,545
Bullerton Bar, Ark.	782R	27,320
Sunrise Towhead, Tenn.	776R	13,565
Lookout, Tenn.	774R	5,005
Lookout Bar, Tenn.	772R	2,990
Chute of Island 35, Tenn.	764R	29,190
Cedar Point-Densford, Tenn.	759L	20,190
Dean Island, Ark.	756R	7,555

(continued on following sheet)

MILEAGE IS APPROXIMATE CENTER OF REVETMENT

LEGEND

EXISTING REVETMENTS

Note: River Miles Above Head of Passes

MISSISSIPPI RIVER COMMISSION

FLOOD CONTROL & NAVIGATION IMPROVEMENT

MISSISSIPPI RIVER CHANNEL IMPROVEMENT

REVETMENTS

OFFICE OF THE DISTRICT ENGINEER

MEMPHIS, TENN.

30 JUNE 1973

Scale of Miles

CORPS OF ENGINEERS

U. S. ARMY

1-11(2)

Revetment	1962 River Mile AHP	Operative Length Feet
Shelby Forest, Tenn.	753L	9,560
Brandywine, Ark.-Tenn.	750R	18,010
Island 40, Tenn.	744R	30,750
St. Clair, Ark.	742R	2,930
Loosahatchie Bar, Tenn.	740R	2,070
Loosahatchie-Memphis, Tenn.	737L	31,293
Hopefield Point, Ark.-Tenn.	736R	5,390
Presidents Island, Tenn.	733L	12,755
Bauxippi-Wyanoke, Ark.	730R	23,300
Dismal Point, Ark.	724R	7,200
Ensley, Tenn.	723L	36,566
Coahoma, Tenn.	717L	9,270
Cow Island Bend Upper, Tenn.	716R	7,003
Cow Island Bend, Ark.	714R	22,274
Norfolk-Star, Miss.	709R	35,582
Pickett, Ark.-Miss.	703L	12,575
Porter Lake, Ark.	700R	34,155
Commerce, Miss.	695L	11,615
Peters, Ark.	692R	23,690
Mhoon Bend, Miss.	685L	35,828
Walnut Bend, Ark.	680R	27,220
Harbert Point, Miss.	675L	8,065

Revetment	1962 River Mile AHP	Operative Length Feet
St. Francis, Ark.	672R	13,515
Flower Lake, Miss.	667L	16,385
Trotters Landing, Miss.	665L	32,905
Helena, Ark.	660R	36,460
Delta-Friars Point, Miss.	655L	30,090
Westover, Ark.	650R	12,730
Horseshoe, Miss.	647L	16,385
Oldtown Bend, Ark.	644R	25,995
Island 63 Bar, Ark.	639L	18,610
Island 62, Ark.	638R	9,030
Burke Landing, Miss.	637L	19,070
Fair Landing, Ark.	632R	16,850
Rescue Landing, Ark.-Miss.	629L	27,020
Ludlow, Ark.	626R	10,390
Island 68 Bar, Ark.	622R	6,445
Island 67, Miss.	621L	7,625
Knowlton, Ark.	620R	16,900
Cessions Towhead, Ark.	615L	10,615
Henrico, Ark.	606R	25,040
Scrubgrass Bend, Ark.	600R	7,450
Big Island, Ark.	598R	3,905

Total linear feet of Revetment ...... 1,683,099 = 318.75 miles

LEGEND

EXISTING REVETMENTS

Note: River Miles Above Head of Passes

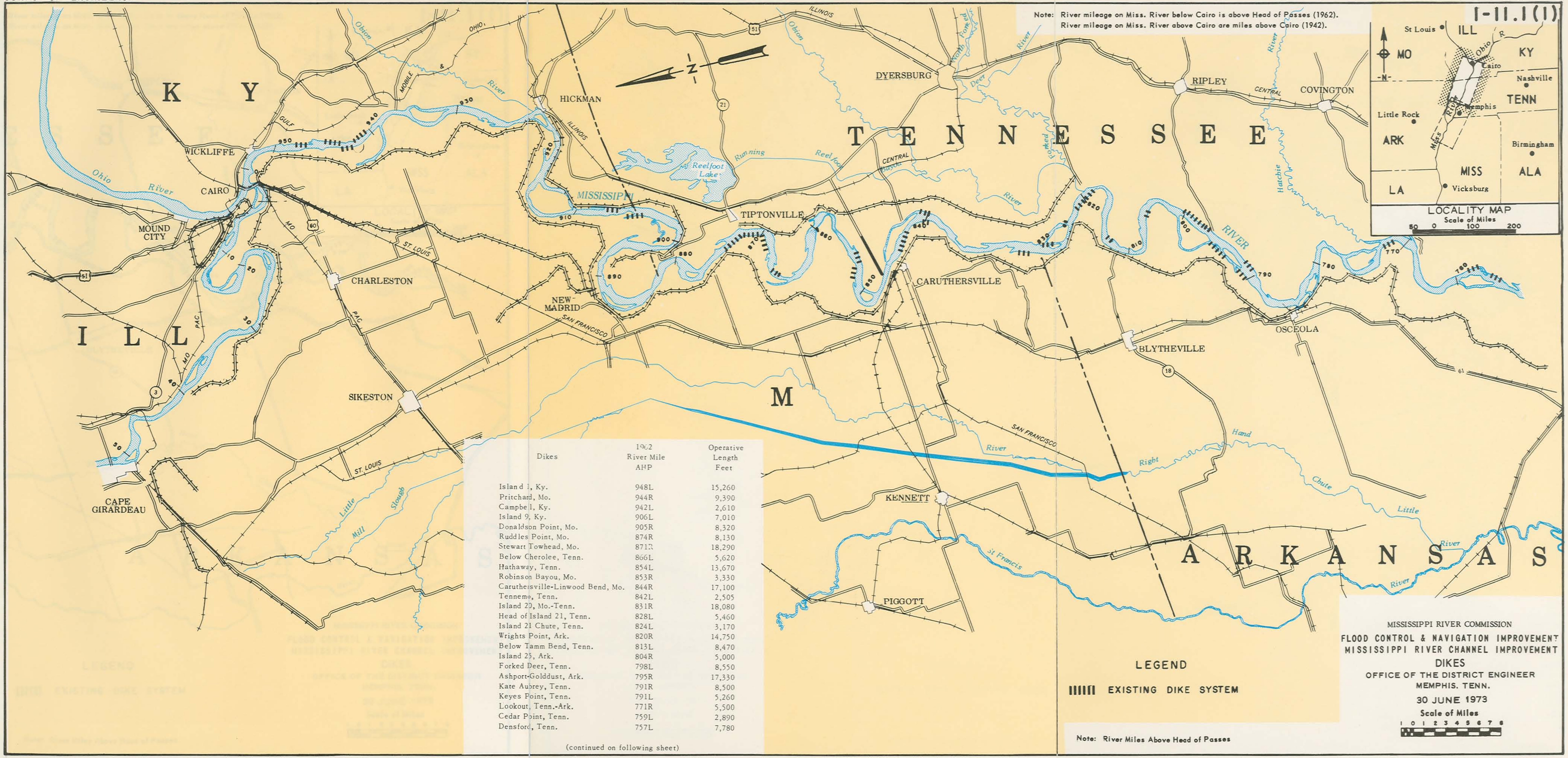
MILEAGE IS APPROXIMATE CENTER OF REVETMENT

MISSISSIPPI RIVER COMMISSION

FLOOD CONTROL & NAVIGATION IMPROVEMENT
MISSISSIPPI RIVER CHANNEL IMPROVEMENT
REVETMENTS

OFFICE OF THE DISTRICT ENGINEER
MEMPHIS, TENN.
30 JUNE 1973

Scale of Miles



Dikes	1962 River Mile AHP	Operative Length Feet
Island 1, Ky.	948L	15,260
Pritchard, Mo.	944R	9,390
Campbell, Ky.	942L	2,610
Island 9, Ky.	906L	7,010
Donaldson Point, Mo.	905R	8,320
Ruddles Point, Mo.	874R	8,130
Stewart Towhead, Mo.	871R	18,290
Below Cherolee, Tenn.	866L	5,620
Hathaway, Tenn.	854L	13,670
Robinson Bayou, Mo.	853R	3,330
Caruthersville-Linwood Bend, Mo.	844R	17,100
Tennemo, Tenn.	842L	2,505
Island 20, Mo.-Tenn.	831R	18,080
Head of Island 21, Tenn.	828L	5,460
Island 21 Chute, Tenn.	824L	3,170
Wrights Point, Ark.	820R	14,750
Below Tamm Bend, Tenn.	813L	8,470
Island 25, Ark.	804R	5,000
Forked Deer, Tenn.	798L	8,550
Ashport-Golddust, Ark.	795R	17,330
Kate Aubrey, Tenn.	791R	8,500
Keyes Point, Tenn.	791L	5,260
Lookout, Tenn.-Ark.	771R	5,500
Cedar Point, Tenn.	759L	2,890
Densford, Tenn.	757L	7,780

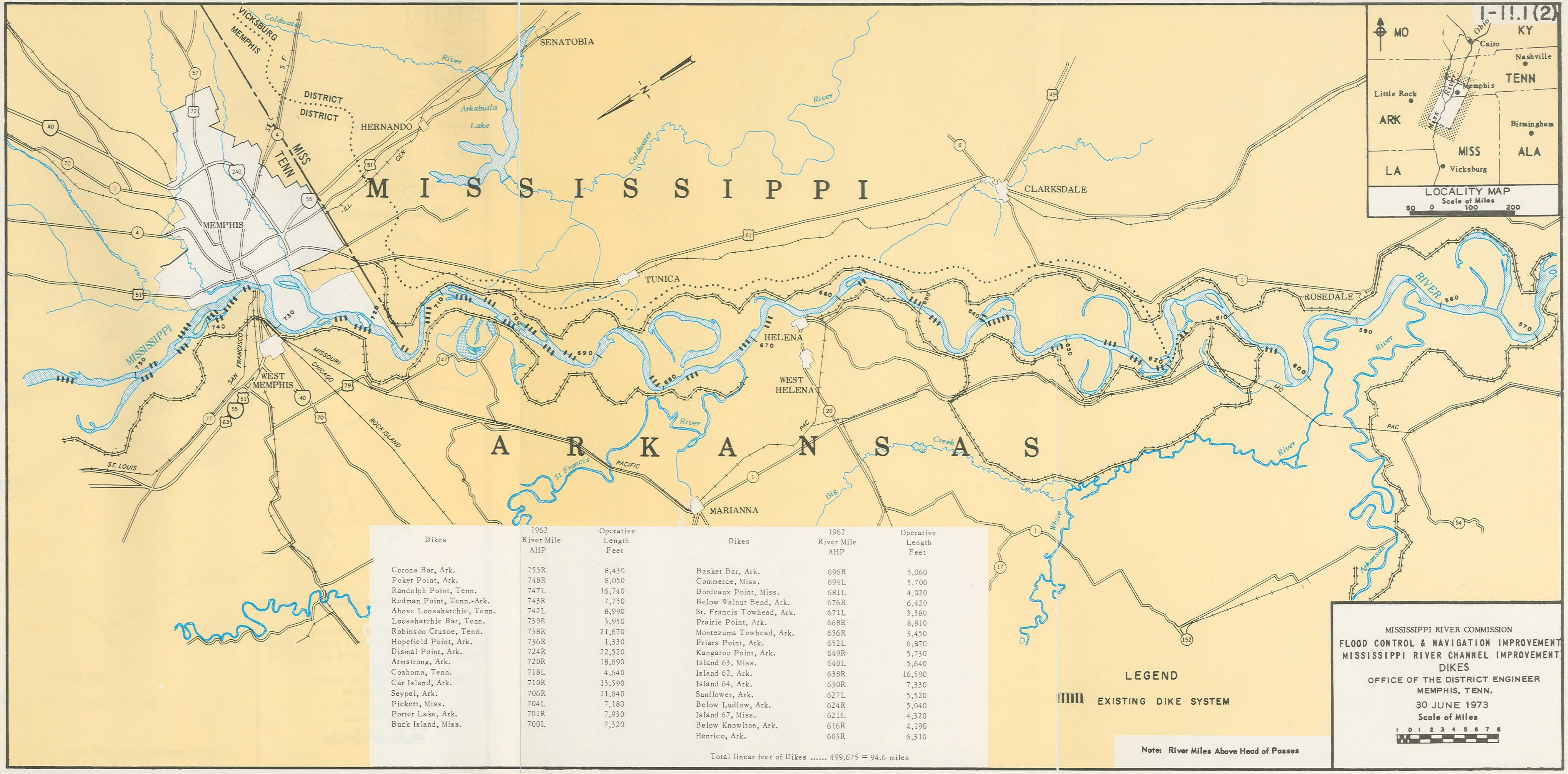
(continued on following sheet)

LEGEND

IIIIII EXISTING DIKE SYSTEM

Note: River Miles Above Head of Passes

MISSISSIPPI RIVER COMMISSION
FLOOD CONTROL & NAVIGATION IMPROVEMENT
MISSISSIPPI RIVER CHANNEL IMPROVEMENT
DIKES
OFFICE OF THE DISTRICT ENGINEER
MEMPHIS, TENN.
30 JUNE 1973
Scale of Miles
0 1 2 3 4 5 6 7 8



Dikes	1962 River Mile AHP	Operative Length Feet
Corona Bar, Ark.	755R	8,430
Poker Point, Ark.	748R	8,050
Randolph Point, Tenn.	747L	16,740
Redman Point, Tenn.-Ark.	743R	7,750
Above Loosahatchie, Tenn.	742L	8,990
Loosahatchie Bar, Tenn.	739R	3,950
Robinson Crusoe, Tenn.	738R	21,670
Hopefield Point, Ark.	736R	1,330
Dismal Point, Ark.	724R	22,520
Armstrong, Ark.	720R	18,690
Coahoma, Tenn.	718L	4,640
Cat Island, Ark.	710R	15,590
Seypel, Ark.	706R	11,640
Pickett, Miss.	704L	7,180
Porter Lake, Ark.	701R	7,930
Buck Island, Miss.	700L	7,320

Dikes	1962 River Mile AHP	Operative Length Feet
Basket Bar, Ark.	696R	5,060
Commerce, Miss.	694L	5,700
Bordeaux Point, Miss.	681L	4,920
Below Walnut Bend, Ark.	676R	6,420
St. Francis Towhead, Ark.	671L	3,380
Prairie Point, Ark.	668R	8,810
Montezuma Towhead, Ark.	656R	3,450
Friars Point, Ark.	652L	6,870
Kangaroo Point, Ark.	649R	5,730
Island 63, Miss.	640L	5,640
Island 62, Ark.	638R	16,590
Island 64, Ark.	630R	7,330
Sunflower, Ark.	627L	5,520
Below Ludlow, Ark.	624R	5,040
Island 67, Miss.	621L	4,320
Below Knowlton, Ark.	616R	4,190
Henrico, Ark.	603R	6,310

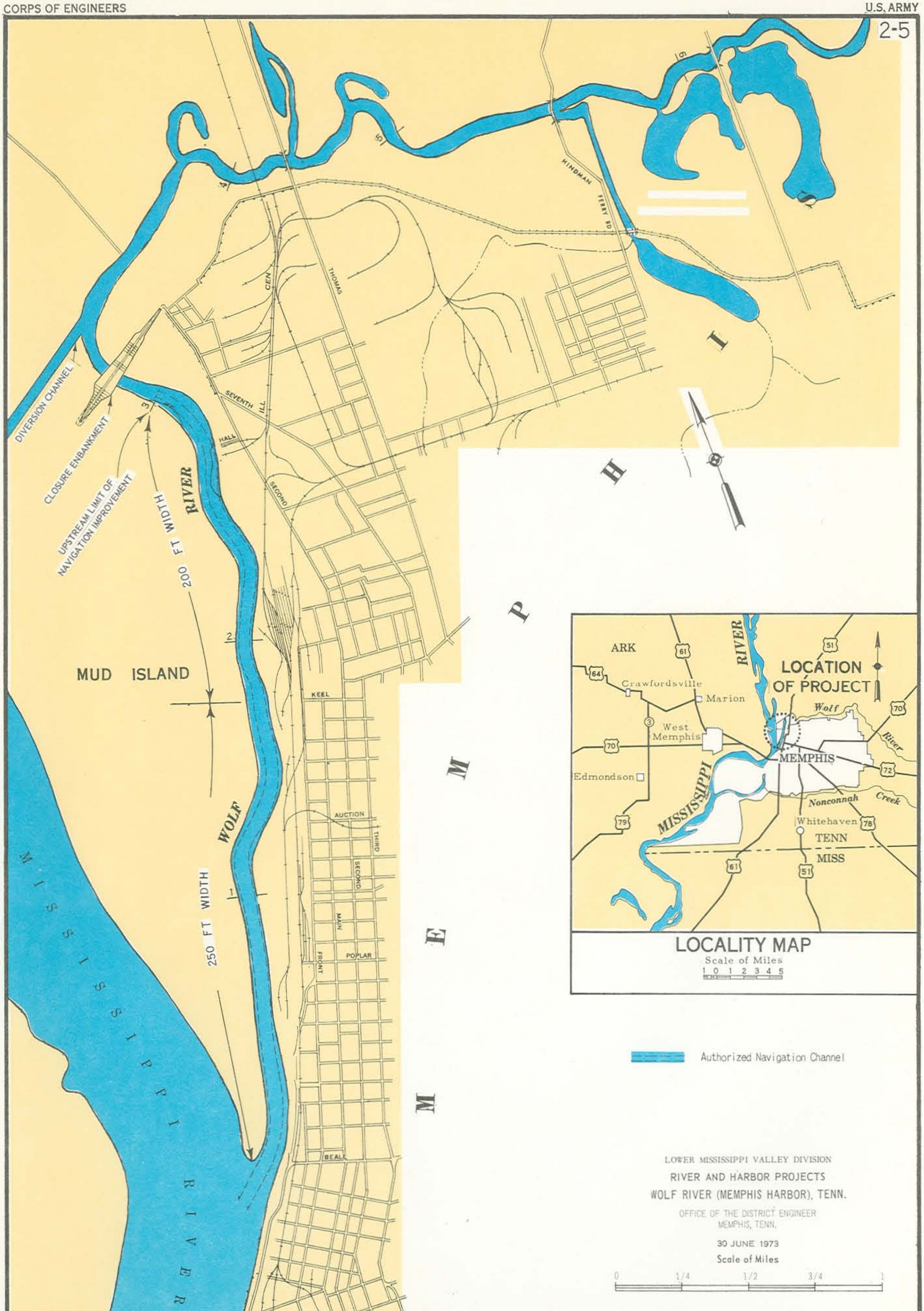
Total linear feet of Dikes ...... 499,675 = 94.6 miles

LEGEND

EXISTING DIKE SYSTEM

Note: River Miles Above Head of Passes

MISSISSIPPI RIVER COMMISSION
FLOOD CONTROL & NAVIGATION IMPROVEMENT
MISSISSIPPI RIVER CHANNEL IMPROVEMENT
DIKES
OFFICE OF THE DISTRICT ENGINEER
MEMPHIS, TENN.
30 JUNE 1973
Scale of Miles
1 0 1 2 3 4 5 6 7 8



LOWER MISSISSIPPI VALLEY DIVISION

RIVER AND HARBOR PROJECTS

WOLF RIVER (MEMPHIS HARBOR), TENN.

OFFICE OF THE DISTRICT ENGINEER
MEMPHIS, TENN.

30 JUNE 1973

Scale of Miles

0 1/4 1/2 3/4 1

LOWER MISSISSIPPI VALLEY DIVISION

NAVIGATION WORK UNDER SPECIAL AUTHORIZATION

HICKMAN HARBOR

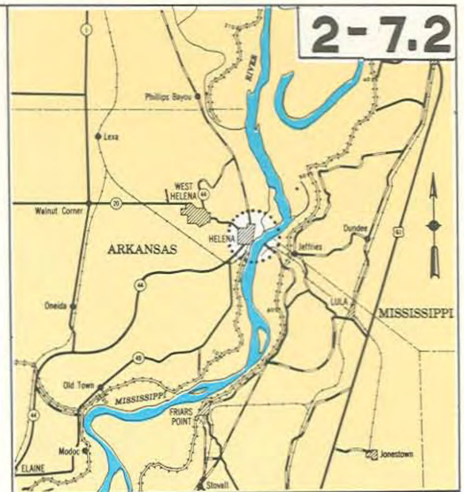
OFFICE OF THE DISTRICT ENGINEER
MEMPHIS, TENN.

30 JUNE 1972

SCALE IN FEET

1000 0 1000 2000 3000 4000 5000

2-7.2



LOCALITY MAP

SCALE OF MILES

0 2 4 6 8 10

LOWER MISSISSIPPI VALLEY DIVISION

NAVIGATION WORK UNDER
SPECIAL AUTHORIZATION

HELENA HARBOR

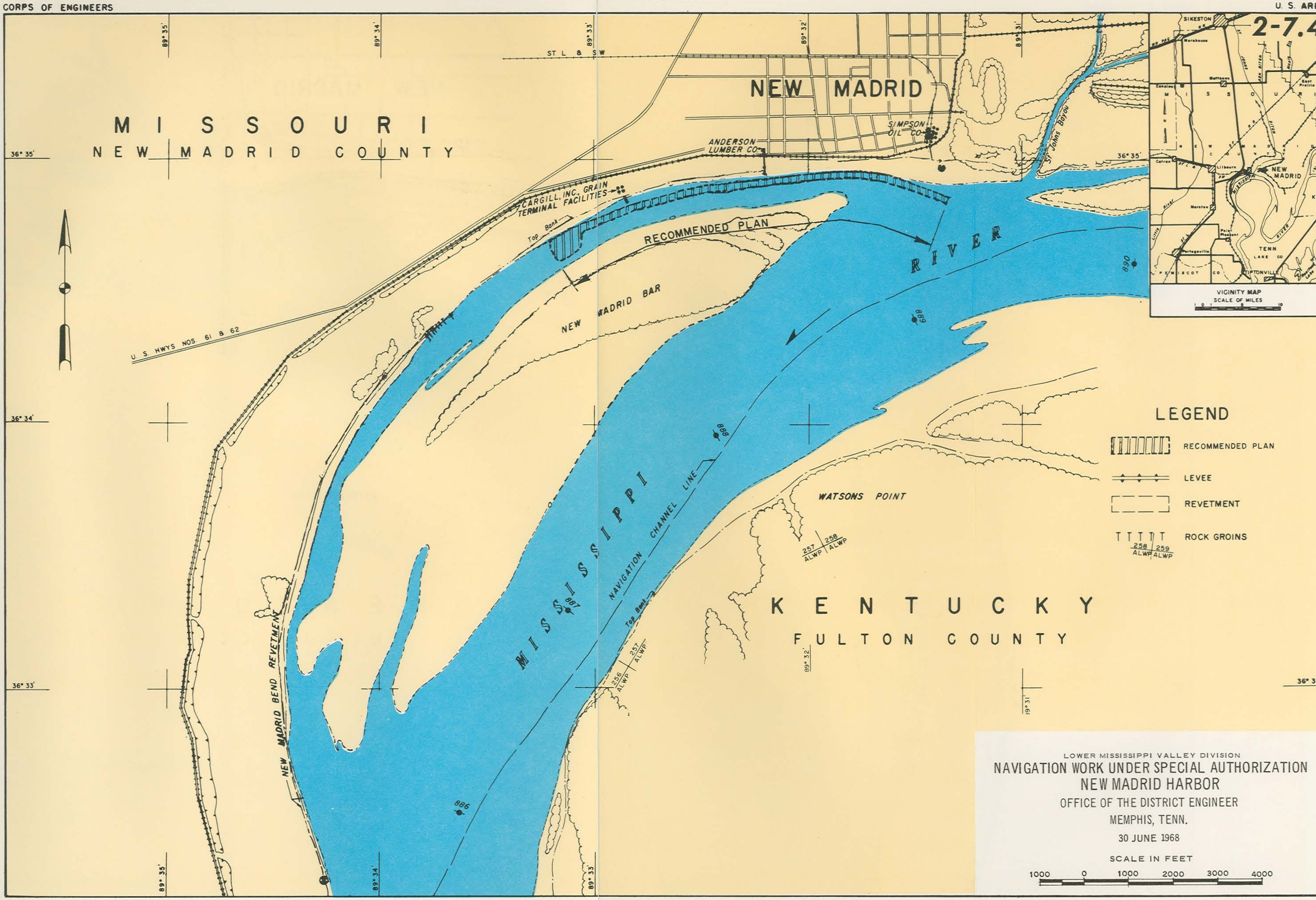
OFFICE OF THE DISTRICT ENGINEER
MEMPHIS, TENN.

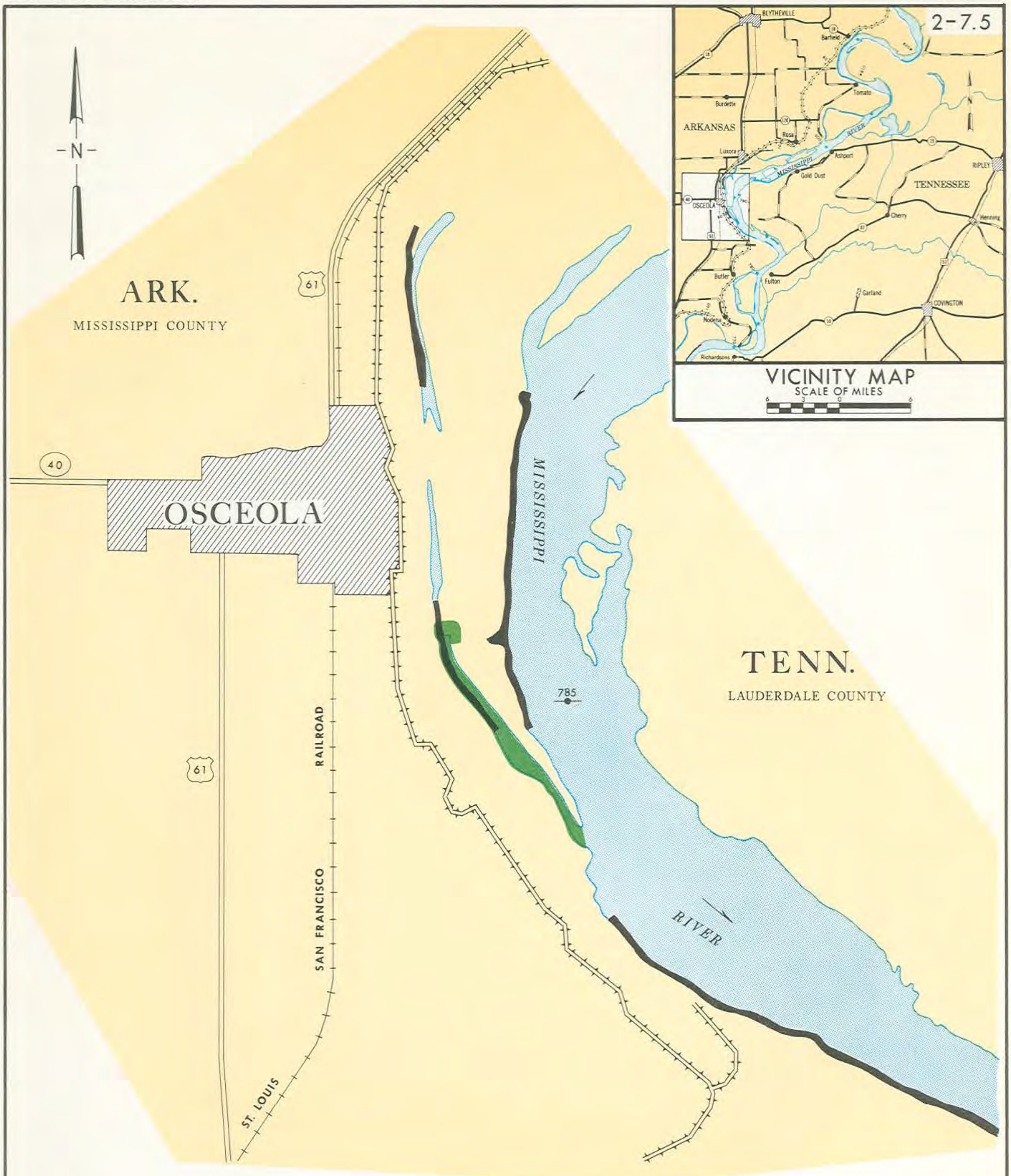
30 JUNE 1969

Scale of Feet

1000 0 1000 2000

CORPS OF ENGINEERS U. S. ARMY





LEGEND

AUTHORIZED CHANNEL DREDGING

LEVEE

REVETMENT

LOWER MISSISSIPPI VALLEY DIVISION

NAVIGATION WORK UNDER SPECIAL AUTHORIZATION

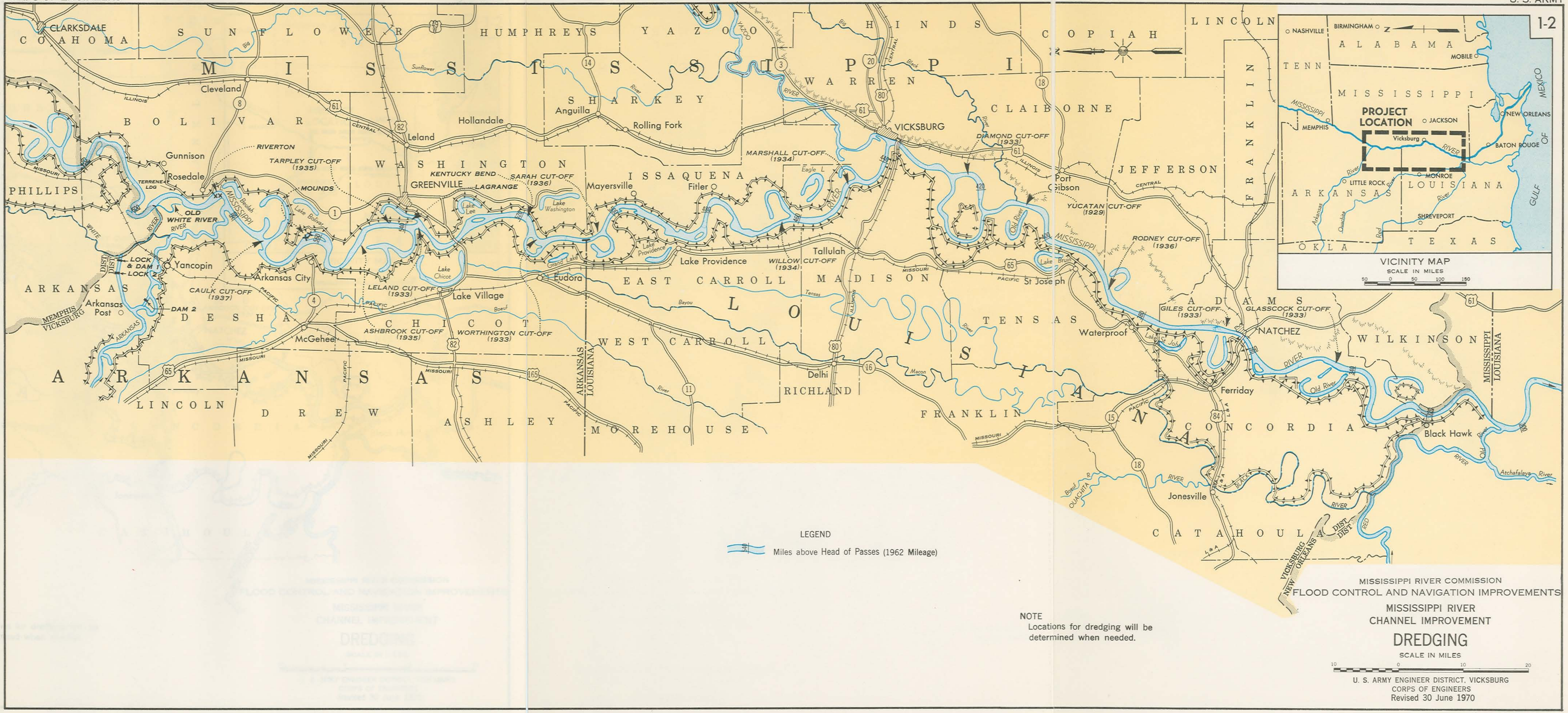
OSCEOLA HARBOR

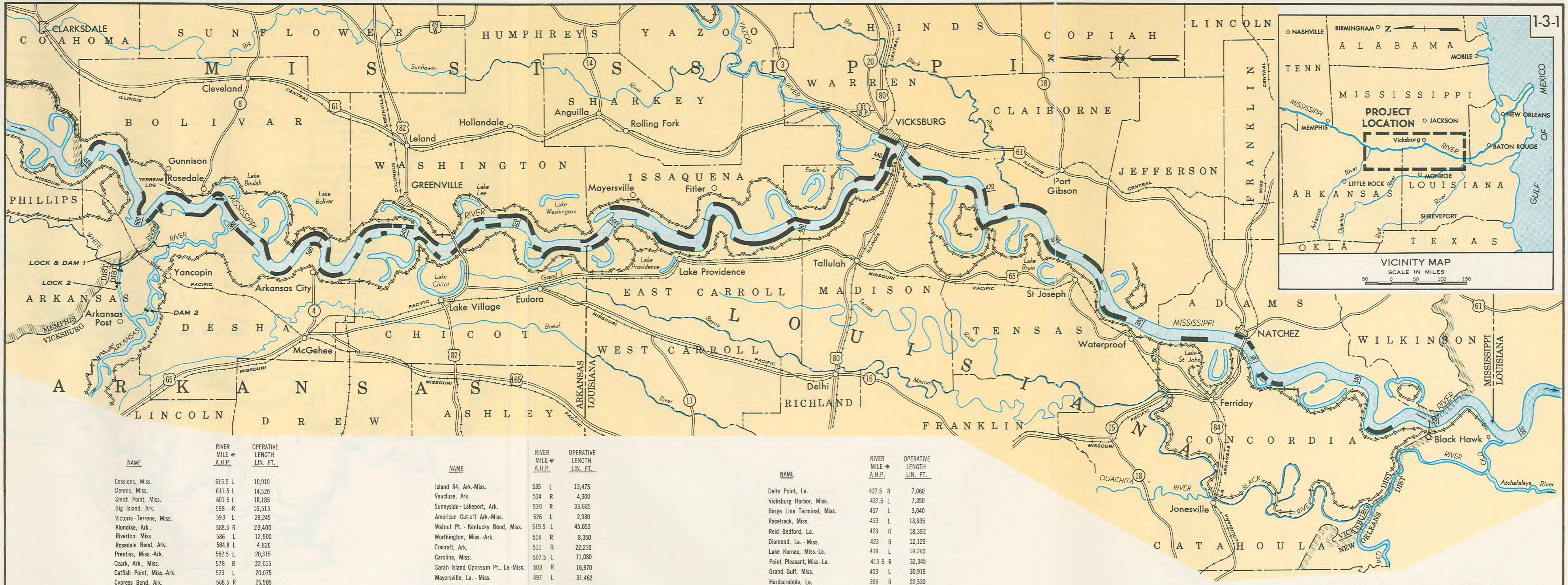
OFFICE OF THE DISTRICT ENGINEER
MEMPHIS, TENNESSEE

30 JUNE 1970

SCALE OF MILES

1 1/2 0 1


1-2
VICINITY MAP
SCALE IN MILES
PROJECT LOCATION
LEGEND
Miles above Head of Passes (1962 Mileage)
NOTE
Locations for dredging will be determined when needed.
MISSISSIPPI RIVER COMMISSION
FLOOD CONTROL AND NAVIGATION IMPROVEMENTS
MISSISSIPPI RIVER
CHANNEL IMPROVEMENT
DREDGING
SCALE IN MILES
U. S. ARMY ENGINEER DISTRICT, VICKSBURG
CORPS OF ENGINEERS
Revised 30 June 1970



NAME	RIVER MILE * A.H.P.	OPERATIVE LENGTH LIN. FT.
Cessions, Miss.	615.5 L	10,910
Dennis, Miss.	611.5 L	14,520
Smith Point, Miss.	601.5 L	18,185
Big Island, Ark.	598 R	16,515
Victoria - Terrene, Miss.	593 L	29,245
Klondike, Ark.	588.5 R	23,400
Riverton, Miss.	586 L	12,500
Rosedale Bend, Ark.	584.8 L	4,820
Prentiss, Miss.-Ark.	582.5 L	20,315
Ozark, Ark., Miss.	578 R	22,015
Catfish Point, Miss.-Ark.	573 L	20,075
Cypress Bend, Ark.	568.5 R	26,585
Eutaw - Mounds, Miss.	563.5 L	36,023
Pair O' Dice. Ark.	561 R	9,095
Huntington Point, Miss.	556 L	10,045
Ark. City - Yellow Bend, Ark.	553 R	40,560
Ashbrook Island, Miss.	549 R	3,455
Island 82, Ark.	546 R	3,080
Miller Bend, Miss.	544 L	29,360
Tarpley Island, Miss.	542.5 R	2,000
Leland Cut-off, Ark.	539.5 L	1,300
Spanish Moss, Ark.	539 R	4,580
La Grange Towhead, Miss.	538 R	9,130
Warfield Point, Miss.	537 L	4,320

*: Mileage approximately mid-point of revetment

NAME	RIVER MILE * A.H.P.	OPERATIVE LENGTH LIN. FT.
Island 84, Ark.-Miss.	535 L	13,475
Vaucluse, Ark.	534 R	4,300
Sunnyside - Lakeport, Ark.	530 R	33,685
American Cut-off Ark.-Miss.	526 L	2,980
Walnut Pt. - Kentucky Bend, Miss.	519.5 L	45,653
Worthington, Miss.-Ark.	514 R	8,350
Cracraft, Ark.	511 R	22,210
Carolina, Miss.	507.5 L	11,080
Sarah Island-Opossum Pt., La.-Miss.	503 R	16,970
Mayersville, La. - Miss.	497 L	31,462
Baleshed - Stack Island, Miss.-La.	488 R	44,310
Lake Providence, La.	489 R	11,600
Ben Lomond, Miss.	486.5 L	10,235
Hagaman, La.	481 R	37,756
Fitler - Cottonwood, Miss.	474.5 L	28,427
Goodrich, La.	467.5 R	32,300
Belle Island, La.-Miss.	460.5 L	23,160
Milliken Bend, La.	453 R	44,650
Marshall-Brown's Point, La. - Miss.	446.5 L	19,580
False Point, La.	443 R	12,860
Kings Point-Opposite Delta Pt., Miss.-La.	439 L	19,330

NAME	RIVER MILE * A.H.P.	OPERATIVE LENGTH LIN. FT.
Delta Point, La.	437.5 R	7,060
Vicksburg Harbor, Miss.	437.5 L	7,350
Barge Line Terminal, Miss.	437 L	3,040
Racetrack, Miss.	433 L	13,935
Reid Bedford, La.	429 R	18,392
Diamond, La. - Miss.	423 R	12,125
Lake Karnac, Miss.-La.	419 L	19,260
Point Pleasant, Miss.-La.	413.5 R	32,345
Grand Gulf, Miss.	403 L	30,915
Hardscrabble, La.	398 R	22,530
Goldbottom, Miss.	392 L	23,300
Browns Field, La.	388 R	9,280
Kemp Bend, La.	383.5 R	19,180
Gibson, La.	371.5 R	11,770
Natchez Front, Miss.	364 L	6,045
Carthage, Miss.	361.5 L	6,180
Natchez Island, Miss.	357.5 R	2,180
Morville, La.	356.5 R	5,730
Bougere Bend, La.	329 R	20,805
Total		1,117,828

LEGEND

Levees

Completed Bank Protection

Miles above Head of Passes (1962 Mileage)

MISSISSIPPI RIVER COMMISSION

FLOOD CONTROL AND NAVIGATION IMPROVEMENTS

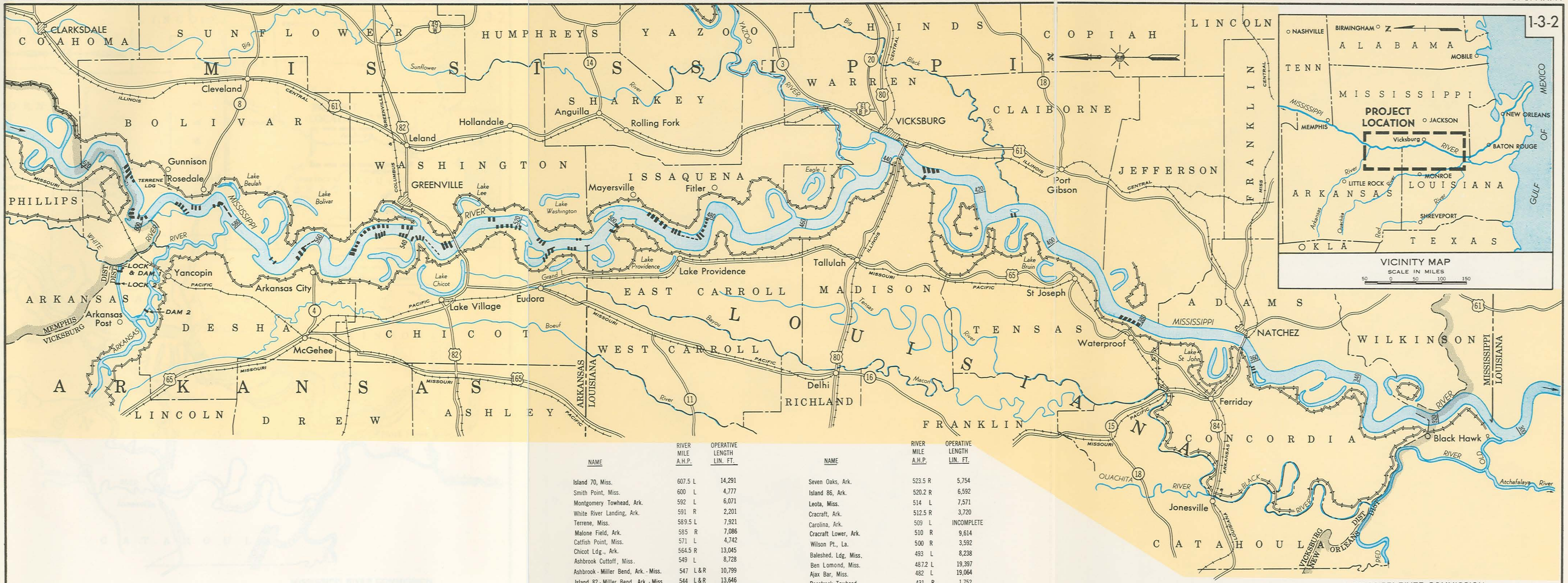
MISSISSIPPI RIVER
CHANNEL IMPROVEMENT

REVETMENTS

SCALE IN MILES

10 0 10 20

U. S. ARMY ENGINEER DISTRICT, VICKSBURG
CORPS OF ENGINEERS
Revised 30 June 1973



NAME	RIVER MILE A.H.P.	OPERATIVE LENGTH LIN. FT.
Island 70, Miss.	607.5 L	14,291
Smith Point, Miss.	600 L	4,777
Montgomery Towhead, Ark.	592 L	6,071
White River Landing, Ark.	591 R	2,201
Terrene, Miss.	589.5 L	7,921
Malone Field, Ark.	585 R	7,086
Catfish Point, Miss.	571 L	4,742
Chicot Ldg., Ark.	564.5 R	13,045
Ashbrook Cuttoff, Miss.	549 L	8,728
Ashbrook - Miller Bend, Ark. - Miss.	547 L & R	10,799
Island 82 - Miller Bend, Ark. - Miss.	544 L & R	13,646
Leland Neck, Miss.	540.5 L	4,315
Tarpley Cutoff, Miss. - Ark.	540.3 R	5,100
Leland Bar, Miss.	538 R	14,428
Island 84, Ark.	532.5 L	4,580
Walnut Point, Miss.	524.6 L	4,725

NAME	RIVER MILE A.H.P.	OPERATIVE LENGTH LIN. FT.
Seven Oaks, Ark.	523.5 R	5,754
Island 86, Ark.	520.2 R	6,592
Leota, Miss.	514 L	7,571
Cracraft, Ark.	512.5 R	3,720
Carolina, Ark.	509 L	INCOMPLETE
Cracraft Lower, Ark.	510 R	9,614
Wilson Pt., La.	500 R	3,592
Baleshed, Ldg, Miss.	493 L	8,238
Ben Lomond, Miss.	487.2 L	19,397
Ajax Bar, Miss.	482 L	19,064
Racetrack Towhead	431 R	1,752
Below Racetrack, Miss.	430.5 L	6,055
Yucatan, La.	410.1 R	8,592
Waterproof, La.	379 R	8,180
Natchez Island, Miss.	358 R	3,700
Total		238,276

LEGEND

Levees

Completed Dikes

Miles above Head of Passes (1962 Mileage)

MISSISSIPPI RIVER COMMISSION

FLOOD CONTROL AND NAVIGATION IMPROVEMENT

MISSISSIPPI RIVER

CHANNEL IMPROVEMENT

DIKES

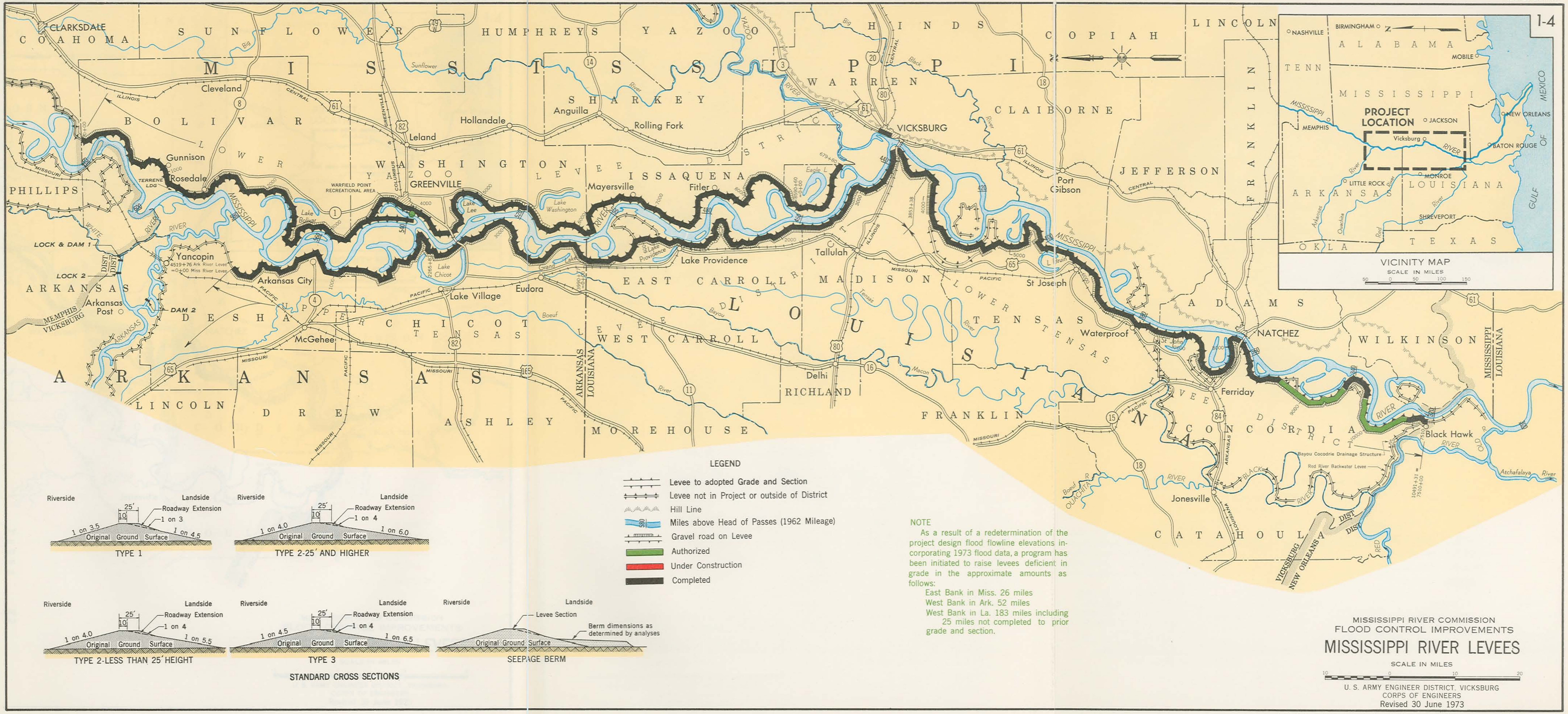
SCALE IN MILES

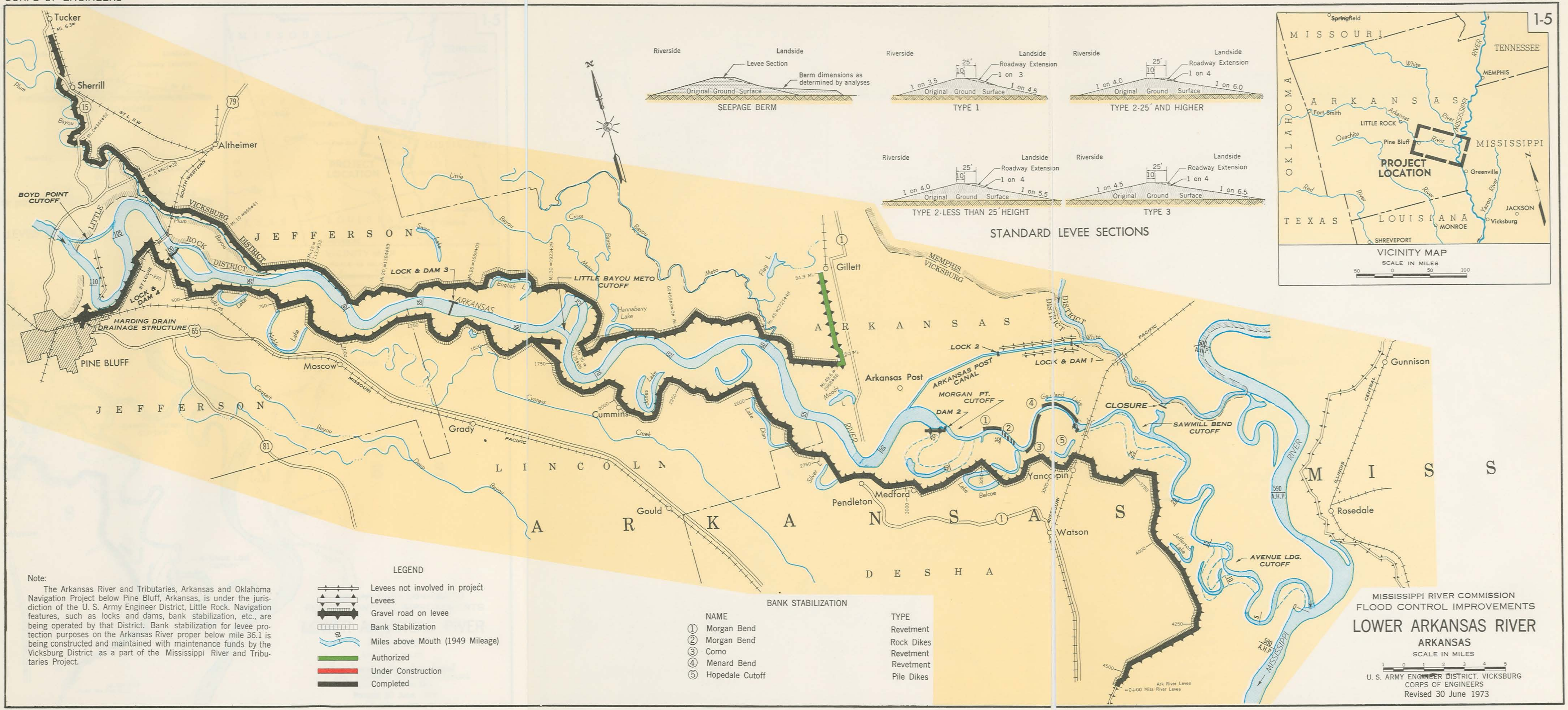
10 0 10 20

U. S. ARMY ENGINEER DISTRICT, VICKSBURG

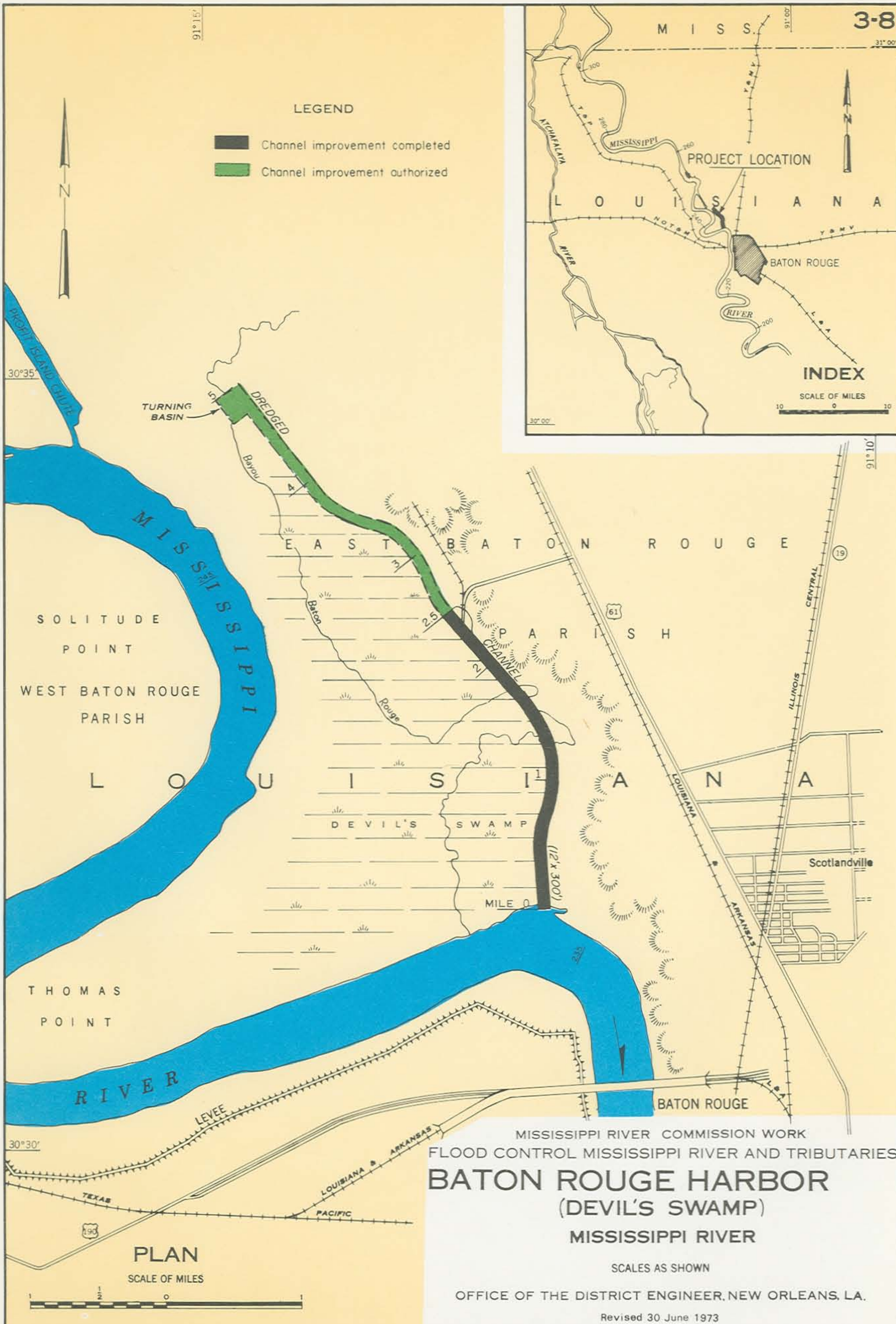
CORPS OF ENGINEERS

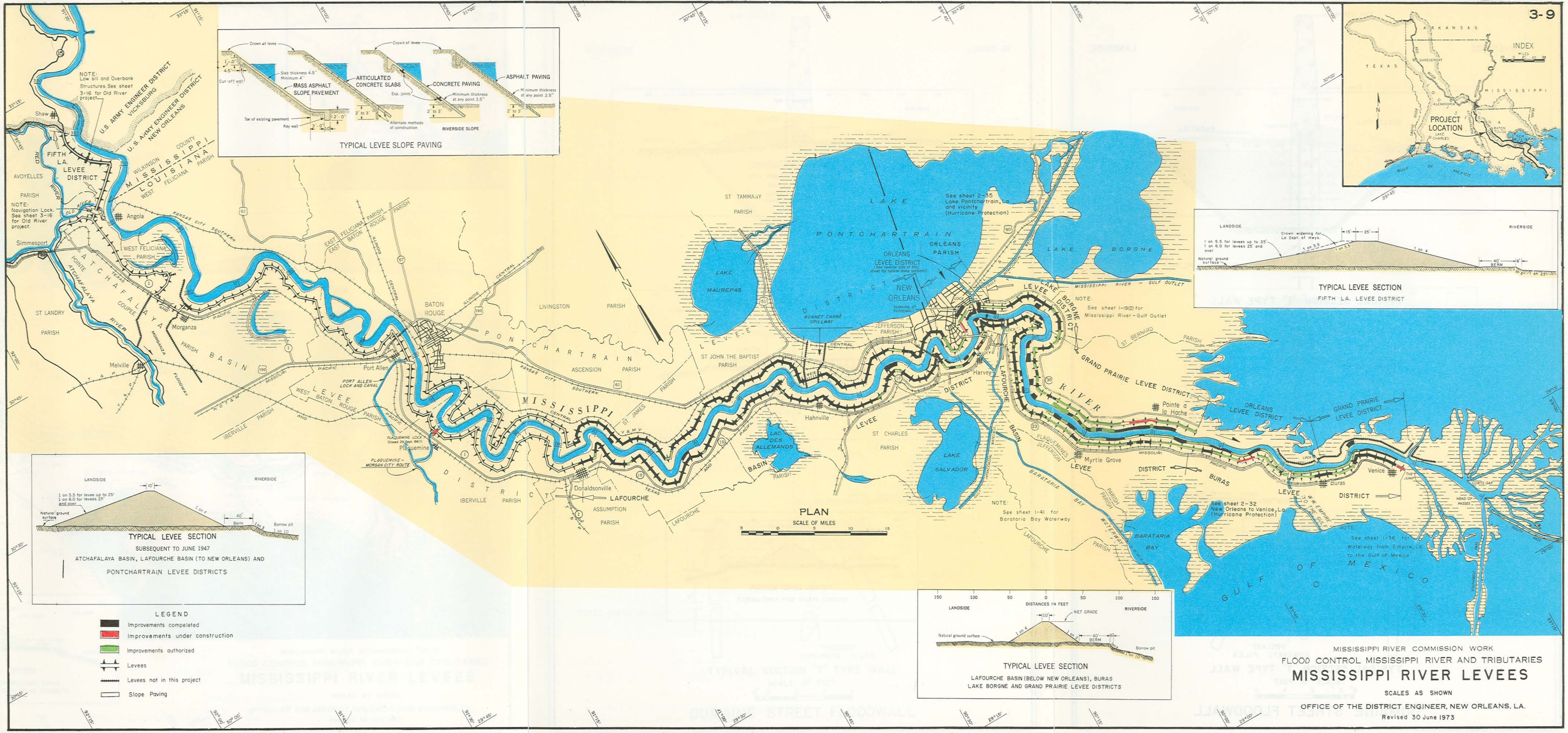
Revised 30 June 1973


1-4
MISSISSIPPI RIVER COMMISSION
FLOOD CONTROL IMPROVEMENTS
MISSISSIPPI RIVER LEVEES
SCALE IN MILES
U. S. ARMY ENGINEER DISTRICT, VICKSBURG
CORPS OF ENGINEERS
Revised 30 June 1973
LEGEND
Levee to adopted Grade and Section
Levee not in Project or outside of District
Hill Line
Miles above Head of Passes (1962 Mileage)
Gravel road on Levee
Authorized
Under Construction
Completed
NOTE
As a result of a redetermination of the project design flood flowline elevations incorporating 1973 flood data, a program has been initiated to raise levees deficient in grade in the approximate amounts as follows:
East Bank in Miss. 26 miles
West Bank in Ark. 52 miles
West Bank in La. 183 miles including 25 miles not completed to prior grade and section.
STANDARD CROSS SECTIONS
Riverside
Landside
Roadway Extension
Original Ground Surface
TYPE 1
TYPE 2-25′ AND HIGHER
TYPE 2-LESS THAN 25′ HEIGHT
TYPE 3
Levee Section
Berm dimensions as determined by analyses
SEEPAGE BERM
VICINITY MAP
SCALE IN MILES
PROJECT LOCATION
TENN
ALABAMA
MISSISSIPPI
ARKANSAS
LOUISIANA
TEXAS
OKLA
GULF OF MEXICO
NASHVILLE
BIRMINGHAM
MEMPHIS
JACKSON
Vicksburg
NEW ORLEANS
BATON ROUGE
MOBILE
MONROE
LITTLE ROCK
SHREVEPORT
MISSISSIPPI
LOUISIANA
ARKANSAS
CLARKSDALE
COAHOMA
SUNFLOWER
HUMPHREYS
YAZOO
HINDS
COPIAH
LINCOLN
BOLIVAR
Cleveland
Hollandale
Leland
WASHINGTON
GREENVILLE
SHARKEY
Anguilla
Rolling Fork
ISSAQUENA
Mayersville
Fitler
WARREN
VICKSBURG
CLAIBORNE
Port Gibson
JEFFERSON
FRANKLIN
Gunnison
Rosedale
PHILLIPS
Yancopin
Arkansas City
Lake Village
Eudora
Lake Providence
Tallulah
EAST CARROLL
MADISON
St Joseph
TENSAS
Waterproof
ADAMS
NATCHEZ
WILKINSON
Ferriday
CONCORDIA
Black Hawk
Jonesville
CATAHOULA
DESHA
Arkansas Post
McGehee
CHICOT
WEST CARROLL
Delhi
RICHLAND
LINCOLN
DREW
ASHLEY
MOREHOUSE
FRANKLIN
LOCK & DAM 1
LOCK 2
DAM 2
Lake Chicot
Lake Washington
Lake Bolivar
Lake Lee
Eagle L.
WARFIELD POINT RECREATIONAL AREA
Bayou Cocodrie Drainage Structure
Red River Backwater Levee
Atchafalaya River


1-5
MISSISSIPPI RIVER COMMISSION
FLOOD CONTROL IMPROVEMENTS
LOWER ARKANSAS RIVER
ARKANSAS
SCALE IN MILES
U. S. ARMY ENGINEER DISTRICT, VICKSBURG
CORPS OF ENGINEERS
Revised 30 June 1973
Note:
The Arkansas River and Tributaries, Arkansas and Oklahoma Navigation Project below Pine Bluff, Arkansas, is under the jurisdiction of the U. S. Army Engineer District, Little Rock. Navigation features, such as locks and dams, bank stabilization, etc., are being operated by that District. Bank stabilization for levee protection purposes on the Arkansas River proper below mile 36.1 is being constructed and maintained with maintenance funds by the Vicksburg District as a part of the Mississippi River and Tributaries Project.
LEGEND
Levees not involved in project
Levees
Gravel road on levee
Bank Stabilization
Miles above Mouth (1949 Mileage)
Authorized
Under Construction
Completed
BANK STABILIZATION
NAME
TYPE
① Morgan Bend
Revetment
② Morgan Bend
Rock Dikes
③ Como
Revetment
④ Menard Bend
Revetment
⑤ Hopedale Cutoff
Pile Dikes
STANDARD LEVEE SECTIONS
Riverside
Landside
Levee Section
Berm dimensions as determined by analyses
Original Ground Surface
SEEPAGE BERM
Roadway Extension
1 on 3
1 on 3.5
1 on 4.5
TYPE 1
1 on 4
1 on 4.0
1 on 6.0
TYPE 2-25′ AND HIGHER
1 on 5.5
TYPE 2-LESS THAN 25′ HEIGHT
1 on 4.5
1 on 6.5
TYPE 3
VICINITY MAP
SCALE IN MILES
MISSOURI
TENNESSEE
MEMPHIS
ARKANSAS
MISSISSIPPI
OKLAHOMA
TEXAS
LOUISIANA
PROJECT LOCATION
LITTLE ROCK
Fort Smith
Pine Bluff
Greenville
JACKSON
Vicksburg
MONROE
SHREVEPORT
Springfield
Tucker
Sherrill
Altheimer
BOYD POINT CUTOFF
LOCK & DAM 4
HARDING DRAIN DRAINAGE STRUCTURE
PINE BLUFF
Moscow
JEFFERSON
Grady
Cummins
LINCOLN
Gould
ARKANSAS
LOCK & DAM 3
LITTLE BAYOU METO CUTOFF
Gillett
Arkansas Post
ARKANSAS POST CANAL
LOCK 2
LOCK & DAM 1
MORGAN PT. CUTOFF
DAM 2
CLOSURE
SAWMILL BEND CUTOFF
Pendleton
Medford
Yancopin
Watson
DESHA
AVENUE LDG. CUTOFF
Gunnison
Rosedale
MISS
VICKSBURG DISTRICT
MEMPHIS VICKSBURG
ARKANSAS RIVER
MISSISSIPPI RIVER


LOWER MISSISSIPPI VALLEY DIVISION
FLOOD CONTROL IMPROVEMENTS
OUACHITA RIVER & TRIBUTARIES
ARKANSAS AND LOUISIANA
SCALE IN MILES
U. S. ARMY ENGINEER DISTRICT, VICKSBURG
CORPS OF ENGINEERS
Revised 30 June 1973
Riverside
Landside
1 on 3
1 on 4
10'
Original Ground Surface
STANDARD CROSS SECTION
1 on 6 Seepage Line
STANDARD CROSS SECTION
CLASS A
OUACHITA RIVER LEVEES
VICINITY MAP
SCALE IN MILES
PROJECT LOCATION
MISSOURI
KENTUCKY
TENNESSEE
ARKANSAS
OKLAHOMA
MISSISSIPPI
ALABAMA
GEORGIA
TEXAS
LOUISIANA
GULF OF MEXICO
WICHITA
Springfield
TULSA
NASHVILLE
MEMPHIS
LITTLE ROCK
Pine Bluff
Greenville
DALLAS
MONROE
JACKSON
Vicksburg
MONTGOMERY
HOUSTON
NEW ORLEANS
LITTLE ROCK DISTRICT
MEMPHIS DISTRICT
VICKSBURG DISTRICT
NEW ORLEANS DISTRICT
ARKANSAS
LOUISIANA
MISSISSIPPI
BLAKELY MOUNTAIN DAM-LAKE OUACHITA
DE GRAY LAKE (UNDER CONSTRUCTION)
NARROWS DAM-LAKE GREESON
MURFREESBORO LAKE AUTHORIZED
OUTLET CANAL
INTERCEPTING CANAL
CALION LEVEE
U S LOCK & DAM NO 8
U S LOCK & DAM NO 6
FLOODWALL GAP CLOSURE
COLUMBIA LOCK AND DAM
JONESVILLE LOCK AND DAM
LEGEND
Existing levee not in project
Levee
Authorized Lake
Channel Improvement
Miles above Mouth
Levee Not to Grade and Section
New Dam
Highwater Closure
Authorized
Under Construction
Completed
Design Water Level
Landside
Ground Surface
Concrete Buttress 16" thick Spaced 9'-9½" Centers
Steel Sheet Piling
8"X8" Steel Pile
TYPICAL SECTION
TYPE A WALL
SCALE OF FEET
Concrete Buttress 20" thick Spaced 9'-9½" Centers
TYPICAL SECTION
TYPE B WALL
SCALE OF FEET
TYPICAL SECTION
TYPE C WALL
SCALE OF FEET
EXISTING MONROE & WEST MONROE FLOODWALL


3-8
LEGEND
Channel improvement completed
Channel improvement authorized
INDEX
SCALE OF MILES
10 0 10
MISS.
LOUISIANA
PROJECT LOCATION
BATON ROUGE
ATCHAFALAYA
RIVER
MISSISSIPPI
RIVER
31° 00'
30° 00'
91° 00'
91° 15'
91° 10'
30°35'
30°30'
PROFIT ISLAND CHUTE
TURNING BASIN
DREDGED
CHANNEL
(12' x 300')
MILE 0
Bayou
Baton
Rouge
EAST BATON ROUGE PARISH
SOLITUDE POINT
WEST BATON ROUGE PARISH
LOUISIANA
MISSISSIPPI
RIVER
DEVIL'S SWAMP
THOMAS POINT
LEVEE
Scotlandville
BATON ROUGE
ILLINOIS CENTRAL
LOUISIANA & ARKANSAS
TEXAS PACIFIC
MISSISSIPPI RIVER COMMISSION WORK
FLOOD CONTROL MISSISSIPPI RIVER AND TRIBUTARIES
BATON ROUGE HARBOR
(DEVIL'S SWAMP)
MISSISSIPPI RIVER
SCALES AS SHOWN
OFFICE OF THE DISTRICT ENGINEER, NEW ORLEANS, LA.
Revised 30 June 1973
PLAN
SCALE OF MILES



MISSISSIPPI RIVER COMMISSION WORK

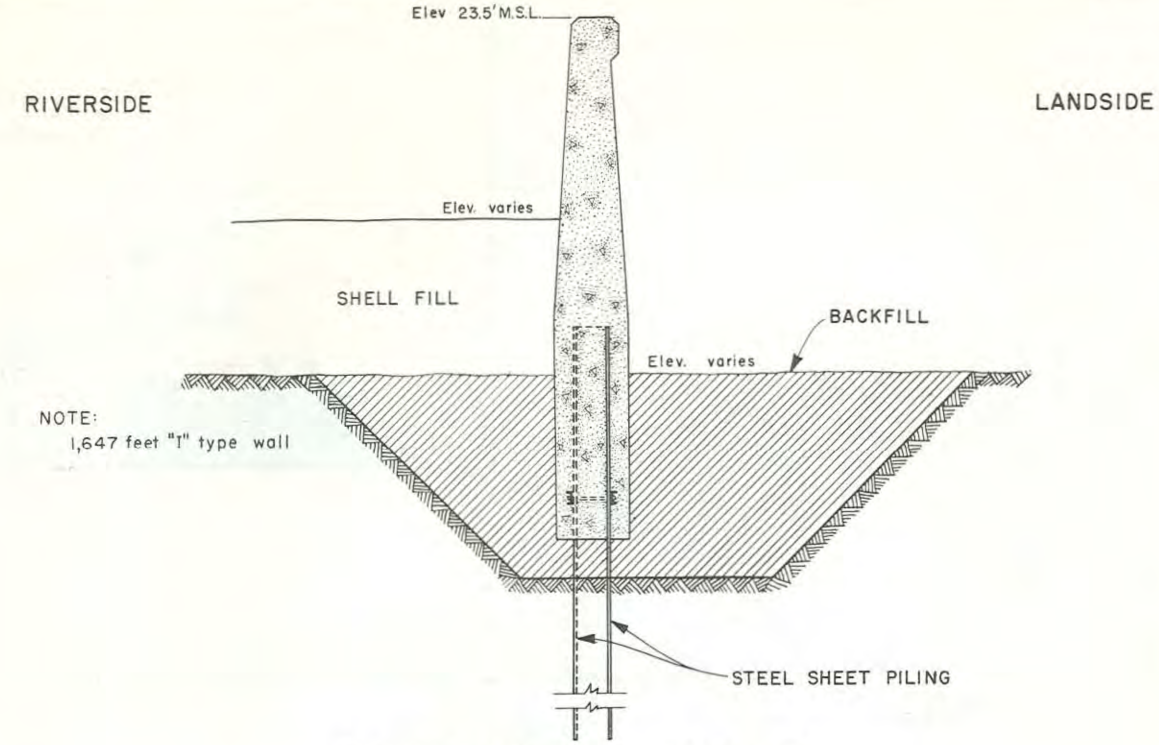
FLOOD CONTROL MISSISSIPPI RIVER AND TRIBUTARIES

MISSISSIPPI RIVER LEVEES

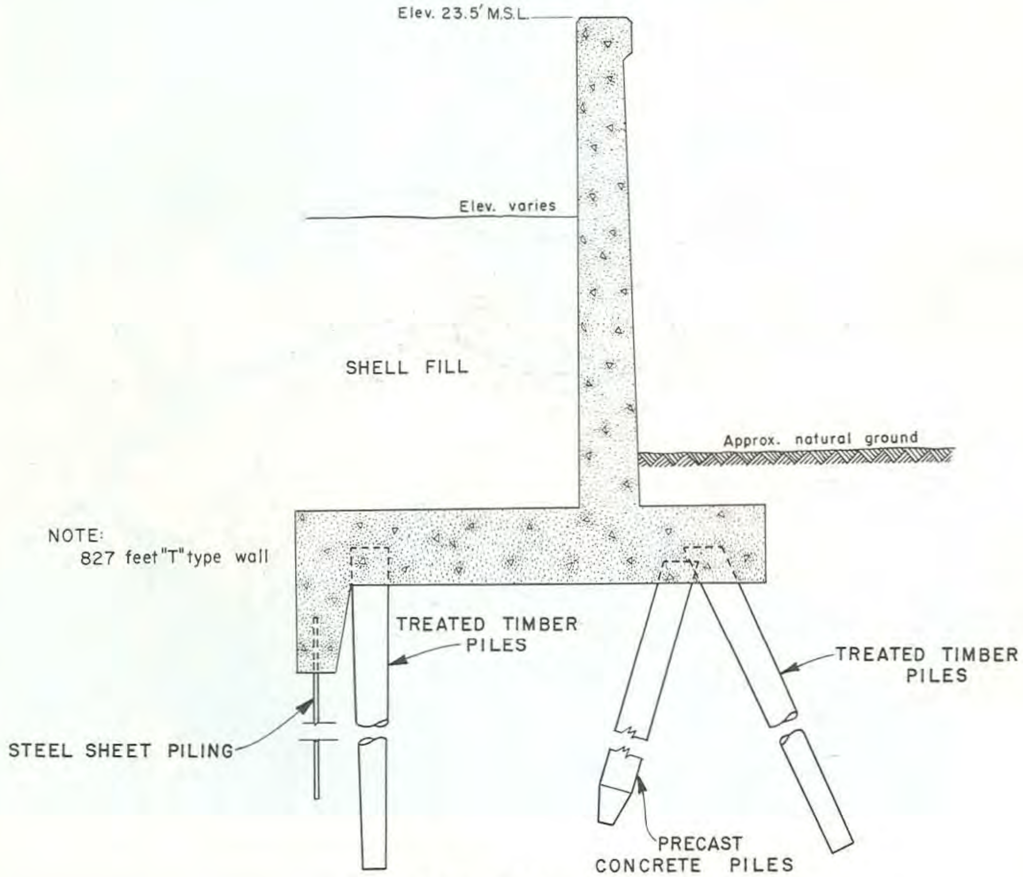
SCALES AS SHOWN

OFFICE OF THE DISTRICT ENGINEER, NEW ORLEANS, LA.

Revised 30 June 1973



TYPICAL SECTION "I" TYPE WALL

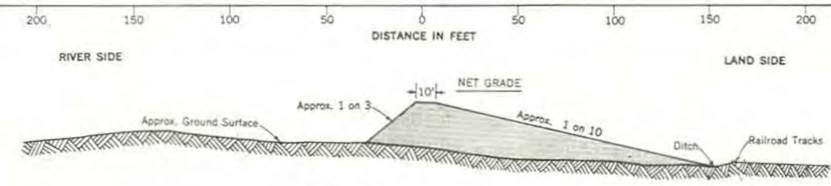


TYPICAL SECTION "T" TYPE WALL

SCALE OF FEET

12" 0 2 4 6

DUMAINE STREET FLOODWALL



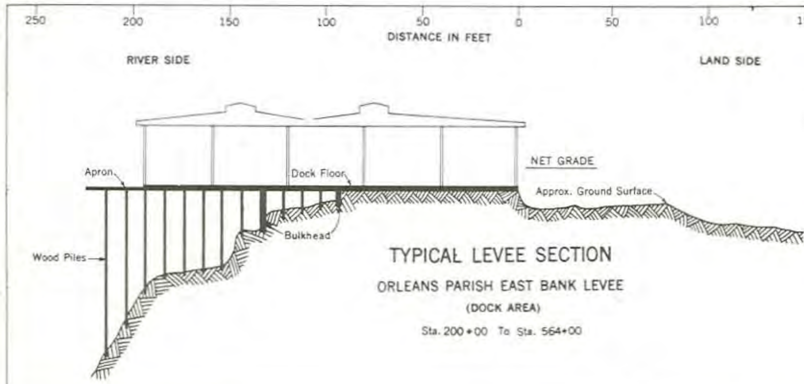
TYPICAL LEVEE SECTION

ORLEANS PARISH EAST BANK LEVEE

(OUTSIDE DOCK AREA)

Sta. 0+00 To Sta. 200+00

Sta. 564+00 To Sta. 695+89

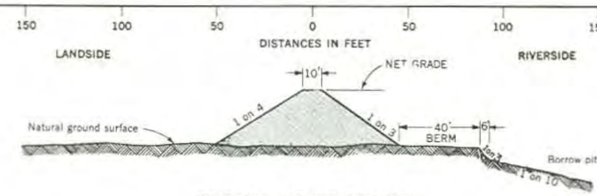


TYPICAL LEVEE SECTION

ORLEANS PARISH EAST BANK LEVEE

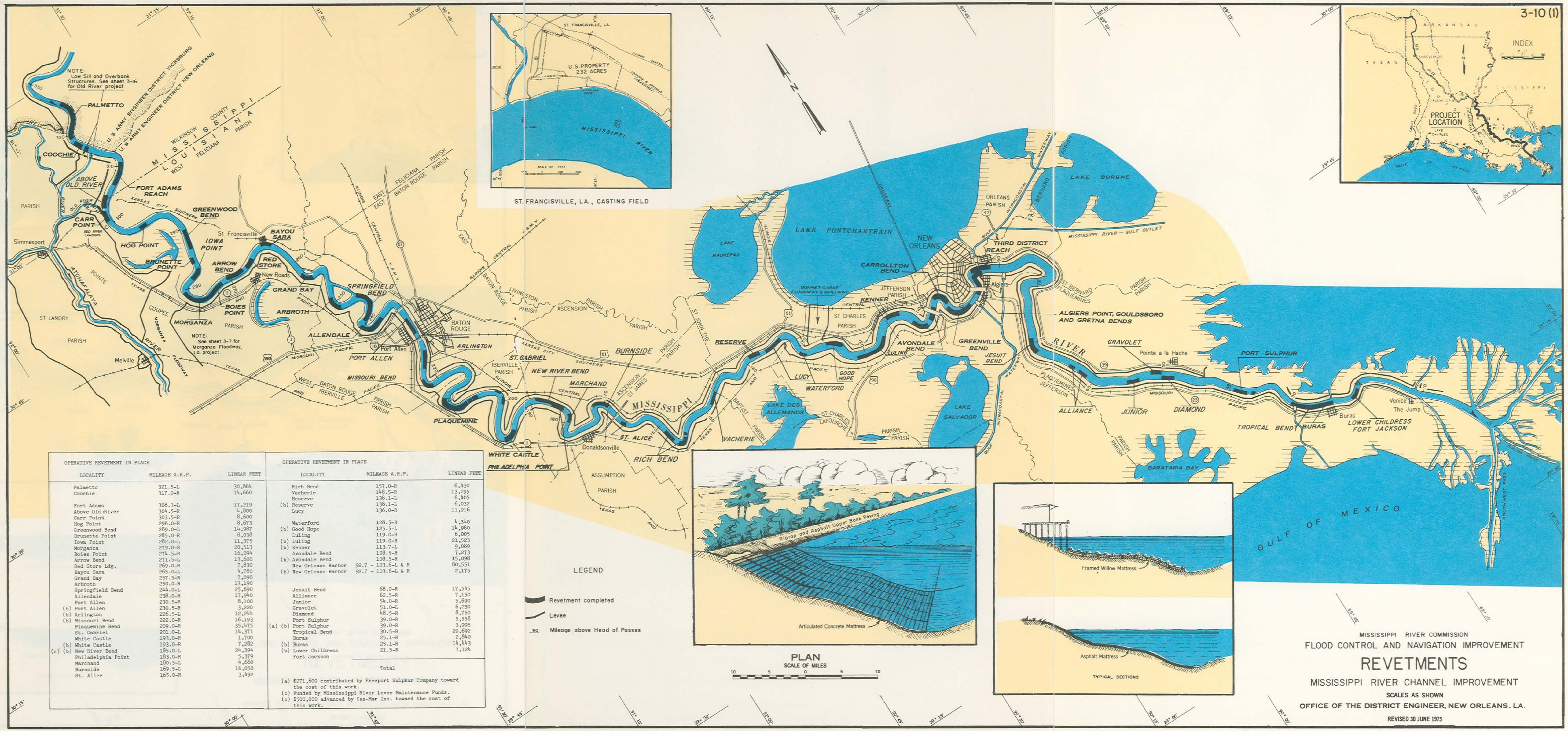
(DOCK AREA)

Sta. 200+00 To Sta. 564+00



TYPICAL LEVEE SECTION

ORLEANS PARISH WEST LEVEE DISTRICT



OPERATIVE REVETMENT IN PLACE

	LOCALITY	MILEAGE A.H.P.	LINEAR FEET
	Palmetto	321.5-L	30,864
	Coochie	317.0-R	14,660
	Fort Adams	308.3-L	17,219
	Above Old River	304.5-R	4,800
	Carr Point	303.5-R	8,600
	Hog Point	296.0-R	8,673
	Greenwood Bend	289.0-L	14,987
	Brunette Point	285.0-R	8,038
	Iowa Point	282.0-L	11,375
	Morganza	279.0-R	20,513
	Boies Point	274.5-R	16,094
	Arrow Bend	271.5-L	13,600
	Red Store Ldg.	269.0-R	7,830
	Bayou Sara	265.0-L	4,780
	Grand Bay	257.5-R	7,090
	Arbroth	250.0-R	13,190
	Springfield Bend	244.0-L	25,690
	Allendale	238.0-R	17,940
	Port Allen	230.5-R	8,100
(b)	Port Allen	230.5-R	3,220
(b)	Arlington	226.5-L	12,244
(b)	Missouri Bend	222.0-R	16,193
	Plaquemine Bend	209.0-R	35,475
	St. Gabriel	201.0-L	14,371
	White Castle	193.0-R	1,700
(b)	White Castle	193.0-R	7,282
(c) (b)	New River Bend	185.0-L	24,394
	Philadelphia Point	183.0-R	5,379
	Marchand	180.5-L	4,660
	Burnside	169.5-L	16,050
	St. Alice	165.0-R	3,492

OPERATIVE REVETMENT IN PLACE

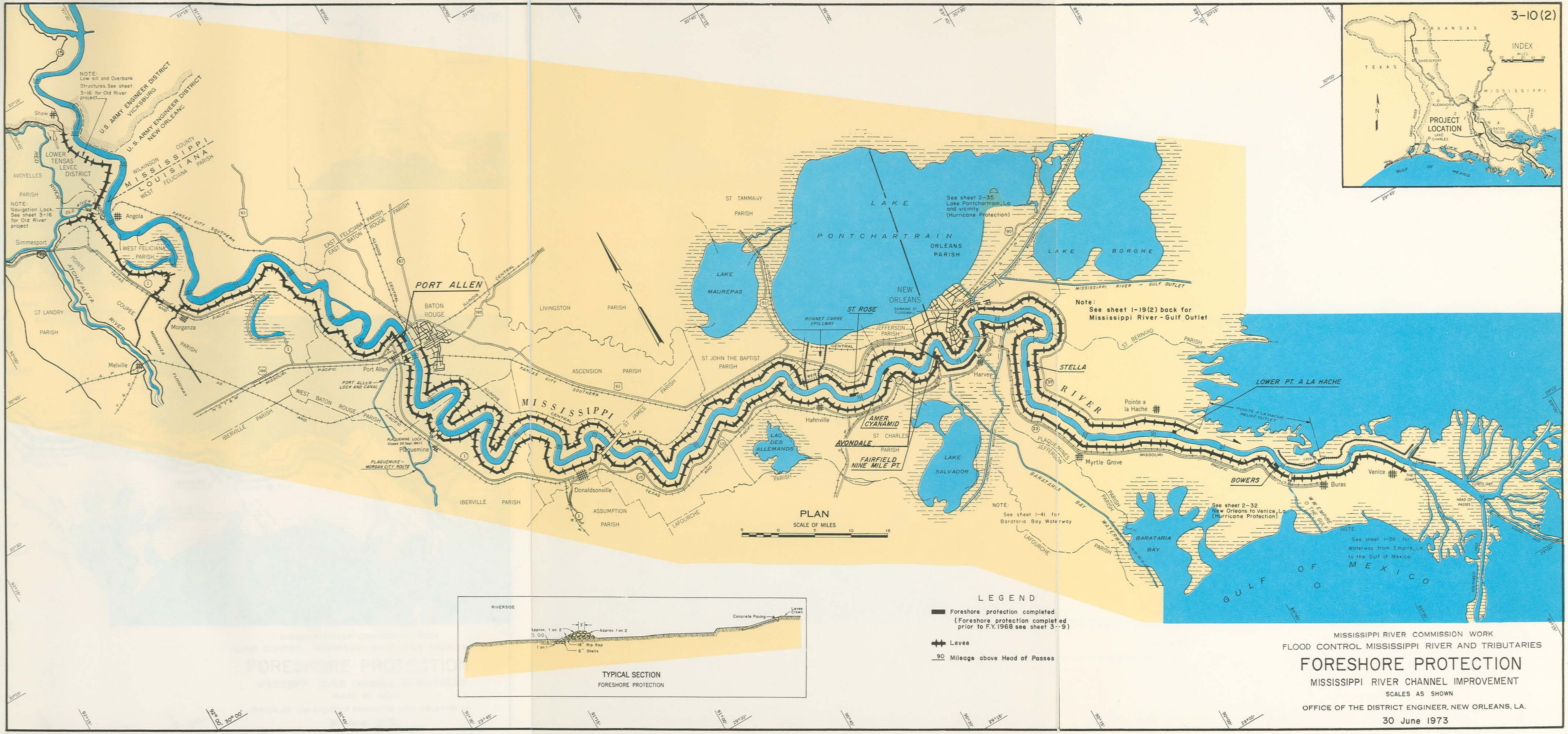
	LOCALITY	MILEAGE A.H.P.	LINEAR FEET
	Rich Bend	157.0-R	6,430
	Vacherie	148.5-R	13,295
	Reserve	138.1-L	6,405
(b)	Reserve	138.1-L	6,032
	Lucy	136.0-R	11,916
	Waterford	128.5-R	4,340
(b)	Good Hope	125.5-L	14,980
	Luling	119.0-R	6,005
(b)	Luling	119.0-R	21,523
(b)	Kenner	113.7-L	9,089
	Avondale Bend	108.5-R	7,273
(b)	Avondale Bend	108.5-R	15,098
	New Orleans Harbor	92.7 - 103.6-L & R	80,551
(b)	New Orleans Harbor	92.7 - 103.6-L & R	2,175
	Jesuit Bend	68.0-R	17,545
	Alliance	62.5-R	7,150
	Junior	54.0-R	5,690
	Gravolet	51.0-L	6,230
	Diamond	48.5-R	8,750
	Port Sulphur	39.0-R	5,558
(a) (b)	Port Sulphur	39.0-R	3,995
	Tropical Bend	30.5-R	20,692
	Buras	25.1-R	2,840
(b)	Buras	25.1-R	14,443
(b)	Lower Childress	21.5-R	7,124
	Fort Jackson		
		Total	

(a) \$271,600 contributed by Freeport Sulphur Company toward the cost of this work.
(b) Funded by Mississippi River Levee Maintenance Funds.
(c) \$500,000 advanced by Cas-Mar Inc. toward the cost of this work.

MISSISSIPPI RIVER COMMISSION
FLOOD CONTROL AND NAVIGATION IMPROVEMENT

REVETMENTS

MISSISSIPPI RIVER CHANNEL IMPROVEMENT
SCALES AS SHOWN
OFFICE OF THE DISTRICT ENGINEER, NEW ORLEANS, LA.
REVISED 30 JUNE 1973



MISSISSIPPI RIVER COMMISSION WORK

FLOOD CONTROL MISSISSIPPI RIVER AND TRIBUTARIES

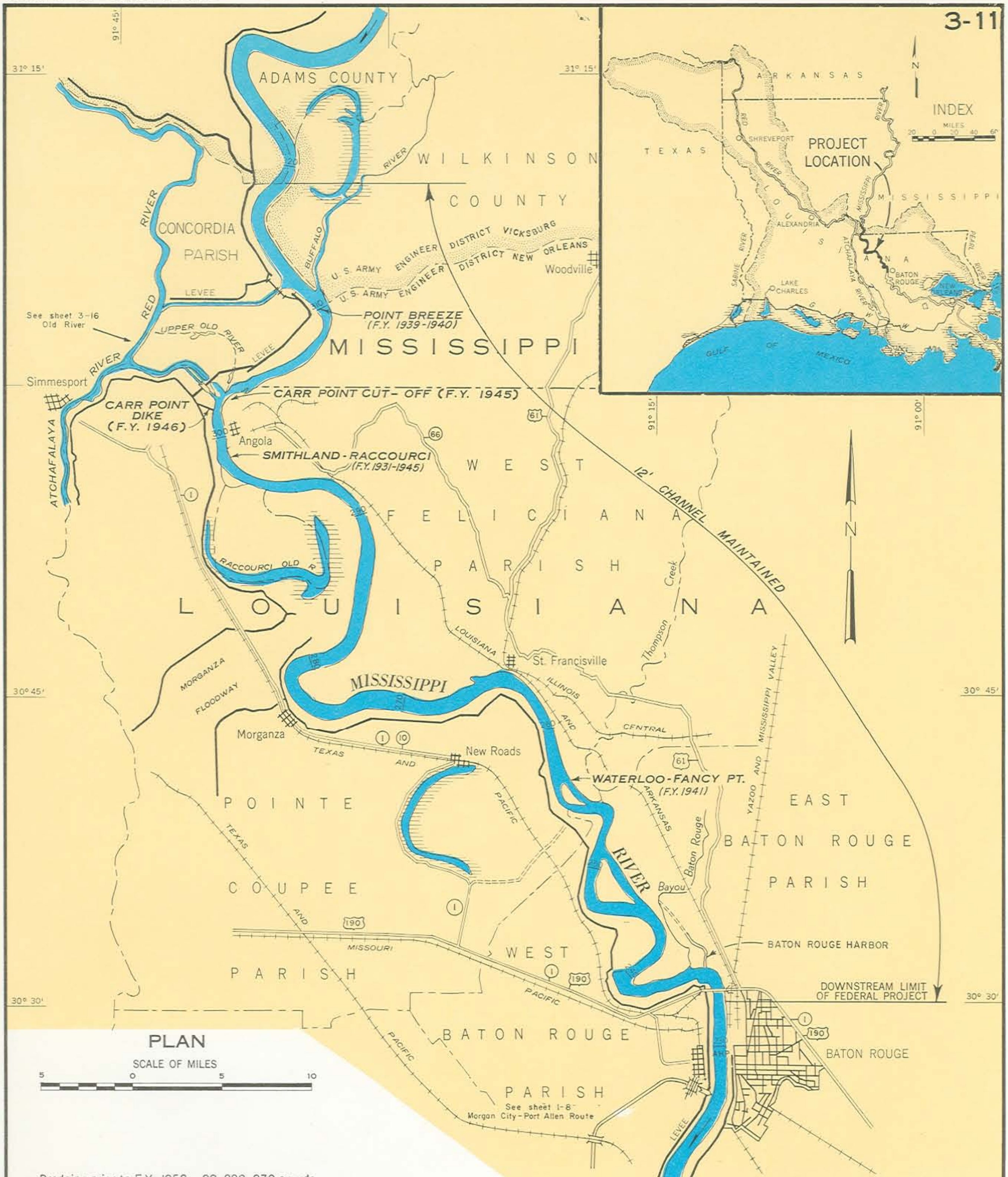
FORESHORE PROTECTION

MISSISSIPPI RIVER CHANNEL IMPROVEMENT

SCALES AS SHOWN

OFFICE OF THE DISTRICT ENGINEER, NEW ORLEANS, LA.

30 June 1973



Dredging prior to F.Y. 1958 – 28,282,239 cu. yds.
Dredging F.Y. 1958-1962 – None

NOTE:
Proposed dredging for flood control is not indicated on this map. Location of the dredging will be determined as needed.

MISSISSIPPI RIVER COMMISSION

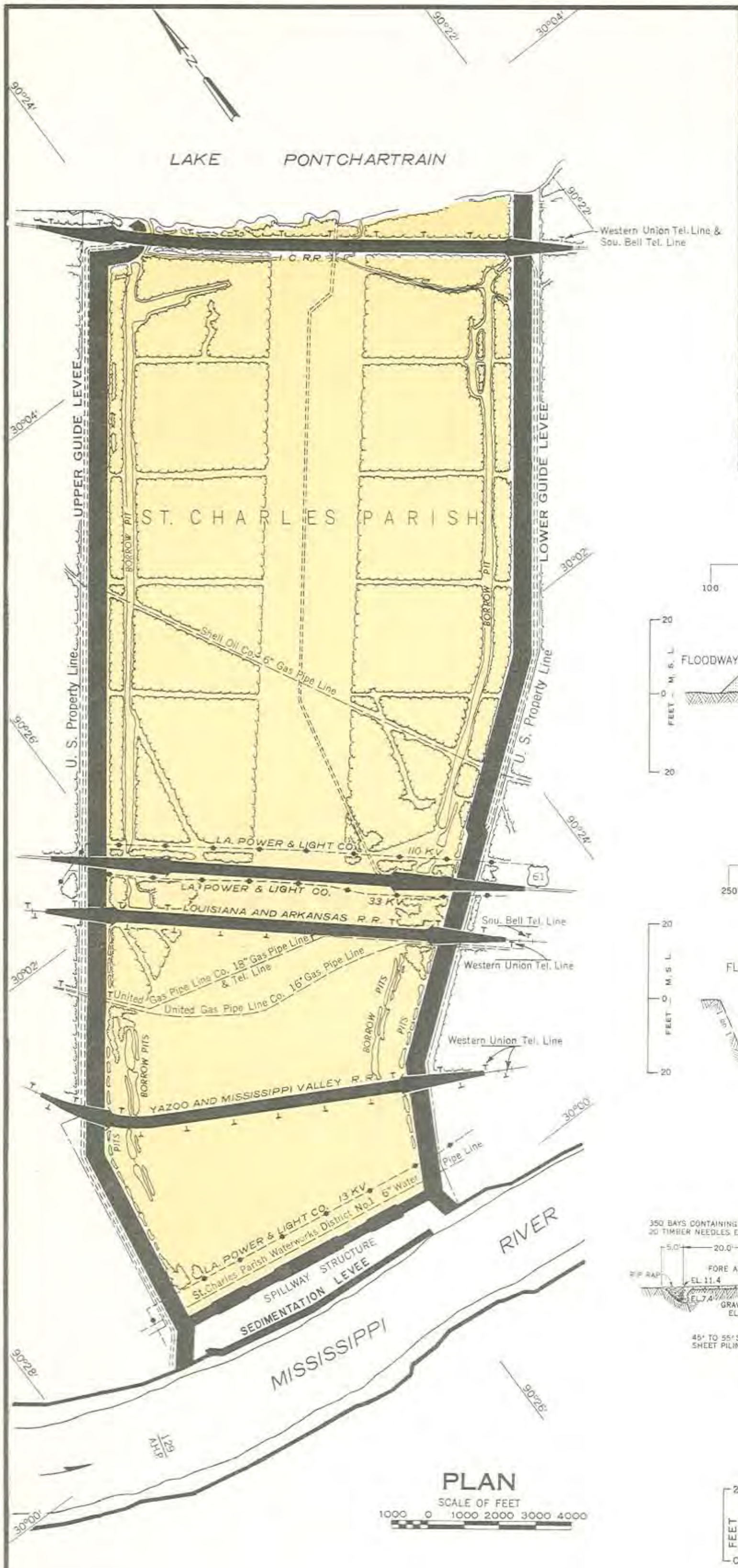
FLOOD CONTROL AND NAVIGATION IMPROVEMENT

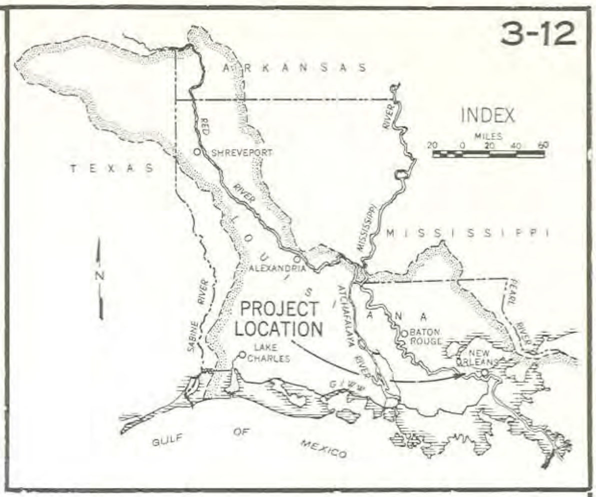
MISSISSIPPI RIVER CHANNEL IMPROVEMENT

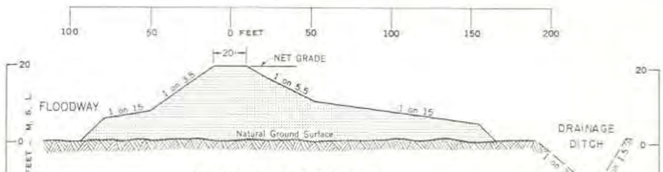
DREDGING

SCALES AS SHOWN

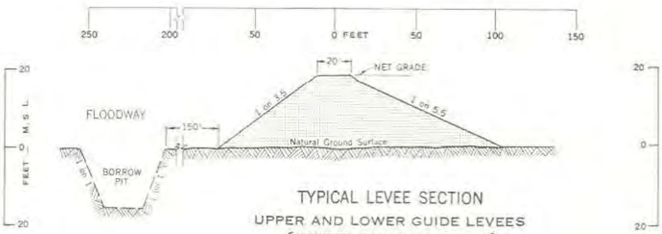
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
Revised 30 June 1964



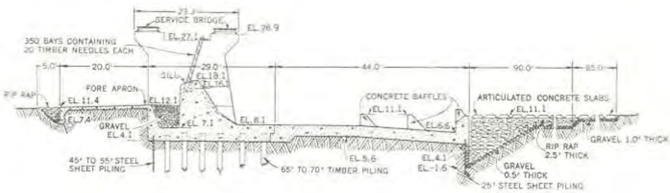




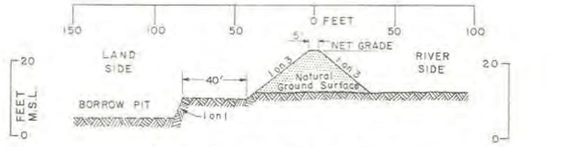
TYPICAL LEVEE SECTION
UPPER AND LOWER GUIDE LEVEES
SWAMP PORTION OF FLOODWAY
(U. S. HY. NO. 61 TO LAKE PONTCHARTRAIN)



TYPICAL LEVEE SECTION
UPPER AND LOWER GUIDE LEVEES
(MISSISSIPPI RIVER TO U. S. HY. NO. 61)



SECTION THROUGH SPILLWAY STRUCTURE



SEDIMENTATION CONTROL LEVEE

LEGEND

Improvements completed

MISSISSIPPI RIVER COMMISSION WORK

FLOOD CONTROL MISSISSIPPI RIVER AND TRIBUTARIES

BONNET CARRE SPILLWAY

SCALES AS SHOWN

OFFICE OF THE DISTRICT ENGINEER, NEW ORLEANS, LA.

Revised 30 June 1961

NOTE: Elevations are in feet and refer to Mean Sea Level

APPENDIX F

LETTERS RECEIVED ON THE DRAFT EIS

UNITED STATES DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

P.O. Box 678, Champaign, Illinois 61820

November 13, 1974

Colonel Gerald E. Galloway
District Engineer
U. S. Army Corps of Engineers
P. O. Box 60
Vicksburg, Mississippi 39180

Attention: LMKED-PQ

Dear Colonel Galloway:

The draft environmental impact statement for the Mississippi River and Tributaries, Mississippi River Levees and Channel Improvement prepared by the U. S. Army Engineer District, Vicksburg, Mississippi, dated September 1974, that was addressed to the State Conservationist, Soil Conservation Service, U. S. Department of Agriculture, Champaign, Illinois, September 30, 1974, has been reviewed as requested.

Page 155 (3) - This paragraph indicates an expected increase in borrow pit acreage by 10,000 to 20,000 acres. Page 156 (1) states "natural growth in the borrow areas would resume at the cessation of construction activities." You may wish to consider planting adapted species for early cover and wildlife habitat.

Page 210 (4) - indicates an interest in finding adapted grasses for overall levee maintenance. The Soil Conservation Service technical guide lists suggested seedings for such areas. Each Soil Conservation Service field office can make this information available on request.

Sedimentation from spoil is recognized as a problem and revegetation is planned. No mention is made of erosion control during nonconstruction periods. This may require the use of temporary seedings in some cases.

If you have questions relating to erosion control, vegetative seedings (temporary or permanent), woody plantings, borrow area development, soils, or any soil and water conservation practice, don't hesitate to get in touch with our district conservationist at the Soil Conservation Service field office or this office.

We appreciate the opportunity to review and comment on this project.

Sincerely,

Arlon L. Hanson, Acting
Howard W. Busch
State Conservationist

UNITED STATES DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

P. O. Box 2323, Little Rock, Arkansas 72203

November 7, 1974

Re: LMKED-PQ

Col. Gerald E. Galloway
District Engineer
Vicksburg District, Corps of Engineers
P. O. Box 60
Vicksburg, Mississippi 39180

Dear Colonel Galloway:

The draft environmental impact statement "Mississippi River and Tributaries, Mississippi River Levees and Channel Improvement," overall is very good to excellent. However, it was noted that paragraph 5 omits adverse effects on biological communities. Also, paragraph 6.05 omits biological parameters and impacts.

I appreciate the opportunity to review and comment on this document.

Sincerely,

M J Spears

M. J. Spears
State Conservationist

UNITED STATES DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

P.O. Box 459, Columbia, Missouri 65201

November 21, 1974

Vicksburg District
Corps of Engineers
P.O. Box 60
Vicksburg, Mississippi 39180

Gentlemen:

We appreciate receiving the copies of the Draft Environmental Impact Statement for the Missouri River Levees and Channel Improvement. We have reviewed the statement and believe that you have done an excellent job of preparing a thorough statement. We have no comments regarding the works of improvement in the State of Missouri.

If we can be of any additional assistance, please let us know.

Sincerely,

J. Vernon Martin

J. Vernon Martin
State Conservationist

cc: William Heard, State Conservationist, Jackson, Mississippi
T. C. Byerly, Office of the Secretary of Agriculture, Washington

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

P. O. Box 610
Jackson, Mississippi 39205

November 18, 1974

Colonel Gerald E. Galloway
District Engineer
U. S. Army, Corps of Engineers
P. O. Box 60
Vicksburg, Mississippi 39160

Dear Colonel Galloway:

We have reviewed your draft environmental impact statement, Mississippi River and Tributaries (Mississippi River Levees and Channel Improvement) dated September 1974.

Your statement is well written and gives a good description of the project, the environmental resources in the project area and the impacts on these resources resulting from the project. The expected changes in land use are clearly documented.

The project covers the main stem of the Mississippi River only and does not cover tributary streams; therefore, it will have no effect on Soil Conservation Service projects in Mississippi.

A positive statement on page 6, paragraph 1.03, "Project Features," that this proposed action will not affect projects of other agencies would be helpful if this is, in fact, the case.

We thank you for the opportunity to review and comment on this draft statement.

Sincerely,

W. L. Heard
W. L. Heard
State Conservationist

cc:
Kenneth E. Grant, Administrator
W. L. Vaught, Director, TSC
Council on Environmental Quality (5 copies)
Coordinator of Environmental Quality Activities

UNITED STATES DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

561 U. S. Courthouse, Nashville, TN 37203

November 18, 1974

Colonel Gerald E. Galloway
District Engineer
U. S. Corps of Engineers
P. O. Box 60
Vicksburg, Mississippi 39180

Dear Colonel Galloway:

Subject: Mississippi River and Tributaries, Mississippi River Levees and Channel Improvement Draft Environmental Impact Statement

We have studied the subject draft environmental impact statement and offer these comments for your consideration:

1. Page 69, lines 11 and 12: Page 62, paragraph 2, line 1, states that the northern sector of the project is characterized by agriculture. We suggest that these acreages be displayed separately not grouped with sandbars, etc.

2. Page 70, line 2: The Levin and Read citation is incomplete (see page 240).

3. Page 184, last 4 lines: The biology known of slackwater areas and chutes should have been included in the environmental setting.

4. Pages 186 and 190: Trade off of slackwater areas for borrow pits is not equitable in distribution. Loss of slackwater is between river miles 600-700 and between 800 and 900. Areas of gain are primarily between river miles 200 and 500. This makes the loss of productive habitat even more adverse for those areas of loss.

We appreciate the opportunity to review and comment on this proposed project.

Sincerely,

Paul M. Howard

Paul M. Howard
State Conservationist

CC: Kenneth E. Grant, Administrator, SCS (1 copy)
Office of the Coordinator of Environmental Quality Activities (1 copy)
Council on Environmental Quality (5 copies)

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

333 Waller Avenue, Lexington, KY 40504

November 13, 1974

U. S. Army Engineer District
Attention: LMKED-PQ
Corps of Engineers
Post Office Box 60
Vicksburg, MS 39180

Gentlemen:

This is in response to Mr. Gerald E. Galloway's letter of September 30, 1974, requesting comments of a draft environmental impact statement prepared for the Mississippi River Levees and Channel Improvement, a feature of the Mississippi River and Tributaries Project.

We have reviewed the subject statement and have no comments to make regarding the project's effects upon the environment since the statement appears to adequately consider the conservation of land, water, and other related natural resources.

We appreciate the opportunity to comment on this draft environmental impact statement.

Sincerely,

G E Murray

Glen E. Murray
State Conservationist

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION VI
1600 PATTERSON, SUITE 1100
DALLAS, TEXAS 75201

December 12, 1974

Colonel Gerald E. Galloway
Vicksburg District
Corps of Engineers
P. O. Box 60
Vicksburg, Mississippi 39180

Dear Colonel Galloway:

We have reviewed the Draft Environmental Impact Statement, Mississippi River and Tributaries (MR&T), Mississippi River Levees and Channel Improvement. The proposed project is designed to improve navigation and reduce flooding between Cairo, Illinois and Venice, Louisiana. Project features include dikes, revetments, levees, and maintenance and construction dredging of the mainstem and several harbors. The proposed project will affect portions of Arkansas, Illinois, Kentucky, Louisiana, Mississippi, Missouri, and Tennessee.

We have classified your Draft Environmental Impact Statement as Category 3, Inadequate. Our reason for categorizing the statement as Inadequate is based on the lack of sufficient information to assess adequately the total impact of project implementation on the Mississippi River Basin System. For example, we do not believe the draft statement provides enough information on the Atchafalaya segment of the MR&T project. The Atchafalaya Floodway (authorized as part of the MR&T and currently being studied by the New Orleans District) is designed to act as a diversion channel for Mississippi River floodwaters and is subject to frequent overbank flooding. Presently, one of the major concerns in the Atchafalaya Basin is the increased siltation rates and resultant land building. Siltation rates have been accelerated by the numerous river alterations that have occurred in the Mississippi River Basin. We believe the potential long-term effects of siltation in the Atchafalaya Basin are related to the various project actions in the MR&T system, and therefore, a consideration of all MR&T actions and their interrelationship to the integrity of the lower Mississippi River Basin is needed in the final statement. Without this information it is not possible to determine the full environmental effect of the proposed MR&T program. Therefore, we suggest that an environmental evaluation of the interrelated effects of the Atchafalaya Basin project and the remaining MR&T projects be included in the final statement. Also, the final statement should provide additional information on water quality, sediment analysis, secondary environmental impacts, dredge material placement, and alternatives.

The following additional comments are offered for your consideration in preparing the final impact statement:

Water Quality Monitoring

The statement (pg. 158) mentions that EPA criteria for heavy metals and nitrogen may be exceeded during dredging operations. However, no information concerning existing water quality for the above parameters is given in the draft statement. Therefore, we would suggest that a water quality monitoring program be implemented at the dredge and disposal sites which would, at a minimum, record dissolved oxygen, total dissolved and suspended solids, Total Kjeldahl Nitrogen, and heavy metal concentrations, before, during, and after dredging operations. Assurances that State water quality standards will not be exceeded during the dredging operations should be given in the statement. If concentrations of pollutants should reach levels harmful to the environment, we suggest that temporary suspension, reduction or other modifications of the operation be considered to insure that water quality will be maintained at acceptable levels.

We also suggest that the statement identify and discuss the municipal and industrial water supply intakes in the project area which could be adversely affected by the resuspension of pollutants during dredging operations. Mitigative measures which could be employed to minimize any adverse impacts upon these intakes should be described.

Dredged Material

The discussion of dredged material placement should include a project map depicting the proposed open water and land disposal sites. Also, we believe the statement should include a discussion of the criteria that will be used to determine the disposal sites. Because of the volume of dredged material involved (75 million cubic yards), the impacts associated with spoil placement could be severe if mitigative controls are not provided. The statement should specify the controls (such as ring levees) that will be used during channel enlargement to lessen the effects of dredging and spoil placement on marshland areas and water quality. We would also like to point out that EPA believes wetlands should be protected from adverse dredging and filling practices. It is our contention that the placement of dredged material on any ecologically productive wetland area could be considered as an adverse environmental impact.

To help in evaluating the potential environmental impacts of dredging and dredged material placement, the final statement should include information on the physical, chemical, and biological characteristics of the dredged material. We would suggest the analysis of the following elements:

A. Physical Quality: A general description of the composition of the dredged spoil material (i.e., sand, silty clay, sludge, etc.), settleability, and the source of the spoil material for various reaches of the project area should be included in the statement.

B. Biological Quality: The dredge spoil should be analyzed for bacterial quality and acute toxicity (48 hr. TL_{50}) to fish, algae or invertebrates.

C. Chemical Quality: Volatile solids, Chemical Oxygen Demand, Total Kjeldahl Nitrogen, heavy metals, and chlorinated hydrocarbons should be determined for the various reaches of the project area. Also, we would suggest that a water quality monitoring program be established to analyze heavy metals, total dissolved solids, total suspended solids, and dissolved oxygen concentrations of the supernatant effluents from manually operated ring levee discharge points. Concentrations of these elements in supernatant discharges should not exceed levels that would be harmful to the maintenance and propagation of aquatic life.

Additional information concerning the long-term effects of dredging and the placement of dredged material within the project area is needed in the final statement. For example, the statement should discuss the effect of annual operation and maintenance activities (over a period of many years) on water quality and land disposal areas. In particular, the impacts of increased sedimentation on the Louisiana Delta and the Atchafalaya Floodway should be considered. Inclusion of this information would strengthen the statement and should aid the decision-maker in assessing the long-term environmental impacts associated with project implementation.

Relationship to Other Projects

Several projects related to the MR&T Project are considered briefly in the draft statement. However, we believe the statement could be strengthened by including a discussion of the major Federal projects located on the tributaries of the Mississippi River between Cairo, Illinois and Venice, Louisiana (e.g. Red River Project). The cumulative effects of these projects and their relationship to the MR&T program should be discussed in the final statement. This information is needed in order to determine the full impact of the MR&T project and related projects on the Lower Mississippi River and Tributaries System.

We also suggest that the future plans to enlarge the lower Mississippi Channel to accomodate deep draft vessels, between the parts of Baton Rouge and New Orleans, be discussed.

Secondary Impacts

According to CEQ guidelines (Federal Register, Aug. 1, 1973), an environmental statement should discuss secondary or indirect impacts as well as primary impacts. Although the statement predicts that the project's impact on river transportation would be "to protect the capacity of the river to continue to move increasing numbers of ton-miles of cargo," the statement does not fully consider the secondary effects associated with increased river commerce. We suggest that the final statement discuss the effects such increases in river travel could have on the environmental quality of the project area. For example, the need for new and larger harbors, future industrial growth and possible accelerated urban growth could generate potential adverse effects on land, air, and water uses in the project area. Also, channelization of many of the tributaries to the Mississippi River is being carried out for flood control. These operations could tend to worsen flood conditions in the lower reaches of the Mississippi River. This could result in a continuous cycle of levee and channel improvement projects. We believe that the final statement would be strengthened by further discussing the secondary environmental impacts that could occur as a result of project implementation.

Alternatives

The final statement should include a discussion of the feasibility of transporting present waterborne commodities by other transportation methods. For example, the final statement should evaluate and compare the environmental and economic impacts of various transportation alternatives, such as rail, truck, airline, or combinations of these transportation modes. The draft statement mentions that barge traffic is more efficient from an energy standpoint (BTU per ton mile), when compared to other modes of transportation. We believe the statement should also compare energy requirement for the operation and maintenance of the various systems. This would better depict the total energy requirements for any transportation system.

We also believe that the final statement could include alternate mitigative measures which, if implemented, could lessen the environmental impacts associated with the deposition of 75 million cubic yards of dredged spoil annually. Such measures as land treatment for tributaries contributing heavy sediment loads to the main stem; revegetation and/or stabilization of spoil piles to reduce the erosion process; and the possible commercial market for dredged material. We suggest that these alternatives be discussed in the final statement and considered in the operation and maintenance plan for the Mississippi River mainstem wherever feasible.

General Comments

1. Due to the size of the project area, we believe that the final statement should be divided into and discussed in segments. By utilizing this approach, it would be possible to provide detailed information on the existing environmental setting in each segment; actions to be implemented in each segment; and environmental impacts anticipated in each segment. These segments could vary in size depending on the type of habitat and the detail necessary to describe adequately the proposed action and its impacts. We would, however, emphasize that while a segmented approach would benefit the decision-maker in determining the project's impacts on each individual river section, it would still be necessary to discuss the overall or cumulative impact of project implementation on the total project area.

2. Tables 23 and 24 (pgs. 167 and 168) of the statement summarize the impacts of habitat change on terrestrial and aquatic vertebrates respectively. However, no mention is made regarding the source or the method used to compile this summary. We believe the final statement would be strengthened by including this information.

3. Approximately 200 acres of swamp forest is scheduled to be destroyed during Operation and Maintenance Activities. While this represents a small percentage of the total wetlands in the project area, we believe that the loss of these very productive areas should be discussed as a potential adverse environmental impact. Also, the discussion of chutes (pg. 184) and slackwater areas (pg. 186) does not address adequately the importance of these very productive biological systems. The statement does note that a reduction in these areas would represent a negative environmental impact. However, the statement implies that off-setting factors (loss of chutes in one instance and increase in slackwater in another) could result in a net positive gain in selected local areas. We believe the final statement should include additional information to support this contention.

4. We recognize that herbicide use on the mainline levees is generally performed by the independent levee districts. However, we suggest that the specific types of herbicides presently being applied or being considered for future use be listed in the final statement. Care should be taken to use EPA approved pesticides in the project area in accordance with their labelling instructions. Also, we would suggest that the impacts on air quality, associated with maintaining the mainline levees by burning, be discussed in the final statement.

5. Chapter 4, "Environmental Impacts of the Proposed Action", and Chapter 5, "Adverse Environmental Effects", should acknowledge that, by concentrating waters in a narrower and deeper channel and narrowing the floodplain, natural flood plain efficiency may be lost and water quality could be degraded by altering the following elements:

a) The broad flood plain environment contains trees, shrubs, vegetation, and organisms which in their growth, absorb and utilize nutrients and minerals from runoff.

b) Water velocity decreases on a flood plain result in sedimentation. Also, water trapped in flood plain pools seeps into the ground, is filtered or evaporated, and is returned in the hydrological cycle in a purer form.

c) Pockets and pools in the flood plain and shallow water areas afford ideal conditions for photosynthetic reduction of stream impurities and the production of oxygen.

d) Shallow water areas contain a multitude of aquatic organisms which help in the natural purification process. Reduction of shallow areas could therefore reduce stream purification capabilities.

e) By concentrating water in a straightened, deeper channel, the friction afforded by a shallow, vegetated, meandering channel is greatly reduced and stream velocities are increased considerably, thereby increasing the erosive qualities of the stream as well as its silt-carrying capacity. Silt deposition could therefore increase downstream in these reaches where velocities are reduced below settling velocities and where conditions are suitable for sedimentation. This point should be discussed in the final statement.

6. The proposed project requires that 450 miles of levee be raised in order to provide minimum freeboard above the 1973 flood flow line. However, the draft statement does not give the revised flow line nor does it denote the location of the levees to be raised. Inclusion of this information would strengthen the final statement.

7. Page 6(p) The final statement should discuss why significant reductions have occurred in the flood capacity of the river.

8. Page 7(e) The final statement should clarify whether the benefits of the main stem include those attributed to tributary projects. For example, river training devices on the Missouri River could transpose flood waters to the Lower Mississippi Basin. Are these considered costs to flood control and benefits to navigation?

9. Page 11(c)(Revetments) Additional information specifying the amount of concrete and other materials in place and proposed in the Mississippi as a result of bank protection (cubic yards of concrete mattress, or square miles of concrete beneath the Mississippi River) should be given in the statement. Also, the effects of the mattress on the riverine ecosystem should be discussed.

10. Page 57 Oyster mortality can be expressed as a quantitative loss. Therefore, dollars lost versus dollars gained in beds south of the areas of mortality could be stated. The area south of the area of mortality should be located on a project map.

11. Page 155(3) What is the life of the project?

12. Page 163(2) Approximately 75 million cubic yards are dredged annually. According to the draft statement, this figure is not expected to significantly increase due to the proposed project. This statement seems to be inconsistent with the information presented in the B/C analysis in the attachment. Here there is a reduction in dredging of $700,000. This point should be clarified in the final statement.

13. Page 195(2) Borrow pits increase from 10,000 to 20,000 acres initially. The maximum areal extent of transition from borrow pits to low-lying inundated land equals existing borrow pits and projected pits resulting from this project. Total area ranges from 51,000 to 58,000 acres. However, information on Page 155(2) & (3) appears to be inconsistent with this by stating that a maximum increase of low-lying inundated areas would be approximately 67,000 acres. The difference in 9,000 - 16,000 acres of this land transition should be accounted for in the statement.

14. Attachment The Benefit-Cost Analysis could be strengthened in order to independently evaluate the project on economic terms or balance the economic benefits against environmental and economic costs.

Footnote 1 states the ratio was derived from measuring total benefits against total costs. If the total project benefits are annual benefits, it should be reworded by inserting the word "annual". If the benefits are all annual benefits, a question is raised especially regarding the line "Increased Returns of Wooded Land" (349,319,000). The statistics in the body of the EIS present the following information:

Page 65	Total Woodlands	876,000 acres
Page 197	Loss of Woodlands to Project	30,000 acres
Page 198	Loss of Timber Revenue	$300,000-450,000/year
page 77	Plantations	23,600 acres
Page 151	Total Timberland including plantations excluding early successional woodland	796,000 acres of oaks, gum, cypress, cottonwood, sycamore and maple.
		Woodlands yield $10-15/acre
		Plantations yield $20/acre

Thus, total net revenue from forests would be $7.5-12.5 million/year. The question arises, how can benefits of almost $350 million be credited to the project when existing revenues and acreage will decrease $300,000-450,000/yr and 30,000 acres respectively? The economic analysis should list the assumptions used in computing the benefit/cost ratio including the discount rate and the life of the project.

Definitions of the categories are provided on the attachment. Our procedure is to categorize our comments on both the environmental consequences of the proposed action and on the adequacy of the impact statement at the draft stage, whenever possible.

We appreciate the opportunity to review the Draft Environmental Impact Statement. Please send us two copies of the Final Environmental Impact Statement at the same time it is sent to the Council on Environmental Quality.

Sincerely yours,

Arthur W. Busch

Arthur W. Busch
Regional Administrator

Enclosure

ENVIRONMENTAL IMPACT OF THE ACTION

LO - Lack of Objections

EPA has no objections to the proposed action as described in the draft impact statement; or suggests only minor changes in the proposed action.

ER - Environmental Reservations

EPA has reservations concerning the environmental effects of certain aspects of the proposed action. EPA believes that further study of suggested alternatives or modifications is required and has asked the originating Federal agency to re-assess these aspects.

EU - Environmentally Unsatisfactory

EPA believes that the proposed action is unsatisfactory because of its potentially harmful effect on the environment. Furthermore, the Agency believes that the potential safeguards which might be utilized may not adequately protect the environment from hazards arising from this action. The Agency recommends that alternatives to the action be analyzed further (including the possibility of no action at all).

ADEQUACY OF THE IMPACT STATEMENT

Category 1 - Adequate

The draft impact statement adequately sets forth the environmental impact of the proposed project or action as well as alternatives reasonably available to the project or action.

Category 2 - Insufficient Information

EPA believes the draft impact statement does not contain sufficient information to assess fully the environmental impact of the proposed project or action. However, from the information submitted, the Agency is able to make a preliminary determination of the impact on the environment. EPA has requested that the originator provide the information that was not included in the draft statement.

Category 3 - Inadequate

EPA believes that the draft impact statement does not adequately assess the environmental impact of the proposed project or action, or that the statement inadequately analyzes reasonably available alternatives. The Agency has requested more information and analysis concerning the potential environmental hazards and has asked that substantial revision be made to the impact statement. If a draft statement is assigned a Category 3, no rating will be made of the project or action, since a basis does not generally exist on which to make such a determination.

United States Department of the Interior

OFFICE OF THE SECRETARY

Southeast Region / 148 Cain St., N.E. / Atlanta, Ga. 30303

DEC 10 1974

ER-74/1292

District Engineer
U.S. Army Corps of Engineers
P.O. Box 60
Vicksburg, Mississippi 39180

Dear Sir:

As requested in your September 30, 1974, letter to the Office of Environmental Project Review, we have reviewed the draft environmental statement for the proposed Mississippi River Levees and Channel Improvement project for its effects on Indian lands, national park areas, outdoor recreation, and cultural, mineral, and fish and wildlife resources.

We offer the following comments for your consideration:

The draft statement does not involve any Indian trust lands that are under the jurisdiction of the Bureau of Indian Affairs; therefore, it will have no adverse impact on the Indian people.

The statement is deficient in its treatment of the impact of the project on recreation. All recreation use areas to be affected by the project should be noted in Chapter 4.03. Several designated recreation use areas, funded under provisions of the Land and Water Conservation Fund Act of 1965 (Public Law 88-578) amended, may be affected by construction of the project. Section 6(f) of the act requires prior approval by the Secretary of the Interior for conversion, to other than public outdoor recreation use, of lands acquired with assistance under provisions of the act. The State Liaison Office in each state should be contacted to determine if provisions of Section 6(f) of the act applies. The names and addresses of the State Liaison officers are as follows:

Arkansas	-	Charles T. Crow, Director Arkansas Department of Planning Capitol Hill Building, 5th Floor Little Rock, Arkansas 72201
Illinois	-	Anthony G. Dean Director of Conservation 602 State Office Building Springfield, Illinois 62706

Kentucky	-	Edward W. Johnson, Commissioner State Department of Parks Capitol Plaza Tower, 10th Floor Frankfort, Kentucky 40601
Louisiana	-	Gilbert C. Lagasse, Director State Parks and Recreation Commission 625 North 4th Street Baton Rouge, Louisiana 70821
Mississippi	-	Rae Sanders Outdoor Recreation Director Mississippi Park System Robert E. Lee Building Jackson, Mississippi 39201
Missouri	-	James E. Wilson, Director Department of Natural Resources 1203 Jefferson Building, Box 176 Jefferson City, Missouri 65101
Tennessee	-	Granville Henton, Commissioner Department of Conservation 2611 West End Avenue Nashville, Tennessee 37203

The environmental impact statement should include a discussion of the impact on recreation of the authorized Hickman-Tiptonville and Tiptonville-Obion levee extension. These project features lie in the vicinity of Realfoot Lake and the Obion River-Forked Deer River areas of recreational interest.

The impact of the project upon recreational boating and boat harbors should be addressed in the statement.

The statement indicates that bottom-land hardwoods, areas of prime recreation attraction, will be destroyed by project construction. Recreation benefits forgone as a result of this destruction should be discussed.

Federal guidelines on cultural (historic, archeological, and architectural) resource preservation require greater detail be furnished in environmental statements. Information contained in this statement is not sufficient to determine if full compliance has occurred.

We are enclosing a copy of a booklet entitled, "Preparation of Environmental Statements: Guidelines for Discussion of Cultural (Historic, Archeological, Architectural) Resources." If the environmental statement prepared on the project reflects the considerations described in these guidelines, the final statement will be adequate insofar as cultural resources are concerned.

Because most of the project is to extend or enlarge existing improvements, we assume that pipelines and other mineral installations already have been protected or relocated. We suggest the statement be expanded to address this point.

The statement is vague about the location of structural features that are planned and authorized, and we are unable to make a meaningful evaluation of the total effects that the project may have on fish and wildlife resources. Several alternatives to the proposed action which were presented in the statement appear to be more environmentally acceptable than the remaining project work planned. Specific beneficial and adverse impacts of the alternatives should be more fully discussed and benefit-cost ratios should be provided to allow a more meaningful and objective comparison of the alternatives.

The threatened and endangered species lists should be revised according to the "United States List of Endangered Fauna," May 1974, published by the Fish and Wildlife Service, pursuant to the Endangered Species Act of 1973 (Public Law 93-205; 87 Stat. 884). The Endangered Species Act supplanted the Endangered Species Conservation Act of 1969, on December 20, 1973. The Office of Endangered Species and International Activities, Washington, D.C., should be contacted to obtain the current status of species which may occur in the project area. In addition, detailed impact evaluations should be provided for endangered species which may be affected directly or indirectly by the proposed project.

Also, the wetlands affected by the proposed project should be classified according to Fish and Wildlife Circular 39, "Wetlands of the United States," so as to better facilitate evaluations of project impacts on individual wetland types.

The following comments refer to specific sections of the statement:

<u>Summary Sheet</u>

<u>Paragraph 3b</u>

The statement, "Slackwater areas of the river would be reduced in the upper reaches of the river," should be revised to indicate the effect that the overall project impact on aquatic habitat from Cairo, Illinois, to Venice, Louisiana, would include a 23 percent reduction of chute areas and a 22 percent reduction of slackwater areas. Greater losses would occur along specific sections of the project area, including 36 percent of chute areas from Memphis, Tennessee, to Baton Rouge, Louisiana, and 35 percent of the slackwater areas from Cairo, Illinois, to Memphis, Tennessee.

Project Description

Page 7, paragraph d

This section states that in evaluating project justification, the premise has been adopted that a balanced plan exists. However, project implementation will result in significant losses of aquatic and terrestrial habitat, including 22 percent of the slackwater areas and 23 percent of the chute areas along the Mississippi River from Cairo, Illinois, to Venice, Louisiana, and 30,000 acres of woodland, including 5,400 acres of botton-land hardwoods and 200 acres of swamp forest. Furthermore, inadequate descriptions of the proposed mitigating measures consisting essentially of 11,400 acres of additional borrow areas and 13,200 acres of additional edge and transitional habitat renders meaningful evaluation of the mitigation items mentioned impossible. We believe the validity of the assumption that a balanced plan exists has not been demonstrated. It should also be noted that the Fish and Wildlife Service has not had previous opportunity to evaluate fish and wildlife aspects of this project.

Page 12, paragraph e

The statement that, "...574 additional dikes have been proposed for 175 locations," contradicts data in Table 1, page 18, which indicates that dikes would be required at 165 locations. Specific information relating to foreshore protection, revetments, levee improvements should be provided to facilitate impact evaluations on affected fish and wildlife resources.

Page 14, paragraph d

This section indicates that the proposed works would include dredging to correct alignment and confine flow to selected channels. The amount and extent of dredging presently required and estimates of that which would be required for the initial work and maintenance of the proposed project would have a direct bearing on the short and long-term impacts of the proposed project and should be discussed in the final environmental impact statement.

Page 16, paragraph 1.09

This section states that the benefit-cost ratio of the project is 17.1. An explanation should accompany this statement explaining what factors were and were not considered in arriving at this figure. If intangible environmental benefits or losses are associated with the proposed project, such factors should be discussed.

2. Environmental Setting

The scientific names for several plants and animals are not included in Section 2.08, "Biological Overview," or in Appendix C, "Biology." The scientific names should be included in the final environmental impact statement.

Page 46, first complete paragraph

This section indicates that dredge material is spoiled in the Mississippi River, sufficiently near to operations to minimize costs and yet not interfere with the channel being dredged. This statement should be clarified to reveal what types of habitats along the river would be affected by dredge spoiling.

In general, dredging and spoil deposition in areas that are highly valuable as habitat for fish and wildlife should be avoided. The Fish and Wildlife Service and other appropriate Federal agencies and State conservation agencies should be consulted in the future selection of dredging and spoil deposition sites and other planning activities that may affect fish and wildlife.

Page 57, second paragraph

This section states that "...discharge of Mississippi River water into the Lake Pontchartrain-Borgne-Mississippi Sound system by operation of the Bonnet Carre' Spillway influences short- and long-term benefits and detriments as did natural flooding many years ago." Such a direct parellel between Bonnet Carre Spilway operation and natural flooding of years past in inaccurate insofar as man's influences on the system have altered such factors as frequency of flooding, rate of flow, and water quality.

Page 84, first paragraph

The term "economically significant" should be more fully explained.

Page 132, Table 19

This list should carefully differentiate between sites listed on the National Register of Historic Places and those not listed.

Port Hudson and Plaquemine Lock are both listed on the National Register and should be designated as such. This section should be expanded to include steps taken to comply with Executive Order 11593 and the National Historic Preservation Act. The Advisory Council on Historic Preservation's "Procedures for the Protection of Historic and Cultural Properties" (Federal Register, January 25, 1974), Section 800, outlines steps required for compliance.

There is no indication that the State Historic Preservation Officers for the States to be affected by the subject statement have been consulted as required in Section 800.4. Their response should be included in the final statement.

It is the constructing agency's responsibility to determine the presence or absence of cultural (historic, archeological, and architectural) resources within the influence of the project. Consultation with State and Federal agencies is but a step to determine what is <u>already</u> known about the area resources. It should not be taken for granted that all cultural resources are known to them.

Onsite examination by competent historians and/or archeologists may be required to locate sites. All cultural resources in the area which may be influenced by the project are to be evaluated to determine if they are eligible for nomination to the National Register of Historic Places. Criteria for eligibility are published in Section 800.10 of "Procedures for the Protection of Historic and Cultural Properties." Agency responsibilities in the evaluation and nomination of sites are covered in Section 800.4(A)(2).

If it is determined that sites meeting the criteria are within the influence of the project, the statement should indicate awareness of this and note progress of surveys of the affected area in compliance with Section 2(a) of Executive Order 11593.

<u>Page 140, paragraph (4)</u>

The possibility of flood control and navigation structures generating adverse aesthetic impacts should be discussed.

<u>4. Environmental Impacts of the Proposed Action</u>

This portion of the draft statement fails to give adequate consideration to the potential impacts on biological resources and water quality from industrial, agricultural, and urban development that will be stimulated by increased flood protection and channelization.

Terms used to describe the environmental impacts of the proposed action on biological communities: minor, significant, and strong should be qualified.

<u>Page 156, paragraph (1)</u>

This section of the statement implies that vegetative cover would be replaced and maintained on the levees, and that natural growth in borrow areas would resume at the cessation of construction activities. It should be noted however that resumption of plant growth does not produce an immediate protective vegetative cover, and may be some time before a sufficient vegetative cover is established, depending on local conditions following construction activities. Also, there may be considerable differences in the ecology of spoil and borrow sites and adjacent areas so that the species composition could be affected.

Page 158, paragraph (5)

It is stated that dredging for harbor maintenance and construction may by virtue of dredging and spoiling cause concentrations of nitrogen and heavy metals to increase and possibly exceed criteria established by the Environmental Protection Agency. It is also stated that care must be taken in such dredging and subsequent soil disposal, since these conditions could cause strong local impacts on water quality. Such care that would be taken in these areas should be discussed in detail.

Page 164, paragraph (6)

This section states that there would be no adverse impact on manmade structures, such as pipelines. Should any mineral related problems arise during construction, we request that Bureau of Mines be informed.

Page 166, Table 22

The data in this table shows that project implementation would result in a 13,200-acre increase in edge and transitional habitat and an 11,400-acre increase in borrow pit areas. In addition, data in Table 26, page 200, indicates that these changes would have a minor positive impact on edge and transitional habitat and a strong positive impact on permanently filled borrow pit areas. The specific locations of the additional edge and transitional habitat should be indicated. The different types of edge and transitional habitat that would be created should be described in detail and acreages of the different types should be indicated. It should be noted that although species inhabiting edge and transitional areas may be benefited in certain areas from project activities (i.e., road building) that would create additional edge and transitional habitat, the overall environmental impact of such activities may be adverse. Also, the additional edge and transitional areas created would not necessarily be immune from subsequent destruction from agricultural activities or other human activities. Information on surface area and bottom configuration of borrow pits should be provided as these factors significantly influence the potential value of these areas for fish and wildlife resources.

4.03 Impacts on Historical/Archeological Sites, c., page 192

This statement should be expanded to show compliance with cultural resource preservation guidelines. The statement admits that many cultural resources are in at least the immediate vicinity of the project's impact but "precise location" is not "generally" known. It is the constructing agency's responsibility to determine the precise location of all cultural resources in the area of the project's impact and to discuss these resources in the environmental document.

Identification of cultural resources should not be left up to construction workers who are not qualified historians or archeologists. It is possible that the objects or sites will remain undetected after the required historic and archeological surveys and evaluations have been made. It is important however that such sites or objects detected by construction activities be called to the attention of competent historians or archeologists for examination and evaluation.

Underwater objects are numerous in the area of the project's impact. Underwater surveys and examinations should be carried out prior to construction.

6. Alternatives to the Proposed Action

Page 200, Table 26

The table indicates that the project would have a strong negative impact on swamp forests in the project area. The statement on page 177, paragraph (4a), which indicates that there would be a minor negative impact on these areas seems contradictory.

7. The Relationship Between Local Short-Term Uses of Man's Environment

Page 229, paragraph c

It is stated that the majority of the newly created borrow pits would not fill in during the life of the project. The life of project features should be stated to make this statement meaningful.

Sincerely yours,

June Whelan

(Miss) June Whelan
Special Assistant to the Secretary
Southeast Region

Enclosure

United States Department of the Interior

OFFICE OF THE SECRETARY

Southeast Region / 148 Cain St., N.E. / Atlanta, Ga. 30303

ER-74/1292 December 17, 1974

District Engineer
U.S. Army Corps of Engineers
Post Office Box 60
Vicksburg, Mississippi 39180

Dear Sir:

The following comments supplement our comments sent to you December 10, 1974, on the draft environmental statement for Mississippi River Levees and Channel Improvement. The comments relate to the project effects on hydrology and geology.

We believe that insufficient detail has been provided in this draft statement to permit an adequate evaluation of the expected environmental impact on geology and hydrology.

An indication of the amount by which the approximately 450 miles of levees would be raised, or the approximate volume of fill required, should be included in the statement. We suggest that the statement be expanded to include information on the probable grain size of 75 million cubic yards of sediments to be dredged, the estimated location of the major dredging, any areal constraints to disposal of dredge spoils, the degree of pollution of the sediments, and the seasonal constraints and other factors related to evaluation of environmental impact.

The statement should be expanded to include an explanation of the impact of the proposed construction on the hydraulics and why significant reductions have occurred in the flood-carrying capacity of the channel (p. 6). Information relating to why the design stage has been revised upward for 461 miles of levees after the 1973 flood (Table 1), how the 1973 discharges compare with the design flood and, how the 1973 stages compare with the design stages should also be included in the statement. It should be stated whether or not the dikes or revetments reduce the flood-carrying capacity of the channel and, if so, by how much and for how long. It should be addressed whether it will be necessary to raise the levees again as more dikes and revetments are constructed. The dikes and revetments provide benefits for low-water navigation, but if they reduce the flood-carrying capacity of the channel, the benefits accrued to navigation could be offset by the reduction in benefits to flood control. We suggest this be accounted for in the cost-benefit analysis. Dredge spoil disposal should be discussed as should the effects of the dredging on the flood-carrying capacity (p. 207).

It is not stated if the technical backup data to support the statement are from the RETA (ref. 5) and references 3 and 26, or if these reports were made available to reviewing interests. This point should be clarified in the final statement.

The requirement for additional foreshore protection has been given as 93.9 miles in Table 1(p. 18), whereas this is given in the text as 74 miles (p. 12, paragraph f). The proposed linear expansion of revetments has been given as 295 miles on page 163 (#3), whereas this was given previously as 325 miles (p. 12, paragraph d). Clarification of these two points should be made in the final statement.

Thank you for the opportunity to review and comment on the draft statement.

Sincerely yours,

(Miss) June Whelan
Special Assistant to the Secretary
Southeast Region

Advisory Council
On Historic Preservation
1522 K Street N.W. Suite 430
Washington D.C. 20005

December 16, 1974

Colonel Gerald E. Galloway
Vicksburg District Engineer
Department of the Army
Corps of Engineers
P.O. Box 60
Vicksburg, Mississippi 39180

Dear Colonel Galloway:

This is in response to your request of September 30, 1974, received October 16, 1974, for comments on the environmental statement for the Mississippi River Levees and Channel Improvement. Pursuant to its responsibilities under Section 102(2)(C) of the National Environmental Policy Act of 1969, the Advisory Council on Historic Preservation has determined that while you have discussed the historical, architectural, and archeological aspects related to the undertaking in great detail, the Advisory Council needs additional information to adequately evaluate the effects on these cultural resources. Please furnish additional data indicating:

I. Compliance with Section 106 of the National Historic Preservation Act of 1966 (16 U.S.C. 470[f]). The Council must have evidence that the most recent listing of the National Register of Historic Places has been consulted (see Federal Register, February 19, 1974, and monthly supplements each first Tuesday thereafter) and that either of the following conditions is satisfied:

   If a National Register property is affected by the project, the environmental statement must contain an account of steps taken in compliance with Section 106 and a comprehensive discussion of the contemplated effects on the National Register property. (Procedures for compliance with Section 106 are detailed in the Federal Register of January 25, 1974.)

II. <u>Compliance with Executive Order 11593 "Protection and Enhancement of the Cultural Environment" of May 13, 1971.</u>

A. Under Section 2(a) of the Executive Order, Federal agencies are required to locate, inventory, and nominate eligible historic, architectural and archeological properties under their control or jurisdiction to the National Register of Historic Places. The results of this survey should be included in the environmental statement as evidence of compliance with Section 2(a).

B. Until the inventory required by Section 2(a) is complete, Federal agencies are required by Section 2(b) of the Order to submit proposals for the transfer, sale, demolition, or substantial alteration of federally owned properties eligible for inclusion in the National Register to the Council for review and comment. Federal agencies must continue to comply with Section 2(b) review requirements even after the initial inventory is complete, when they obtain jurisdiction or control over additional properties which are eligible for inclusion in the National Register or when properties under their jurisdiction or control are found to be eligible for inclusion in the National Register subsequent to the initial inventory.

The environmental statement should contain a determination as to whether or not the proposed undertaking will result in the transfer, sale, demolition or substantial alteration of eligible National Register properties under Federal jurisdiction. If such is the case, the nature of the effect should be clearly indicated as well as an account of the steps taken in compliance with Section 2(b). (Procedures for compliance with the Executive Order are detailed in the <u>Federal Register</u> of January 25, 1974, "Procedures for the Protection of Historic and Cultural Properties," pp. 3366-3370.)

C. Under Section 1(3), Federal agencies are required to establish procedures regarding the preservation and enhancement of non-federally owned historic, architectural, and archeological properties in the execution of their plans and programs.

The environmental statement should contain a determination as to whether or not the proposed undertaking will contribute to the preservation and enhancement of non-federally owned districts, sites, buildings, structures, and objects of historical, architectural or archeological significance.

III. Whenever possible, comments of the Historic Preservation Officers for the affected States should be included in the statement.

Should you have any questions or require any additional assistance, please contact Stephen Cochran of the Advisory Council staff at (202) 254-3974.

Sincerely yours,

John D. McDermott
Director, Office of
Review and Compliance

DEPARTMENT OF TRANSPORTATION
UNITED STATES COAST GUARD

MAILING ADDRESS:
U.S. COAST GUARD (G-WS/73)
400 SEVENTH STREET SW.
WASHINGTON, D.C. 20590
PHONE: (202) 426-2262

20 NOV 1974

Colonel G. E. Galloway
Vicksburg District, Corps of Engineers
P. O. Box 60
Vicksburg, Mississippi 39180

Dear Colonel Galloway:

This is in response to your letter of 30 September 1974 addressed to Mr. H. F. DeSimone concerning a draft environmental impact statement for the Mississippi River Levees and Channel Improvement Project.

The Department of Transportation has reviewed the material submitted. We have no comments to offer nor do we have any objection to this project.

The opportunity to review this draft statement is appreciated.

Sincerely,

W. E. Caldwell

W. E. CALDWELL
Captain, U.S. Coast Guard
Deputy Chief, Office of Marine
Environment and Systems
By direction of the Commandant

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE
NORTHEASTERN AREA, STATE AND PRIVATE FORESTRY
6816 MARKET STREET, UPPER DARBY, PA. 19082
215-597-3772

8400
November 20, 1974

Gerald E. Galloway, Colonel
Corps of Engineers, Vicksburg District
Department of the Army
P.O. Box 60
Vicksburg, Mississippi 398180

Re: LMKED-PQ, Draft Environmental Statement
Mississippi River Levees and
Channel Improvement

Dear Colonel Galloway:

The above statement was forwarded to us for comment by our Milwaukee office, as no National Forest lands are involved.

Because of the size of the area and our lack of on-the-ground familiarity with much of the involved land, our comments must be of a general nature.

We do not feel that the statement makes clear which of the levees and channelization segments are part of the proposed project.

We presume that related projects on tributaries, not described here, will be covered by separate environmental statements. When this is done more detailed descriptions of portions of the main stem project should be discussed where the impact differs from this general statement.

The text classifies the northern portion (above Memphis) as "agricultural" but the histogram on page 63 classifies the greater part of terrestrial resources as woodland.

The full impact of levee construction on riverside forests, and the nature and significance of the losses is not discussed.

Plans should include provision for slowing down the movement of water because channelization is designed to speed the flow during flood periods. Consideration should be given to additional floodways like the New Madrid Floodway, restriction of development in floodplain and in upstream areas, conservation measures like grassed waterways diversions, terraces; grasses and legumes (e.g. crown vetch) on slopes. Without supplementary measures like these, channelization can result in greater flooding and increased sedimentation.

6200 - 11b (4/74)

Rare and endangered plant species should be discussed as well as animal species.

Thank you for the opportunity to review and comment on this statement.

Sincerely,

Alfred H. Troutt

ALFRED H. TROUTT
Assistant Director
Environmental Protection & Improvement

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
AREA OFFICE
210 NORTH 12TH. STREET, ST. LOUIS, MISSOURI 63101

REGION VII
REGIONAL OFFICE
KANSAS CITY, MISSOURI

AREA OFFICES
Kansas City, Kansas
Omaha, Nebraska
St. Louis, Missouri

November 27, 1974

IN REPLY REFER TO:
7.3PP

Mr. Gerald E. Galloway
Corps of Engineers
Vicksburg Engineer District
Post Office Box 60
Vicksburg, Mississippi 39180

Dear Mr. Galloway:

The Draft Environmental Statement prepared by the Vicksburg Engineer District for the Mississippi River Commission has been forwarded to this HUD Area Office for review and comment.

From the information contained in the Draft Statement, it does not appear that there are any conflicts with the plans or programs of this HUD Area Office. We do, however, offer several suggestions.

It was encouraging to read that generally your statements do look beyond selected elements of the environment and judge channel maintenance and improvements on the merits within the broad system of measures planned. Because of this, it was early recognized that trade-offs must occur if desired gains are to be achieved from channel maintenance, and it appears that such trade-offs are reasonable and practical from the short-term viewpoint.

We feel that Federal Flood Insurance and the impact of this new law should be explained in the Draft Statement. The Flood Disaster Protection Act of 1973, passed by Congress late last year and signed by the President on December 31, 1973, will have a major impact on many communities in your service area. This Act requires that communities having a high flood potential join the program or forfeit Federal financial assistance. The purpose of the law is: (1) to protect flood victims by assuring the availability of reasonably priced flood insurance; and, (2) to minimize future flood damage by controlling development in areas subject to flooding. In accomplishing the latter, HUD and the Federal Government have been given a key role in land use decision making in communities applying for flood insurance.

Hopefully, all communities within your project area have been contacted and informed that they contain one or more "flood risk" areas. Flood risk under the legislation is defined as a one percent chance of flooding in any given year, i.e. a probability of a flood once every 100 years. Each community has been asked to apply for admission to the flood insurance program after adopting regulations containing a building permit system. Those who do not join the program by July 1, 1975, will find land development and other real estate activity in the flood areas cut off from most sources of financial assistance. The ultimate purpose of the Flood Disaster Protection Act is to assure that a larger proportion of the flood loss costs will be covered in the future by insurance rather than by the use of public funds.

We feel that the National Flood Insurance Program can promote the public interest by providing appropriate protection against the perils of flood losses and at the same time encourage sound land use by minimizing exposure of property to flood losses. The program is a cooperative effort between the Federal Government and the private insurance industry, which is represented by the National Flood Insurers Association. Special questions relating to the program should be addressed to the Federal Insurance Administration, U. S. Department of Housing and Urban Development, 451 Seventh Street, S.W., Washington, D. C. 20410.

There is no doubt that in the years ahead, complex development and environmental challenges along this 900 mile reach of the Mississippi River will occur. Therefore, we recommend that every effort be made to expand public information and citizen participation programs. Eventually, the time must come when the average individual recognizes that he can actively participate in solving one or more of the problems which he sees along this major drainage and transportation route. Thus, the individual recognition would create that sense of dedication to improvement which not only solves problems but helps prevent the growth of new ones.

Hopefully, continued study and research will also be spent on the fabric of interrelations among all living things in and along this river, both qualitatively and quantitively. In the years ahead, there will be an increasing need to understand these interactions more reliably, more explicitly, and for deeper reasons. To deal with and respect this great river, it will not be enough to predict which way things will change; there will be a definite need to know how much change and for what reasons. It is about interactions and their mechanisms where more knowledge and understanding must be gained so as to restore quality to the total environment and to better understand the longer range impacts.

We appreciate the opportunity afforded us by the Corps of Engineers to review and comment on this Draft Statement, and look forward to receiving a copy of the final statement when it becomes available.

Sincerely,

Jerry L. Bauer
for
Elmo Turner
Area Director

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
KNOXVILLE AREA OFFICE
ONE NORTHSHORE BUILDING
1111 NORTHSHORE DRIVE
KNOXVILLE, TENNESSEE 37919

REGION IV
Peachtree—Seventh Building
50 Seventh Street, N.E.
Atlanta, Georgia 30323

November 4, 1974

IN REPLY REFER TO:
4.7PPC (Steve
Shields 637-9300
ext 1218)

Gerald E. Galloway
Colonel, Corps of Engineers
Vicksburg District
P. O. Box 60
Vicksburg, Mississippi 39180

Dear Col. Galloway:

Subject: Draft Environmental Impact Statement, Mississippi River and Tributaries Project

We have only one comment concerning this draft statement. What measures, if any, are proposed to minimize the adverse impacts that have been identified with this project? This should include both short-term and long-term impacts.

Thank you for the opportunity to review and comment on this statement.

Sincerely,

Richard C. Becker

Richard C. Becker
Environmental Clearance Officer

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
JACKSON AREA OFFICE
101-C, 3RD. FLOOR JACKSON MALL, 300 WOODROW WILSON AVE., WEST
JACKSON, MISSISSIPPI 39213

REGION IV
Peachtree—Seventh Building
50 Seventh Street, N.E.
Atlanta, Georgia 30323

November 5, 1974

IN REPLY REFER TO:
4.5PP

Col. Gerald E. Calloway
District Engineer
U. S. Army Corps of Engineers
P. O. Box 60
Vicksburg, Mississippi 39180

Dear Colonel Calloway:

Subject: Draft Environmental Impact Statement, Mississippi River Levees and Channel Improvements - Mississippi River and Tributaries Between Cairo, Illinois, and Venice, Louisiana

In response to your letter of September 30, 1974, to the Regional Administrator, requesting review comments from the Department of Housing and Urban Development, we would like to advise you as follows:

1. It would be helpful if the extent to which proposed improvements will reduce 100-year levels can be estimated and included in the Environmental Impact Statement. Reductions in flood hazard elevations will contribute materially to our programs of Flood Plain Management.

2. The alternative of widening the leveed channel by setback of two to six miles is not considered a feasible alternative. In addition to the excessive cost, as noted in the impact statement, considerable difficulty would be encountered in handling existing development relocation payments, litigation resulting from eminent domain proceedings, and similar problems may also accrue if such a course of action is contemplated.

We trust that these comments will assist you in finalizing your Environmental Impact Statement for this project.

Sincerely,

for James S. Roland
Area Director

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
REGIONAL OFFICE
1100 COMMERCE STREET
DALLAS, TEXAS 75202

REGION VI

November 29, 1974

IN REPLY REFER TO:

6ME

Your Reference:
LMKED-PQ

Colonel Gerald E. Galloway
District Engineer
Corps of Engineers
P. O. Box 60
Vicksburg, Mississippi 39180

Dear Colonel Galloway:

The Draft Environmental Impact Statement for Mississippi River Levees and Channel Improvement has been reviewed by the Department of Housing and Urban Development, and it has been determined that the Department will not have comments on the subject Statement.

Sincerely,

Otis M. Dille for

David W. Baker
Environmental Clearance Officer

AREA OFFICES
DALLAS, TEXAS · LITTLE ROCK, ARKANSAS · NEW ORLEANS, LOUISIANA · OKLAHOMA CITY, OKLAHOMA · SAN ANTONIO, TEXAS
Insuring Offices
Albuquerque, New Mexico · Fort Worth, Texas · Houston, Texas · Lubbock, Texas · Shreveport, Louisiana · Tulsa, Oklahoma

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
REGION VII
FEDERAL BUILDING
601 EAST 12TH STREET
KANSAS CITY, MISSOURI 64106

OFFICE OF
THE REGIONAL DIRECTOR

November 14, 1974

Mr. Gerald E. Galloway
Colonel, Corps of Engineers
District Engineer
U.S. Army Engineer District
P. O. Box 60
Vicksburg, Mississippi 39180

RE: Draft Environmental Impact Statement
Mississippi River and Tributaries
Mississippi Rever Levees and Channel Improvement

Dear Colonel Galloway:

Review of the above referenced document indicates that there is no apparent impact on programs of the Department of Health, Education and Welfare. It would appear that the impacts of the proposed action and the reasonable alternatives have been adequately addressed.

Thank you for this opportunity to review and comment relative to your anticipated actions.

Sincerely

William H. Henderson

William H. Henderson
Regional Environmental Officer

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

REGION V

300 SOUTH WACKER DRIVE

CHICAGO, ILLINOIS 60606

OFFICE OF
THE REGIONAL DIRECTOR

November 14, 1974

Mr. Gerald E. Galloway
Colonel, Corps of Engineers
Department of the Army
P.O. Box 60
Vicksburg, Mississippi 39180

RE: Draft Environmental Impact Statement
Mississippi River and Tributaries
Cairo, Illinois to Venice, Louisiana

Dear Mr. Galloway:

We have reviewed the Draft Environmental Impact Statement for the above project. To our knowledge, and based upon the information provided, this project will not impact to any significant degree on the health, education or welfare of the population.

Sincerely yours,

Robert A. Ford

Robert A. Ford
Regional Environmental Officer

cc: Charles Custard, OEA
Warren Muir, CEQ

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
REGIONAL OFFICE
1114 COMMERCE STREET
DALLAS, TEXAS 75202

OFFICE OF
THE REGIONAL DIRECTOR

October 24, 1974

Our Reference: EI# 1074-428

U. S. Army Engineer District
Corps of Engineers
Vicksburg, Mississippi

Dear Sir:

RE: Mississippi River and Tributaries
Mississippi River Levee & Channel
Improvement

Pursuant to your request, we have reviewed the Environmental Impact Statement for the abofe project proposal in accordance with Section 102(2) (C) of P. L. 91-190, and the Council on Environmental Quality Guidelines of April 23, 1971.

Environmental health program responsibilities and standards of the Department of Health, Education, and Welfare include those vested with the United States Public Health Service and the Facilities Engineering and Construction Agency. The U. S. Public Health Service has those programs of the Federal Food and Drug Administration, which include the National Institute of Occupalional Safety and Health and the Bureau of Community Environmental Management (housing, injury control, recreational health and insect and rodent control).

Accordingly, our review of the Draft Environmental Statement for the project discerns no adverse health effects that might be of significance where our program responsibilities and standards pertain, provided that appropriate guides are followed in concert with State, County, and local environmental health laws and regulations.

We therefore have no objection to the authorization of this project insofar as our interests and responsibilities are concerned.

Very truly yours,

Wm F. Crawford

William F. Crawford
Environmental Impact Coordinator

ORD EI 1

DEPARTMENT OF HEALTH, EDUCATION AND WELFARE

Reaction Review and Comments on Environmental Impact Statement for Project Proposal:

Draft Environmental Impact Statement Reviewed With Objections [ ]

Draft Environmental Impact Statement Reviewed With No Objections [XX]

Date: 10/18/74 EI# 1074-428

Agency/Bureau: DHEW/PHS

Project Proposal: Mississippi River and Tributaries
Mississippi River Levees and Channel Improvement

Comments: Pursuant to Section 102(2)(f) of Public Law 91-190 we have reviewed thisproject proposal and find no indication of adverse environmental health impact where our program standards and responsibilities are concerned.

STATE OF ARKANSAS
DEPARTMENT OF PLANNING
400 TRAIN STATION SQUARE • VICTORY AT MARKHAM
LITTLE ROCK 72201

DALE BUMPERS
GOVERNOR

CHARLES T. CROW
DIRECTOR

December 13, 1974

Colonel Gerald E. Galloway
Department of the Army
District Engineer
Vicksburg District, Corps of Engineers
Post Office Box 60
Vicksburg, Mississippi 39180

Re: Mississippi River Levees
and Channel Improvements
Draft Environmental Impact
Statement

Dear Colonel Galloway:

The State Planning and Development Clearinghouse has submitted for review and comment the above mentioned document to the State Agencies of Arkansas which are responsible for reviewing Environmental Statements.

The comments of the Department of Planning, Department of Health and the Arkansas Archeological Survey are enclosed for your consideration and utilization. We request that your agency address these comments in your planning.

If we can be of further assistance, please do not hesitate to let us know.

Sincerely,

Bertram Wakeley
Director
Office of State Planning

BW/js/fk

Enclosures

cc: Charles Crow
John Saxton

ARKANSAS

DEPARTMENT OF COMMERCE
DIVISION OF SOIL AND WATER RESOURCES
1200 WESTPARK DRIVE, ROOM 308
LITTLE ROCK, ARKANSAS 72204

NORMAN F. WILLIAMS
ACTING DIRECTOR OF COMMERCE

JOHN P. SAXTON
DIRECTOR
(501) 371-1611

December 10, 1974

MEMORANDUM

TO: Bertram Wakeley, Director, State Planning & Development Clearinghouse

FROM: John P. Saxton, Chairman, Technical Review Committee

RE: Mississippi River and Tributaries,
Mississippi River Levees and Channel Improvements Draft E.I.S.

We believe the previously mentioned report to be adequate and concise. Included please find Archelogical Survey and Health Department's comments, which are all we have received to this date.

Please notify the appropriate personnel that the report is adequate with inclusion and consideration of comments.

JPS:ADF:cc

Enclosures

STATE OF ARKANSAS
DEPARTMENT OF PLANNING
400 TRAIN STATION SQUARE • VICTORY AT MARKHAM
LITTLE ROCK 72201

DALE BUMPERS
GOVERNOR

CHARLES T. CROW
DIRECTOR

M E M O R A N D U M

TO: State Planning and Development Clearinghouse

FROM: Charles T. Crow

SUBJECT: Mississippi River and Tributaries - Mississippi River Levees and Channel Improvements Draft EIS

DATE: December 12, 1974

The above cited study area extends along the Mississippi River from Cairo, Illinois to Venice, Louisiana and includes the Arkansas River between Pine Bluff, Arkansas, and the confluence with the Mississippi River, the adjacent land and water between the mainline levees and, in areas where there are no levees, the land within the project flood flowline (revised 1973 flood flow lines).

Purpose of project is to make the Mississippi more navigable and flood prevention. This objective is to be accomplished through following features:

1. Levees - Approximately 450 miles of levee raised.
2. Revetments - Approximately 325 additional miles.
3. Dikes - Approximately 574 additional.
4. Foreshore - Approximately 74 additional miles.
5. Dredging - No set quantity.

Comments

1. The EIS does not state specifically how much dredging will be done through this project. The miles of dredging to be done should be stated. The EIS also states that biological implications of present dredging operations have not been thoroughly catalogued. We suggest more studies should be made to determine effects of dredging on rivers biological communities.

2. It is difficult to determine from the EIS the need for the 4,700 feet extension of the Slough Landing levee. The statement is made as to the need based on 18,000 acres which will be cut off by extremely high water which tends to cross the neck of the peninsula. Insufficient information is given to the importance of access to this area during high water.

3. The EIS states that dredging for harbor maintenance and construction may introduce dredge spoil to land and/or water that exceeds Environmental Protection Agency criteria for nitrogen and heavy metals. Since these can cause strong local impacts in terms of water quality, care must be taken in such dredging and subsequent spoil disposal. Exactly what care will be taken to alleviate this water quality problem?

4. The EIS states that 30,000 to 45,000 acres of additional land would be disturbed in the project area by construction activities. Increase of borrow pit areas alone would be 10,000 acres. What consideration has been given to reopening old borrow pits to acquire levee material instead of disturbing new areas? Also more detailed plans for disturbing areas within the White River National Wildlife Refuge should be made known, if any are planned.

5. The EIS states that barge transportation is far more effective per ton-mile than rail, pipeline, truck, and aircraft. This is based on the fact that significant fuel savings are made through barge transportation. We question fuel savings shown based on 1972 figures. Evidently fuel consumed in dredging channel alignment, dikes, revetment, and other necessary maintenance for barge operations were not considered. The EIS should consider this factor to show realistic figures for fuel savings.

CLF/mr

PRESERVING THE PAST FOR THE FUTURE

ARKANSAS ARCHEOLOGICAL SURVEY

DIRECTOR • CHARLES R. MCGIMSEY III
STATE ARCHEOLOGIST • HESTER A. DAVIS

Coordinating Office
University of Arkansas Museum
Fayetteville, AR 72701

From: Hester A. Davis, State Archeologist

To: Mr. John P. Saxton, Chairman, Technical Review Committee

Date: November 15, 1974

Re: Comment on Draft Environmental Impact Statement Mississippi River and Tributaries Mississippi River Levees and Channel Improvement

This environmental impact statement contains a limited viewpoint of the impact of the project on the archeological and historical resources along the Mississippi River. The statement is made on page 192 that "while 736 historical and archaeological sites are in the project area, it is likely that only a fraction of these known sites will actually be adversely affected. Destruction of a historical or archaeological site could occur if the area became a source of borrow, or the site could be preserved (although inaccessible) if it were sealed under a berm, levee, or revetment." This considers only one destructive element of the project. In addition to the borrow areas for levees are a number of the other destructive elements. The ground is prepared for levees so that sites which the report indicates may be preserved under levees can be damaged in the process of levee construction. Underseepage problems are partially controlled by cutoff trenches, sublevees and drainage wells, construction of which can damage or destroy sites. Sites may be damaged or destroyed in the construction of revetments and dikes used in river training. Also, realignment of channels and dredging to maintain navigable depths would have an adverse effect on sites located in these areas. While many sites are not known within the river, certain kinds of sites are found only within the river, such as boat wrecks and Pleistocene and/or early Recent age fauna that provide information in regard to earliest man in the Mississippi River valley. The project appears, therefore, to have far more potential for destruction than for preservation of historical and archeological sites.

A second point in which the impact statement is inadequate is in regard to sites as yet undiscovered. The statement is made on page 192 that "many of the archaeological and historical impacts may result in uncovering heretofore unreported historical and archaeological sites. Contract specification would require contractors to cease operations and advise the contracting officer immediately if any historical or archeological sites are discovered." This type of contract specification is necessary because not all sites can be found from surface evidence; however, an intensive survey for as yet undiscovered sites is necessary before construction begins and plans for such a survey should be mentioned in the report. Investigation of sites to assess their significance is needed prior to project construction, as well as excavation of those sites where adverse effects of the project are unavoidable. An assessment of the significance of the total range of archeological and historical resources is needed early in the planning stages so that this information can be used in planning decisions.

A third point for which this impact statement is to be criticized is the publication of archeological site locations in Appendix D. We find it inconceivable that an agency with legislated directives to protect sites and information could so blatantly expose them to destruction. We recognize the need for the agency to have site location information for its planning purposes, but feel strongly that such information does not serve the purpose of preservation by being publicized. Inclusion of specific site location information in the Environmental Impact Statement serves no purpose and furthermore in itself creates an adverse impact on the sites because it provides locations to individuals who are searching for treasure rather than scientific or historical information. Excavation by untrained individuals vandalizes the information in the sites and ruins them for investigation with scientific techniques just as does the agency's construction. We ask that the specific site location information in Appendix D be deleted from the final impact statement.

cc: State Planning and Development Clearinghouse
Advisory Council on Historic Preservation
National Park Service, Southwest Region
District Engineer, Vicksburg
Office of the Chief, Corps of Engineers
State Historic Preservation Officers in: Arkansas, Illinois, Kentucky, Louisiana, Mississippi, Missouri and Tennessee.

ARKANSAS STATE DEPARTMENT OF HEALTH
4815 WEST MARKHAM STREET
LITTLE ROCK

CONSUMER PROTECTION SERVICE
ENGINEERING

TO		INIT'L
	SAXTON	
	MOTT	
	ARYNIARSKI	
✓	FORTENBERRY	AF
	YOUNG	
✓	Cantrell	RRC
	CHAPIN	
	SWEARINGEN	
	FERGUSON	
	WHITE	
	STEPHENS	
	NYITRAI	

October 17, 1974

State of Arkansas Department of Planning
400 Train Station Square
Victory at Markham Streets
Little Rock, Arkansas 72201

Attn: Mr. John P. Saxton

Re: Technical Review Committee
Review Request
Draft Environmental Impact Statement
Mississippi River and Tributaries
Mississippi River Levees and
Channel Improvements
75 E 239

Dear Mr. Saxton:

This office has received and reviewed the U. S. Army Corps of Engineers' above referenced document. The information presented in the statement indicates that the health significance of this project will be minimal. It is pointed out that many municipalities and industries pump their wastewater over the top of the existing levees and where these are to be built higher provisions should be made to assure that the pumping will continue. Provisions should also be taken to assure that pump stations will be capable of operations at higher heads.

This document is being retained for our files.

Yours truly,

BUREAU OF CONSUMER PROTECTION SERVICES

G. T. Kellogg

G. T. Kellogg, P.E., Director by TAL
Chief Engineer

GTK:TAS:GLH:jt

RECEIVED
OCT 24 1974
SOIL AND WATER
CONSERVATION COMMISSION

WATER RESOURCES

STATE OF ILLINOIS

PROJECTS TASK FORCE

DEPARTMENT OF CONSERVATION

605 STATE OFFICE BUILDING

SPRINGFIELD 62706

November 18, 1974

Gerald E. Galloway
Colonel, Corps of Engineers
District Engineer
Department of the Army
Vicksburg District
P. O. Box 60
Vicksburg, Mississippi 39180

Dear Colonel Galloway:

The State of Illinois Projects Task Force has reviewed your Draft Environmental Impact Statement - Mississippi River & Tributaries - Mississippi River Levees and Channel Improvement and has no adverse comment to make thereon. However, we do note that:

1.) The report does not give any Environmental Impact information on vector control, ie., mosquito breeding, etc.

2.) The document lacks data on flood heights and flows of record and operations during those floods. Particular attention is focused on the fuse plug in the New Madrid Floodway.

3.) The document lacks operational plan details for future floods.

4.) The document lacks information on existing and proposed levee profiles.

We appreciate the opportunity for review.

Sincerely yours,

Ralph O. Fisher

Ralph O. Fisher

ROF:jj

cc: Projects Task Force Members

MEMBER DEPARTMENTS

Agriculture, Business and Economic Development, Conservation, Environmental Protection Agency, Health, Institute for Environmental Quality, Local Governmental Affairs, Mines and Minerals, ~~Pollution Control Board,~~ Registration and Education, Transportation, Governor's Task Force for Flood Control, Bureau of the Budget

THOMAS O. HARRIS
SECRETARY

WENDELL H. FORD
GOVERNOR

COMMONWEALTH OF KENTUCKY
DEPARTMENT FOR NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION
OFFICE OF THE SECRETARY
FRANKFORT, KENTUCKY 40601
TELEPHONE (502) 564-3350

November 7, 1974

United States Army Engineer
District
P. O. Box 60
Vicksburg, Mississippi 39180

ATTENTION: Colonel Galloway

SUBJECT: Draft Environmental Impact Statement 74-25
Mississippi River and Tributaries
Mississippi River Levees and Channel Improvement

Dear Colonel Galloway:

The Kentucky Environmental Review Agencies have reviewed the above mentioned impact statement, as requested in your letter dated September 30, 1974. This office, which is the State Clearinghouse for environmental impact statement reviews, has received comments from the following review agencies: Department for Finance and Administration, Department of Fish and Wildlife, and the Department for Natural Resources and Environmental Protection's Division of Air Pollution.

The Department for Finance and Administration has raised the following question. Since the construction and main tenance activities of this proposed action will probably disrupt fish and wildlife and damage water quality, will there be anything done to help alleviate these temporary problems?

The Department of Fish and Wildlife's review of the impact statement found it to be very thorough and to frankly state the adverse biological impacts to fish and wildlife. It is also obvious that the loss of 30,000 acres of mixed bottomland hardwoods and 2,500 acres of cropland is monetarily insignificant when compared to the accrued benefit of the project to river transportation. You cannot compare the monetary value of a shrinking woodland habitat to the value of ports and river barge commerce. These bottomland hardwoods are becoming a scarce and endangered habitat that is irreplaceable. The loss of 2,500 acres of cropland will probably result in the clearing of more timber to replace cropland losses. The worst part about losing woodlands is that it takes 50 or more years to regenerate them. Some will never come back because swamp woods depend upon periodic flooding for their maintenance. Once the flooding regimen is stopped, the land reverts to a different successional series.

One interesting point is that there will be a decrease in surface acreage of 10,000 acres, which would become low-lying inundated area and river backwater. The river will become more constricted and confined by levees. This will result in larger fluctuations during periods of flooding because floodwater cannot spread out. If and when another flood of record does occur, damage will be greater than ever. We suggest that you designate some low-lying lands for use as flood storage areas and divert water to these areas when the need arises. They could be zoned for agriculture and recreation, and crop damages paid when necessary. Raising levee heights seems to be an endless process and not a solution.

The Division of Air Pollution suggested that care be taken to minimize any particulate emissions resulting from activities related to upgrading the levees, installing channel stabilization devices, and floodgate construction. Please adhere to the requirements of AP-3, Section 4, on Fugitive Dust and AP-2, on Control of Open Burning (See the attached).

For your information I have enclosed a list of our review agencies. We hope that these comments will be considered in the final draft.

Sincerely,

Thomas O. Harris

Thomas O. Harris
SECRETARY

TOH:DM:dch

Enclosures (3)

Kentucky Heritage Commission

401 Wapping Street

Frankfort, Kentucky 40601

Colonel Gerald E. Galloway
District Engineer
Department of the Army
Vicksburg District
Corps of Engineers
P. O. Box 60
Vicksburg, Mississippi 39180

Dear Colonel Galloway:

The draft environmental impact statement, Mississippi River and Tributaries Project was tremendously refreshing compared to most statements of this type that we review. The historical data was well organized although for future reference it would be beneficial to explain how the data was gathered (publications or field trips.) Also, during each phase of work it would be helpful for maps of the area affected showing each archaeological, architectural, historical, or cultural site and structure.

Sincerely,

Eldred W. Melton

(Mrs.) Eldred W. Melton
State Historic Preservation Officer

November 8, 1974

EWM:WJH/hv

State of Louisiana
DEPARTMENT OF PUBLIC WORKS
P. O. BOX 44155, CAPITOL STATION
BATON ROUGE, LOUISIANA 70804

ROY AGUILLARD
DIRECTOR

BOARD OF PUBLIC WORKS
GEORGE CHANEY, CHAIRMAN
EMMETT A. EYMARD
P. P. VERRETT, SR.
RICHARD P. GIBSON
ROLAND CARTER

November 26, 1974

Colonel Gerald E. Galloway
District Engineer
Vicksburg District, Corps of Engineers
P. O. Box 60
Vicksburg, Mississippi 39180

Re: LMKED-PQ

Dear Colonel Galloway:

This letter is in response to your written request dated September 30, 1974, for distribution to state agencies and for review and comments on the draft environmental impact statement prepared for the Mississippi River Levees and Channel Improvement, a feature of the MR & T Project. We are pleased to comply with your request.

For your reference we have attached a copy of the memo addressed to state agencies, Attachment No. I, to distribute copies of the draft EIS and requested review and comments. The initial agency distribution list was increased as a result of a recommendation from the Louisiana Commission on Intergovernmental Relations. Their letter dated October 17, 1974, is also attached as Attachment II. These agencies were requested to return their comments either to the office of the Vicksburg District, Corps of Engineers, or to the Department of Public Works. As of this date, we have received only one inquiry other than the October 17 letter from Louisiana Commission on Intergovernmental Relations. The second inquiry was submitted to the Louisiana Department of Public Works from Mr. Clint Pray, Governor's Council on Environmental Quality. The response to this inquiry along with a copy of his letter is being mailed to you under separate cover. If comments other than these mentioned in this paragraph have been submitted to your office, we would appreciate your sending copies of such comments to us at your earliest convenience.

Colonel Gerald E. Galloway
Page 2
November 26, 1974

Regarding comments from the Louisiana Department of Public Works, we have no additions or changes to recommend in the draft statement. We are confident that the draft statement is adequate and will fulfill requirements of this process. The Lower Mississippi Valley cannot afford any stopage, delay, or slow-down of continuing in a most aggressive manner the authorized flood control improvements for Mississippi River Levees and channel improvement. Therefore, this office would appreciate being notified of any advance comments or confusion from interest within the State of Louisiana so that we in our state may respond to these individuals or groups as appropriate.

We appreciate the opportunity to be of assistance in review of this draft EIS. Should you have further need for assistance from the Department of Public Works, please advise.

Sincerely,

Roy Aguillard

ROY AGUILLARD
Director

GRD/pal

Attachments

ATTACHMENT NO. 1
(To Nov. 22, 1974 Letter
From Roy Aguillard to
Col. Galloway
Re: LMKED-PQ)

ROY AGUILLARD
DIRECTOR

State of Louisiana
DEPARTMENT OF PUBLIC WORKS
P. O. BOX 44155, CAPITOL STATION
BATON ROUGE, LOUISIANA 70804

BOARD OF PUBLIC WORKS
GEORGE CHANEY, CHAIRMAN
EMMETT A. EYMARD
P. P. VERRETT, SR.
RICHARD P. GIBSON
ROLAND CARTER

October 9, 1974

TO: STATE AGENCIES (See Attached List)

FROM: Daniel V. Cresap, Chief Engineer D. V. C.

SUBJECT: Environmental Impact Statement--Mississippi River & Tributaries, Mississippi River Levees and Channel Improvement

The draft Environmental Impact Statement (EIS) for the above mentioned statement has now been completed. Enclosed is a copy of the draft EIS for your review and comments.

Any comments and views submitted will be considered in further planning for this project and will be included in the final environmental statements. You are invited to submit comments to the Department of Public Works, address provided above. However, if you wish, you may provide your comments directly to Colonel Gerald E. Galloway, District Engineer, Vicksburg District, Corps of Engineers, P. O. Box 60, Vicksburg, Mississippi 39180. If you choose to submit comments to the Vicksburg District, please provide DPW with a copy. All comments received in our offices will be combined and submitted to the Vicksburg District at the conclusion of the comment period. Comments are requested to be furnished to the Mississippi River Commission no later than November 15, 1974.

Please feel free to contact this office if you have questions or need additional information. It is always a pleasure to work with other state agencies in this type of endeavor.

GRD/pal

Attachments

Mr. Stanley Passman, Executive Director
Department of Commerce & Industry
P. O. Box 44185, Capitol Station
Baton Rouge, Louisiana 70804

Mr. Raymond T. Sutton, Commissioner
Department of Conservation
P. O. Box 44275, Capitol Station
Baton Rouge, Louisiana 70804

Mr. Donald J. Whittinghill, Director
Joint Legislative Committee on
Environmental Quality
P. O. Box 44033, Capitol Station
Baton Rouge, Louisiana 70804

Mr. Clint Pray, Chairman
Governor's Council on Environmental Quality
3101 37th Street
Suite 201
Metairie, Louisiana 70001

Mr. James E. Mixon, State Forester
Louisiana Forestry Commission
P. O. Box 15239, Broadview Station
Baton Rouge, Louisiana 70815

Mr. W. T. Taylor, Jr., Director
Department of Highways
P. O. Box 44245, Capitol Station
Baton Rouge, Louisiana 70804

Mr. Leon R. Tarver, Jr., Executive Director
La. Commission on Intergovernmental Relations
P. O. Box 44455, Capitol Station
Baton Rouge, Louisiana 70804

La. Air Control Commission
P. O. Box 60630
New Orleans, Louisiana 70160

La. Coastal Commission
P. O. Box 200, USL
Lafayette, Louisiana 70130

La. Public Service Commission
P. O. Box 44035, Capitol Station
Baton Rouge, Louisiana 70804

Mrs. Ellen Bryan Moore, Register
State Land Office
P. O. Box 44124, Capitol Station
Baton Rouge, Louisiana 70804

Mr. Leo W. Hough, State Geologist
Louisiana Geological Survey
6554 Florida Blvd.
Baton Rouge, Louisiana 70806

Mr. Jay R. Broussard, Director
Department of Art, Historical and Cultural Preservation
Old State Capitol
Baton Rouge, Louisiana 70801

Mr. C. J. Bonnecarrere, Executive Secretary
State Mineral Board
P. O. Box 2827
Baton Rouge, Louisiana 70821

Mr. Gilbert C. Lagasse, Director
State Parks & Recreation Commission
P. O. Drawer 1111
Baton Rouge, Louisiana 70821

Mr. Patrick W. Ryan, Executive Director
State Planning Office
P. O. Box 44425, Capitol Station
Baton Rouge, Louisiana 70804

Mr. Robert Lafleur, Executive Secretary
Louisiana Stream Control Commission
P. O. Drawer FC
Baton Rouge, Louisiana 70803

Mr. Charley S. Staples, Executive Director
Soil & Water Conservation Committee
P. O. Drawer CS
Baton Rouge, Louisiana 70803

Mr. Robert Murray, Environmental Coordinator
Wildlife & Fisheries Commission
P. O. Box 44095, Capitol Station
Baton Rouge, Louisiana 70804

Bureau of Environmental Health
Division of Health Maintenance & Ambl. Patient Services
P. O. Box 60630
New Orleans, Louisiana 70160

Department of Agriculture
P. O. Box 44302
Baton Rouge, Louisiana 70804

Attorney General's Office
Environmental Section
234 Loyola Street
New Orleans, Louisiana 70112

Governor's Council of Economic Advisors
College of Business Administration
Division of Research
Louisiana State University
Baton Rouge, Louisiana 70803

Attachment No. II

STATE OF LOUISIANA

COMMISSION ON INTERGOVERNMENTAL RELATIONS

EDWIN EDWARDS
GOVERNOR
SENATOR MICHAEL H. O'KEEFE
CHAIRMAN
LEON TARVER
EXECUTIVE DIRECTOR

October 17, 1974

P. O. BOX 44455
BATON ROUGE, LOUISIANA 70804
389-5664

Mr. Daniel V. Cresap
Chief Engineer
Department of Public Works
P.O. Box 44155
Baton Rouge, Louisiana 70804

Dear Mr. Cresap:

The draft Environmental Impact Statement, "Mississippi River and Tributaries, Mississippi River Levees and Channel Improvement", was reviewed by the State Clearinghouse in respect to agency impact and responsibility.

We have enclosed a list of additional state agencies impacted by the referenced project from which, according to your cover letter, no comments were solicited. We request that you forward to each of these agencies a draft Environmental Impact Statement and request for comments.

Please feel free to contact this office if any further assistance is required.

Sincerely,

Regis Allison

Regis Allison
State Clearinghouse Director

Enclosure:

RA:vh

RECEIVED
OCT 22 1974
DEPARTMENT OF PUBLIC WORKS
BATON ROUGE, LA.

State of Mississippi

BOARD OF WATER COMMISSIONERS
416 NORTH STATE STREET
JACKSON, MISSISSIPPI 39201
354-7236

November 18, 1974

Colonel Gerald E. Galloway
District Engineer
Corps of Engineers, Vicksburg District
Post Office Box 60
Vicksburg, Mississippi 39180

Subject: Draft Environmental Impact Statement (EIS):
Mississippi River and Tributaries
Mississippi River Levees and Channel Improvements

Dear Colonel Galloway:

In response to your letter of September 30, 1974, we have conducted State agency review of the above captioned EIS, and have attached for your information all pertinent material.

As indicated by the enclosed material, agency response to the review request was minimal. And, of the comments received, none were critical of the EIS. However, the Mississippi Forestry Commission has indicated their concern for the expected loss of woodlands due to construction activities, and has suggested that means be found to lessen the amount of timber acreage lost due to project implementation.

In summary, we have no objection to the EIS. However, we are concerned with the expected land-use changes in the study area and subsequent environmental damages as a result of project implementation. We hope efforts will be made to lessen the chances of any potential problems occurring.

Sincerely,

MISSISSIPPI BOARD OF WATER COMMISSIONERS

Jack W. Pepper

Jack W. Pepper
State Water Engineer

JWP:mm

State of Mississippi

BOARD OF WATER COMMISSIONERS
416 NORTH STATE STREET
JACKSON, MISSISSIPPI 39201
354-7236

December 2, 1974

Colonel Gerald E. Galloway
District Engineer
Corps of Engineers, Vicksburg District
Post Office Box 60
Vicksburg, Mississippi 39180

Subject: Draft Environmental Impact Statement (EIS):
Mississippi River and Tributaries
Mississippi River Levees and Channel Improvements

Dear Colonel Galloway:

Enclosed herein for your consideration are additional comments received from the Mississippi Forestry Commission in regard to the above captioned EIS. We feel that the suggestions contained therein merit further consideration, and any proposed measures capable of alleviating the potentially harmful environmental and economic effects of the project in the study area should be carefully studied.

Thank you for your cooperation in this matter, and if we may be of further assistance, please contact us.

Sincerely,

MISSISSIPPI BOARD OF WATER COMMISSIONERS

Jack W. Pepper

Jack W. Pepper
State Water Engineer

JWP:mm
Encl.

PROTECTION INFORMATION MANAGEMENT
MISSISSIPPI FORESTRY COMMISSION

Mississippi
FORESTRY COMMISSION
908 ROBERT E. LEE BLDG. • JACKSON, MISS. 39201 • 354-7124

October 28, 1974

File:

Mr. John E. Brown
Board of Water Commissioners
416 North State Street
Jackson, Mississippi 39201

Dear Mr. Brown:

The Environmental Impact Statement for the Mississippi River and Tributaries, Mississippi River Levees and Channel Improvements has been reviewed.

We feel that the proposed action is needed to ensure the existing and continued improvements in flood protection and in the transportation capacity of the Mississippi River. However, we feel that the loss of 30,000 acres of woodland is excessive.

As pointed out in the study, our highly valued hardwood timber acreage in the study area has been greatly reduced since 1960. The loss of 30,000 additional acres (approximately 18,000 of these acres occur in Mississippi) due to construction activities and the inherent danger of additional land being cleared for agricultural use after flood control is achieved will greatly decrease our diminishing hardwood acreages.

Hardwood timber acreage losses due to construction activities alone will result in from $170,000 to $280,000 a year loss in revenue within the State of Mississippi.

We strongly urge that ways to decrease the amount of timber acreage lost due to construction activities be found and that they be incorporated in the final plan.

Sincerely,

Billy T. Gaddis

Billy T. Gaddis
State Forester

OCT 29 1974
MISS. BD. OF WATER COMM

BTG:slf

"SERVING MISSISSIPPIANS SINCE 1926"

November 27, 1974

Mr. John E. Brown
Board of Water Commissioners
416 North State Street
Jackson, MS 39201

Dear Mr. Brown:

Re: The Environmental Impact Statement, Mississippi River Levees and Channel Improvements

In addition to the comments in our letter to you concerning the Environmental Impact Statement for the Mississippi River Levees and Channel Improvements, dated October 28, 1974, we would like to offer the following comments that we have received from a forest landowner in the study area:

P. 106 We do not agree with the statement that the beaver population is declining. In some areas, beaver activity is responsible for heavy timber damage and loss, and it is on the increase.

P. 154 No mention is made of the effect on the timber and other elements of the environment from lower river stages caused by straightened channels. This increases lateral drainage and, in general, lowers the water table in the batture. This can become critical during long periods of low water as in 1954 when many millions of board feet of cottonwood were lost in the area concerned. We know of no way to measure the amount of probable damage.

P. 155 Under these proposed projects, the borrow pit area would be increased by some 14,000 acres. The borrow pits from past projects were left in various conditions with no thought to their future use. Some are shallow, poorly drained areas that support no timber and little aquatic life, then dry up in the Spring or Summer. Others are too deep and too poorly drained to grow timber. Some of these have good populations of fish year round, while others are little more than stagnant, algae-choked pools. The amount and quality of timber in these present borrow pits varies from good to non-merchantable for sawlogs, depending upon the average depth of water, degree of drainage, and soil type. As far as we know, no survey has been made on the percent of area in merchantable timber for the present borrow pits.

Most of the new borrow pit areas to be added could be left in good timber producing condition with proper planning and little additional cost. We are receiving some cooperation at this time from the Corps on this problem in Louisiana. The borrow pits, ideally, should not be left too deep; perhaps, three or four feet at the deepest part. They should be levelled and sloped away from the levee. Small drains or ditches should be made to the River, a slough, or low drainage area. This process should also reduce under levee seepage.

Since many of these new borrow pits would be added to the back edge of the old ones, and since the old pits would be cleared in many instances, the old borrow pits could be improved along with the new ones. This might mean as much as 20,000 acres of good timber producing area which could be planted if natural seeding is not satisfactory. To take advantage of this possibility is simply good land use planning, and the opportunity should not be ignored.

We believe these are valid and constructive comments and that they deserve careful consideration.

Sincerely yours,

Billy T. Gaddis

Billy T. Gaddis
State Forester

BTG:slf

Air & Water Pollution Control Commission

STATE OF MISSISSIPPI

Glen Wood, Jr., Executive Director
P. O. Box 827 - Robert E. Lee Building
Jackson, Mississippi 39205

Telephones:
Administrative Offices 601-354-7513
Air Division 601-354-6783
Water Division 601-354-7661

November 12, 1974

Mr. John E. Brown
Board of Water Commissioners
416 North State Street
Jackson, Mississippi 39201

Dear Mr. Brown:

Re: Draft Environmental Impact Statement
Mississippi River & Tributaries
Mississippi River Levees & Channel Improvements

Review of the above referenced draft Environmental Impact Statement has been completed.

We feel that the Environmental Impact Statement is satisfactory and we are in hopes that care will be taken upon implementation to minimize environmental damage.

Very truly yours,

Scott D. Armstrong
Water Quality Management Section

SDA:tp

Christopher S. Bond
Governor

State of Missouri
OFFICE OF ADMINISTRATION
Jefferson City 65101

Robert L. James
Commissioner

Bill R. Cramer, Director
Division of State Planning and Analysis

November 18, 1974

Mr. Gerald E. Galloway
Colonel, Corps of Engineers
Vicksburg District
Post Office Box 60
Vicksburg, Mississippi 39180

Dear Colonel Galloway:

Subject: Draft Environmental Impact Statement for Mississippi River Levees and Channel Improvement, OA 74100067

The Office of Planning, as the designated State Clearinghouse, has coordinated a review of the above referred draft environmental impact statement with various concerned or affected state agencies pursuant to Section 102(2)(c) of the National Environmental Policy Act.

Enclosed please find the comments received. None of the other state agencies involved in the review had comments or recommendations to offer at this time.

We appreciate the opportunity to review the statement and anticipate receiving the final environmental impact statement when prepared.

Sincerely,

Terry L. Rehma
A-95 Coordinator

MISSOURI DEPARTMENT OF CONSERVATION

2901 North Ten Mile Drive - Jefferson City, Missouri 65101

P. O. Box 180 - Telephone 314 751 4115

CARL R. NOREN, Director

November 12, 1974

Mr. Terry Rehma
Office of Administration
Division of State Planning and Analysis
State Capitol Building - Room B-22
Jefferson City, Missouri 65101

Re: 74100067

Dear Mr. Rehma:

We have reviewed the draft environmental statement for Mississippi River and Tributaries, Mississippi River Levees and Channel Improvement prepared by the Vicksburg District of the Corps of Engineers. The statement, as we understand it, is for continuation of work under the 1928 Flood Control Act. However, we are confused by Item N, Page 5 which states, "The present project dates from this Act (1928). . .". A clear statement of work planned, authorized, etc. would be a most helpful beginning.

The statement mentions in several places "significant reductions have occurred in the flood capacity of the river". A more complete discussion of how this has occurred, how the proposed action differs from past action and how it will correct previous "mistakes" is necessary. Efforts to lower the flood stage were apparently successful, however, we understand that the river is not at equilibrium. We are concerned that the planned action will result in substantial losses of fish and wildlife habitat, and not alleviate the cause of increasing flood levels at similar flows. Data gathered on the Middle Mississippi River indicate dikes, levees and dredge spoil disposal in the floodway have aggravated the flooding problem. The proposal as outlined in the EIS seems to offer more of the same.

Specific comments are appended to this letter. Thank you for the opportunity to review this statement.

Sincerely,

Larry R. Gale

LARRY R. GALE
DEPUTY DIRECTOR

Attachment

COMMENTS

by

MISSOURI DEPARTMENT OF CONSERVATION

on

DRAFT EIS MISSISSIPPI RIVER AND TRIBUTARIES, VICKSBURG DISTRICT

Page 5, Item n - The project being discussed is not clear. What is authorized? What is proposed but not authorized? Are conflicts between flood control and navigation anticipated?

Page 6 - Item p - The loss of flood capacity in the river must be addressed in greater detail. How will the proposed action correct the loss of flood capacity when the proposed action is similar to previous action?

Page 6 - Item b, c and d - Are these elements all authorized? What was the date of the authorization? What has been the cost?

Page 9 - Item d - Why was the flood flow line revised in 1973? How will the proposed action prevent further revision?

Page 12 - Item e - Side channels and chutes are important to fish and wildlife, and no doubt increase the river's ability to store and pass flood waters.

Page 13 - Item c - The backwater areas in divided channels provide fish and wildlife habitat. Filling of such areas either by depositing spoil, or accretion from dike fields will result in a loss of habitat and reduction in flood capacity. Is this loss of flood capacity considered in the project?

Page 15 - First Paragraph - We wonder how the 97 acres can be "flood free", when it is obviously located in the flood plain.

Page 21 - Figure 2 - This figure represents a "project design flood", however the flows depicted from the Mississippi River at St. Louis are extremely small. The 1973 flood, a relatively small flood, had a volume of 850,000 cfs. The figure indicates flood flows of 240,000 cfs.

Page 27 - First Sentence - Standard Methods would alleviate this problem.

Page 54 - Last Paragraph - Wildlife would reinvade the floodway soon after the water receded.

Page 61 and 62, Item 2 - The superficial statement that ocean ranging animals make "occasional visits" to the estuary fails to address the importance of the visits. In many cases these occurrences are essential for the species existence.

Page 62 - Item 3 - The statement, "Half the aquatic habitat. . . is deep, fast water which is low in productivity", is interesting. Was the meandering Mississippi River made deep and fast by dredging cutoffs and dikes? Will the proposed action change this process or further reduce aquatic habitat?

Page 67 - Item 5 - The statement fails to consider the fact that if the land were protected from flooding the habitat essential for terrestrial wildlife, as well as aquatic wildlife would be lost. We would be interested in seeing data presented on the impact of flooding vs. intensive agriculture on the "normal breeding cycles" of wildlife species.

Page 68 - The loss of vegetative cover due to flooding is less serious since the habitat returns. When flood protection is provided, habitat is permanently cleared. In some cases, successional stages can be set back to the benefit of a variety of wildlife species.

Page 75 - We would be interested in the data that supports the last two sentences.

Page 87 - Item d - Data to support the generality that "Mississippi tributaries are of degraded water quality" should be presented due to the importance of water quality to the riverine system.

Page 88 - Item e - The value of the river swamps far exceeds that of waste assimilation. We suggest you study Charles H. Wharton; Southern River Swamp, A Multiple Use Environment (1970).

Page 93 - Source material listed in Table 13 is not included in the "List of References".

Page 95 - No fish harvest data are presented for the Missouri reach of the Mississippi River.

Page 101 - Item 7 - The discussion of swamps and sloughs is very weak, and indicate either a lack of knowledge on their value, or superficial treatment of this extremely valuable ecosystem.

Page 106-107 - Item 4a - The mainstem of the Mississippi River includes chutes and backwaters. Therefore it is misleading to state "The mainstem Mississippi River is dangerous for sport or commercial fishing".

Page 113 - How will the project affect rare and endangered species? How does the Corps of Engineers propose to meet the requirements of the Rare and Endangered Species Act?

Page 136 - Item 12 - The statement, "The project area is generally unprotected from flood damages" is not clear. Page 10 states that river training devices increase the flood carrying capacity. Once again, we are not clear on what the project is, and how it is expected to function.

Page 137 - If "land uses in the lower Mississippi Valley are well adjusted to the flood hazard" what is the real need to spend millions of dollars?

Page 141 - Item c - A population of only 9,000 persons could probably be protected more efficiently if removed from the flood plain.

Page 152 - Item g - (1) This section disregards the "National Priority" placed on environmental values and completely ignores fish, wildlife and recreation;

(2) Data presented by railroads dispute the statement that barges are more efficient; and (3) Data are not presented to indicate the energy demand for project construction

Page 154 - Item a - The conversion of 10,000 acres of water to land will change fish, wildlife and flood carrying capacities. The design channel may be more efficient for some purposes, but if it does not have the capacity, higher levees, more floods, and greater dependency on artificial flood protection will be necessary. The end result will likely be more years like 1973, 1950, 1927, and 1913.

Page 155 - Item 2 - We doubt that scour will be permitted to develop or restore water areas. Data to support the statement "small lakes will not fill in during the life of the project features" should be presented.

Item 4 - Which project features will inhibit flows from tributaries? How will they inhibit flows? How much will be inhibited?

Page 158 - Item 5 - Data presented in Table 21 raise several questions. Why did dissolved solids decrease substantially below dredging operation, while settleable solids increased?

Page 162 - Item 2 - If the channel is pinned down and the banks are stabilized, we fail to see how there will be an "increase in sediment contribution generated by the natural meander process of the river".

The stabilization and improvement in the channel of the Middle Mississippi River has resulted in higher stages at similar flows.

Page 163 - Line 3 states dredging would decrease; Line 6 and 7 state dredging is not expected to increase. What are the facts?

Page 163 - Item 3 - The Lower Mississippi River no longer has a "natural alignment".

Item 4 - Constricting the river area, will aggravate flood problems and eliminate fish and wildlife habitat. The proposed action seems to counter the need for flood carrying capacity (Page 9, Item p).

Page 164-169 - What plans have been made to reduce impacts on fish and wildlife species? How will the project comply with the Rare and Endangered Species Act?

Page 168 - Table 24 - Data in this table are misleading and in some cases incorrect. We question the improvement of habitat in borrow pits for riverine fish species.

Page 171 - Table 25 - If water areas are converted to land, how can they be listed in a table that attempts to indicate time to "recover"? This table is misleading. Aquatic habitat is lost to terrestrial, and good terrestrial habitat is converted to cleared agriculture land.

Page 170-181 - What measures are included in the project to reduce or minimize habitat losses? The data should be presented in a more understandable manner. How many thousand acres of each habitat type will be lost due to the project?

Page 182 - Item 1 - What is the purpose of creating a deeper channel? Is a 12 or 15 foot navigation channel part of this project? Data must be presented to support the statement "little or no effect on large river species". It seems that in order to deepen the river some backwaters and side channels would be eliminated. Will this not affect river fish species?

Data should be presented to support the statement that trading mayflies for caddisflies will not affect fish. Bottom habitat type, time of emergence, and habitat preference of each insect group are substantially different.

Page 184 - Item 2 - The closure of chutes and their filling with sediment reduces the cross sectional area of the river available to pass flood waters. Chute type habitat is important to certain species, while other species prefer slack water. The elimination of chutes would no doubt reduce certain species.

Page 186 - Item a - We believe the loss of slackwater will be a strong negative impact, which the creation of a limited acreage of borrow pits will not moderate. The loss of 20 percent of the slack water acreage must be looked at as extremely detrimental to aquatic life.

Item b - Aquatic life cannot survive in areas filled by sediment. The fact that in "some cases" areas behind dikes don't fill is little consolation. What is being done to prevent filling and encourage backwater development?

Page 188 - Item c - This is misleading and fails to present objective disclosure of the environmental impacts. The positive impact referred to is based on a chance development, while the tremendous negative impact is nearly certain.

The presentation of charts of one slackwater area is interesting; are plans being made to duplicate the effort on other reaches of the river? If not, why not?

Page 192 - Item a - The creation of 17,000 acres of sand will be at the loss of water area.

Item b - What is the basis for the statement that there will be "greater visual diversity"?

Page 196 - Item 3 - The filling processes discussed are not entirely "natural". They are man induced by the placement of dikes, closing structures and revetments.

Item 4 - From a fish and wildlife standpoint the loss of habitat diversity is bad. In addition, similar losses of water areas to land, and agriculture has aggravated the flooding problems on the Middle Mississippi River.

Page 197 - Item a - If the project will adversely affect 2,500 acres of cropland and 30,000 acres of woodland, why is the project necessary?

Page 199 - Item 6.01 - This section seems to extravagate the consequences of no federal action.

Page 211 - Item 6.03 - If the existing project is based on "an integrated framework of mutually supporting structures" we fail to see how continued maintenance of that framework would result in failure of the project.

Based on experiences on the Middle Mississippi and Missouri Rivers, and readings of experts (Modern Hydrology, by Raphael Kazmann, 1972), we are concerned that raising levees is not the long term solution. Man must recognize his abilities are limited by natural forces. The raised levees will also be subjected to overtopping and failure.

Page 213 - Item 1 - The statement that lands would be abandoned is not supported by our experiences. More and more land on the river side of levees is being cleared each year. A display of data on land being abandoned vs. land being cleared should be presented.

Item 2 - Loss of aesthetics would be very temporary and in the long run could provide for a more "diverse" setting.

Item 3 - With the proposed actions the historical and archaelogical resources will suffer from man's activities.

Page 214 - Item 4 - The population of 9,000 people is quite sparce at present.

Page 232 - Item 1 - Is the river presently in its "natural alignment"? What about cutoffs, dikes, etc.? We disagree with the statement that the impacts of channel stabilization devices are "short term". Experience on the Missouri and Mississippi Rivers indicates otherwise.

Page 233 - Item b - Additional dikes, revetment, etc. will not create "more diverse aquatic communities". On the contrary, there will be a loss of diversity due to closure of side channels and loss of aquatic habitat.

Page 234 - Item a - Include "river side channels and backwaters" in the first sentence.

Page 237 - The Missouri Department of Conservation has not been contacted by the Corps of Engineers regarding this project. Therefore, we have not had meetings or other opportunities to offer comments and suggestions of project elements.

MISSOURI
STATE HIGHWAY COMMISSION

Jefferson City, Missouri 65101
Telephone (314) 751-2551

October 30, 1974

GENERAL: A-95 Review
Application No. 74100067

Mr. Terry Rehma
A-95 Coordinator
Office of Administration
Division of State Planning and Analysis
Capitol Building - P. O. Box 809
Jefferson City, Missouri 65101

Dear Mr. Rehma:

The Draft Environmental Impact Statement involving the Mississippi River and tributaries, Mississippi River levees, and channel improvement by the U.S. Army District does not recognize the impact on State highway facilities should the floodway area be utilized. The Environmental Impact Statement should recognize the fact that a severe impact to the State Highway System will occur if the floodway is used.

Very truly yours,

L. V. McLaughlin
Assistant Chief Engineer -
A-95 Review Agent

STATE OF TENNESSEE
OFFICE OF URBAN AND FEDERAL AFFAIRS

SUITE 1312
ANDREW JACKSON STATE OFFICE BUILDING
NASHVILLE 37219

JAMES A. PAYNE
DIRECTOR

615-741-2714

November 14, 1974

Colonel Gerald E. Galloway
Department of the Army
Vicksburg District, Corps of Engineers
Post Office Box 60
Vicksburg, Mississippi 39180

RE: Draft Environmental Impact Statement - Mississippi River and Tributaries Project - Levees and Channel Improvement

Dear Colonel Galloway:

As the designated State Clearinghouse for Federal grant programs under OMB Circular A-95 guidelines, we have coordinated a review of the draft statement for the above referenced proposed project.

Enclosed are comments submitted by the Tennessee Wildlife Resources Agency. These substantive remarks merit your attention and responsive consideration prior to finalization of the environmental impact statement.

We appreciate the opportunity to review this proposal which generally emphasizes benefits of flood protection and improved navigation between Cairo, Illinois and Venice, Louisiana. While we do not object to the general proposals, we strongly urge that more detail be provided to outline the manner in which these measures are to be effected, particularly at the selected locations indicated in the enclosed comments.

The State of Tennessee reserves the right to further evaluate these project features as additional information becomes available to us. If our office, as the State Clearinghouse, can be of assistance in this or other matters, please do not hesitate to contact us.

Sincerely,

Stephen H. Norris/mn

Stephen H. Norris
Grant Review Coordinator

SHN: mn

Enclosure

TENNESSEE WILDLIFE RESOURCES AGENCY

ELLINGTON AGRICULTURAL CENTER
P. O. BOX 40747
NASHVILLE, TENNESSEE 37204

HARVEY G. BRAY, Director
ROY H. ANDERSON, Ass't. Dir.

November 13, 1974

Mr. Stephen H. Norris
Grant Review Coordinator
Office of Urban and Federal Affairs
Suite 1312
Andrew Jackson State Office Building
Nashville, Tennessee 37219

Re: Corps Draft EIS - Mississippi River & Tributaries Levee & Channel Improvement

Dear Mr. Norris:

This project concerns flood control and navigation features of the Mississippi River and tributaries between Cairo, Illinois and Venice, Louisiana. This draft EIS describes the broad aspects of the project including levees, "river training" devices, and maintenance dredging.

Project Description

As stated on page 8, levees are proposed to upgrade flood control by providing a minimum freeboard above the revised 1973 flood flow line. To accomplish this, approximately, 450 miles of levees are proposed to be raised along the mainstream between Cairo and Venice. The fill material will be obtained from borrow areas generally located on the river side of the levees. No detailed description is provided for individual projects, but, according to Map 1-8 (1), the Tiptonville-Obion Levee Extension, along with the Obion Diversion Channel, would be included.

According to pages 10-12, proposed river training devices include: (1) dikes for directing the channel into favorable alignment, (2) revetment of stream banks by means of underwater articulated concrete mattresses and riprap above low water levels on stripped and graded banks; and (3) foreshore protection by placement of large stones close to and parallel to the river bank in order to minimize the erosive action of waves. A total of 574 dikes would be added to the system at 165 locations (page 163).

Maintenance dredging of existing 9-foot channels will be provided to maintain navigable depths in selected sections of the main channel.

In a related project (page 15), the Mud Creek project of Lake County, Tennessee would provide a pumping station to excavate ponded water from that area when high stages on the Mississippi River prevent gravity drainage. A new inlet channel is proposed beginning at a point about 2,000 feet upstream from the existing Mud Lake culverts and extending northerly to the Mississippi River Levee. A 150-cfs pumping station is proposed to discharge the water into the Mississippi River.

Project Impacts and Recommendations

The proposed Tiptonville-Obion Levee Extension and the Obion Diversion Channel would provide potential severe adverse effect on the Anderson-Tully Wildlife Management Area and on existing large natural lakes: If not properly designed, this project could cause severe sedimentation, resulting in the loss of trees on the W. M. A. and in the filling of valuable fishing and waterfowl lakes with sand. Since the draft EIS does not provide a detailed description of this particular project, it is recommended that a separate draft environmental impact statement be prepared for this project.

Dikes and revetments would have a strong negative impact on slackwater areas (page 186). Slackwater is described on page 71 as, "very slow moving and shallow, providing important spawning and nursery sites for fishes and abundant food in the form of benthos and plankton" and "valuable for both commercial and sport fishing". It is projected (page 166) that slackwater would be reduced between Cairo, Illinois and Memphis, Tennessee by 3,300 acres or 35%. Since no description is given in the draft EIS concerning the Tennessee portion of the dike and revetment projects, we recommend that a separate environmental impact statement be prepared, including full details of proposed work in Tennessee.

Underwater concrete revetments could have a strong negative impact on benthos and fish spawning areas along the Mississippi River. Sections of 3-inch thick concrete are proposed to extend from the bank to the deepest point in the channel (page 11). These concrete sections would extend up and downstream until the desired degree of protection would be provided. There are already 673 miles of revetment in the project area. The proposed project includes approximately 325 additional miles at about 154 locations (slightly conflicting figures on pages 12 and 163). We reserve our comments until we can learn the location and extent of such revetments in Tennessee. An EIS is recommended for inclusion of this project description.

We conclude that proposed bank riprap and foreshore protection would provide overall benefits to fish and wildlife by protection of stream banks.

We recently commented on an EIS concerning maintenance dredging in the Tennessee portion of the Mississippi River. We do not object to the proposals as described in that EIS.

Insufficient information is presented concerning the proposed pumping of ponded water from the Mud Creek area of Lake County (page 15). We will want to comment on a later EIS giving more specific details.

Summary and Conclusions

The draft EIS broadly describes flood control and navigation projects of the Mississippi River and tributaries between Cairo, Illinois and Venice, Louisiana. While we do not object to these general proposals at this time, we conclude there is a potential threat to fish and wildlife habitat. We recommend that additional details be provided in separate EIS's concerning: (1) Tiptonville-Obion Levee Extension and Obion Diversion Channel, (2) dikes, (3) revetments, and (4) Mud-Creek Project of Lake County. We, therefore, recommend that additional EIS's be prepared concerning these projects.

We appreciate this opportunity for comment and look forward to further evaluation of these projects.

Sincerely,

Harvey Bray

Harvey Bray, Director
Tennessee Wildlife Resources Agency

RMH/ss

cc: Mr. Wilbur Vaughan
Mr. Bob Robinson

Missouri

Bootheel

Bootheel Regional Planning Commission
& Economic Development Council

P.O. Box 397 Telephone 314 276-2242 Malden, Missouri 63863

PAT LEA, CHAIRMAN
PHILIP SHELTON, DIRECTOR

November 12, 1974

Mr. Gerald E. Galloway
Colonel, Corps of Engineers
District Engineer
U.S. Army Engineer District
P.O. Box 60
Vicksburg, Miss. 39180

Dear Mr. Galloway:

The Bootheel Regional Planning Commission and the Bootheel's A-95 PNRS Committee have reviewed the Draft Environmental Impact Statement for the Mississippi River Levees and Channel Improvement Program. It was the recommendation of both committees that an article be run in two local newspapers informing the public that a copy of this Environmental Impact Statement was available for their review. We are enclosing copies of the article as it appeared in two different newspapers for your files.

We received no negative comments or recommendations as a result of the article. Therefore, the Bootheel Regional Planning Commission endorses this Environmental Impact Statement as it applies to the Bootheel's six member counties.

Sincerely,

Ronald C. Yersak

Ronald C. Yersak
Planning Director

RCY:gw
Encl.

cc: Mr. Philip Shelton

Central Arkansas Planning and Development District, Inc.

112 Northeast Front Street, Post Office Box 187, Lonoke, Arkansas 72086

Telephones: Lonoke 676-2721, Little Rock 374-4669

COUNTIES SERVED:

FAULKNER
LONOKE
MONROE
PRAIRIE
PULASKI

October 11, 1974

Colonel Gerald E. Galloway
Vicksburg District,
Corps of Engineers
P. O. Box 60
Vicksburg, Mississippi

Attention: LMKED-PQ

Dear Colonel Galloway:

This office has no recommendations to offer in regard to the environmental impact statement prepared for the Mississippi River Levees and channel improvement. We do wish to state that the document was rather thorough and impressive even though we feel not qualified to render a valued judgement thereon.

Sincerely,

L E Barber

L. E. Barber
Planner

LEB/lf

Natchez-Adams County Port Commission

Post Office Box 1182 — Telephone Area Code 601 442-2561

Natchez, Mississippi 39120

November 20, 1974

Colonel Gerald E. Galloway
District Engineer
Vicksburg District, Corps of Engineers
P. O. Box 60
Vicksburg, Mississippi 39180

Dear Colonel Galloway:

I am sorry I am a few days late in forwarding my comments on the environmental impact statement prepared by your office for the Mississippi River Levees and Channel Improvement project.

I have read many sections of the statement carefully and scanned the others. I do not feel qualified to make any substantive comments. It is a very comprehensive study and seems to me to be adequate in all respects.

We are still looking forward to a visit from you. With best personal regards, I am

Sincerely yours,

Bill

William A. Adams
Colonel, USAF (Retired)
Port Director

November the Thirteenth
1 9 7 4

Colonel Gerald E. Galloway
Corps of Engineers Vicksburg District
Department of the Army
P. O. Box 60
Vicksburg, Mississippi 39180

Dear Colonel Galloway:

The Environmental Action Council of Memphis comments as follows on the draft environmental impact statement "Mississippi River and Tributaries Mississippi River Levees and Channel Improvement".

Section 1, Project Description, and Section 2, Environmental Setting, Pages 1 thru 153, are well done and adequate. In fact, all residents of the valley should read it to learn or refresh their knowledge of the environment in which they live.

The meat of the statement is in Section 4, Environmental Impacts of the Proposed Action, Pages 154 thru 190. The statement will stand or fall on the content of this section because it is supposed to state effects of the project upon the environment.

In general the section seems adequate, but here are some comments:

Page 158, par. 5. A specific plan to alleviate adverse effects of dredging would be better than the statement - "Care must be taken in such dredging and subsequent spoil disposal", otherwise what assurance is offered that care will in fact be taken to mitigate such effects?

Dredging is not a one-time operation but must be continued as a maintenance operation constantly throughout the life of the project. The adverse effects are therefore spread into future years. Perhaps more attention should be focused on elimination of most dredging in favor of alternative operations less damaging to water quality. Otherwise we can foresee many years of disturbance of the river.

Table 21 states that water quality effects of dredging has strong local impacts but is minor compared to ambient water quality. However, there is a question as to how far water quality may be affected by colloidal and other fine material. Probably all the way from Cairo to New Orleans.

Page 162, par. 2. Probably a typographical error, but the statement says "Channel stabilization techniques will increase sediment contribution generated by the natural meander processes of the river" thereby reducing dredging requirements. It would seem that channel stabilization will decrease sediment contribution.

Page 166, Table 22. Note that borrow pits to supply fill material for levees and other items will increase by 11,400 acres, more than double existing area; also that 29,300 forest acres will be lost by clearing for improvements, for borrow pits, etc. (Also see Page 195, par. 2)

eacm
ENVIRONMENTAL ACTION COUNCIL OF MEMPHIS
P. O. BOX 4526 MEMPHIS, TENNESSEE 38104

Page 198, 5.02 d. Economics. Losses of cropland resulting in $300,000 per year and timberland $300,000 to $450,000 per year would result from project, but the report nowhere states how many acres of crop and timberland will be protected from flooding and therefore result in increased production. This, too, is an impact of the project. The report does show that project benefits would be 17 times the cost (page 16, 1.09).

Based on the historical benefits of the completed portions of the Mississippi Flood Control project, we must conclude that the sum total of national and local goals would require the completion and continued maintenance of the project.

No sensational adverse effects to the environment have been observed. In fact, up to now, the project has generally been without controversy except for purely local conflicts. To curtail the project, or fail to proceed, would on the other hand, undoubtedly generate extreme pressures from a multitude of residents who are now enjoying its benefits. If for no other reason, the Mississippi Valley must be protected from flooding to maximize its gigantic agricultural potential.

We feel that the draft statement can be improved especially in Section 4. This section will benefit by considering all comments and by providing more specific assessments of project impact.

The Environmental Action Council of Memphis appreciates the opportunity to review and comment on this important project.

Sincerely,

Marguerite K. Hoffman

MARGUERITE K. HOFFMAN
Board of Directors

MKH:s

eacm
ENVIRONMENTAL ACTION COUNCIL OF MEMPHIS
P. O. BOX 4526 MEMPHIS, TENNESSEE 38104

ENVIRONMENTAL DEFENSE FUND

162 OLD TOWN ROAD, EAST SETAUKET, N.Y. 11733/516 751-5191

November 11, 1974

The United States Army Corps of Engineers
Vicksburg Engineer District
Vicksburg, Mississippi 39180

Re: Mississippi River and Tributaries, Mississippi River Levees and Channel Improvements Draft Environmental Impact Statement

Gentlemen:

We have received a copy of your Draft Environmental Impact Statement entitled "Mississippi River and Tributaries, Mississippi River Levees and Channel Improvements." This Impact Statement describes proposed projects along more than 900 miles of the Mississippi River between Cairo, Illinois and Venice, Louisiana. They are all designed to make the Mississippi River more navigable and prevent flooding by the utilization of various channel devices, according to the project description.

Although we have numerous comments, we shall limit ourselves to three.

1. The economic analysis for the project does not properly quantify and consider the costs of the destruction of 2500 acres of cropland and 30,000 acres of woodland and associated wildlife habitat.

We enclose with this letter a copy of a letter which we have sent to Colonel Heiberg of the New Orleans District Corps of Engineers relating to the Central Louisiana Coastal Study and the Draft EIS Deep Draft Access to the Ports of New Orleans and Baton Rouge, Louisiana. It has become apparent that channelization and flood control projects throughout the section of the Mississippi River described in your Impact Statement, and tributaries of the Mississippi River, have produced conditions whereby flood waters and sediments in those waters move much more quickly down the Mississippi River than would be the case under natural conditions. All of this water and sediment has to go somewhere. The two principal outlets are the Mississippi and Atchafalaya Rivers and their respective deltaic systems in backwater areas. The coastal area of Louisiana has, in the process, become the dumping ground for all the flooding water and sediments which the Corps of Engineers is trying to push through the upper Mississippi River. This program of action in the upper Mississippi has caused enormous problems for coastal Louisiana. These problems are described at length in our letter to Colonel Heiberg. We would request this letter be incorporated as part of our comments on your Impact Statement.

Because of the conditions which the Corps of Engineers has created in the upper Mississippi River, the New Orleans District Corps of Engineers is in the process of struggling to remedy the problems which have been heaped upon it. It is trying to develop some program of action for the Atchafalaya Basin center channel floodway area and the lower Atchafalaya Basin, the whole Louisiana coastal area between the Atchafalaya River and the Mississippi River and the lower Mississippi River and Delta area itself. The problems of maintaining existing navigational channels in the lower Mississippi and Atchafalaya Rivers, Atchafalaya Bay and Mississippi Delta and preventing further erosion of coastal Louisiana and controlling flooding have been exacerbated greatly by channelization projects along the upper Mississippi River. Your proposed project as described in your draft impact statement may further exacerbate these conditions. Insofar as your project exacerbates these navigation, flooding and erosion problems, it should include the costs of rectifying these problems as a cost of the project. In your Impact Statement, you should calculate as precisely as possible all of the costs which your proposed projects along 900 miles of the upper Mississippi River will impose downstream, particularly in coastal Louisiana. We would also request that you furnish us with copies of any hydrologic studies and economic analyses which you have done to determine the impact of your proposed project on downstream Louisiana flood control navigation and erosion problems and the costs of these impacts.

3. The proposed series of projects are designed in part to maintain and improve the "transportation capacity" of the Mississippi River. Such navigational projects of the Corps of Engineers in the upper Mississippi River constitute a 100% capital construction subsidy to the barge industries. Since the freight railroad industry is not comparably subsidized, the railroad industry is necessarily damaged by this proposed action. The railroad industry in the northeast and midwest states is in a financial crisis, as reflected by passage of the Regional Rail Reorganization Act of 1973. Your Impact Statement should discuss in detail the contribution which these proposed navigational and flood control projects will make to either an exacerbation or solution of this rail transportation problem. The consequences for energy consumption and other resource use in this country are enormous.

Thus, your proposed project in the upper Mississippi River may well conflict with the desire of the U.S. Congress as expressed in the Regional Rail Reorganization Act of 1973 to devise a solution to the financial plight of railroads in the eastern part of the country, will destroy extensive wildlife habitats and will exacerbate flooding, dredging, coastal subsidence and declining marine and coastal resource productivity problems in southern Louisiana. These potential and actual impacts are simply not discussed at all here in the Impact Statement or are discussed only very inadequately. In view of the enormous scope of these impacts, they should be totally explored.

We appreciate the opportunity to comment on your Draft Impact Statement.

Very sincerely,

James T. B. Tripp

James T. B. Tripp
Counsel

cc: Colonel E. R. Heiberg, III

Mr. Robert Smythe
Council on Environmental Quality

ENVIRONMENTAL
DEFENSE
FUND

162 OLD TOWN ROAD, EAST SETAUKET, N.Y. 11733/516 751-5191

November 11, 1974

Colonel E. R. Heiberg, III
District Engineer
New Orleans District Corps of Engineers
P O Box 60267
New Orleans, Louisiana 70160

RE: Central Louisiana Coastal Study and Draft EIS Deep Draft Access to the Ports of New Orleans and Baton Rouge, Louisiana (the "DEIS")

Dear Colonel Heiberg:

We have received the notice of a public meeting "To initiate a study of flood problems in the area between the east Atchafalaya Basin Protection Levy and the Mississippi River and Bayou La Fourche from Morganza, Louisiana to the Gulf of Mexico." We have also received a copy of your DEIS Deep Draft Access to the Ports of New Orleans and Baton Rouge, Louisiana. This letter constitutes our comments on both the proposed study and the DEIS.

In our view, the problems of the upper Atchafalaya Basin, the lower Atchafalaya Basin, including the area around Bayous Chene, Boeuf and Black and the Atchafalaya Bay, the portion of central coastal Louisiana which is the focus of the proposed study and the lower Mississippi River and Delta area are all inter-related. To some degree, these problems have been brought about by the fact that the Corps of Engineers over a period of decades has channelized and levied the Mississippi River north of Louisiana, and its tributaries, to a point where vast quantities of water and silt now pour down into the Mississippi and Atchafalaya River Valleys under a range of climatic conditions. There was a time when the vast flood plains of the Mississippi could absorb much of this water and silt. Those times are now in the past. In this connection, we refer you to the September, 1974 DEIS on the Mississippi River and Tributaries, Mississippi River Levees and Channel Improvement of the Vicksburg office of the Corps of Engineers.

Since the Corps of Engineers has developed enormous channelization and levy works along the Mississippi, the huge volumes of water and silt must find an outlet. These huge volumes of water and silt constitute enormous natural forces that even the Corps of

Engineers apparently is finding some difficulty in taming. Witness the dredging problem which you have been experiencing in the Atchafalaya Bay and in the various channelled navigation passages in the Mississippi Delta. These huge volumes of water and silt passing into the Gulf of Mexico through the Mississippi River and its principal tributary, the Atchafalaya River, could be a tremendous force for the good. But before that can happen, the responsible agency, charged with looking for a solution, must ask the right question, namely, what useful purpose can this water and silt serve? Unfortunately, the Corps of Engineers has traditionally looked on this water and silt not as a potential beneficial resource but as a nuisance. Thus, the lower Mississippi River and Mississippi Delta, the Atchafalaya River and the Atchafalaya Bay and Delta have been channelized and dredged or are being channelized and dredged or are planned for dredging with a view in mind to expedite the flow of silt to points deep in the Gulf. The result is that much of the sediment which could be developing huge new deltaic lobes west and east of both of the Mississippi and Atchafalaya River outlets is now being wasted. Thus, while the Atchafalaya Delta is growing at the rate of 6.5 square miles per year, leading coastal ecologists, including Dr. Sherwood Gagliano, fear that further channelization in the Atchafalaya Bay will disrupt that deltaic process by causing more silt to be dumped deep in the Gulf. Further, the Mississippi Delta has almost stopped growing. Thus, while the sediment could be used to build new deltaic areas, nourish existing coastal areas and wetlands and build up the coast line of Louisiana, much of it is being wasted. This is our basic criticism of the DEIS.

So long as the Corps of Engineers continues to consider only "flood control" problems for the coastal Louisiana area, it is bound to continue to consider the water and silt loads of the Mississippi and Atchafalaya Rivers as nuisances rather than as resources. This is a problem that we have encountered both in the Atchafalaya River and Bayous Chene, Boeuf and Black project and the Atchafalaya Basin Center Channel project. At the core of the dispute between the Corps of Engineers and other parties is not so much the exact shape of the technical solution but the asking of the proper question. We are not taking the position that the Corps should do nothing in coastal Louisiana and the Atchafalaya Basin. It is apparent that some action must be taken in view of the fact that coastal Louisiana is not functioning as a natural system at the present time and in view of the extensive channelization of the upper Mississippi River. In this context, we are delighted by the fact that the Corps of Engineers is concerned about what is happening in the area between the eastern Atchafalaya Basin Protection Levy and the Mississippi River and Bayou La Fourche from Morganza, Louisiana to the Gulf of Mexico. Problems in that area of Louisiana are substantial. The most evident problem is the fact that coastal Louisiana is subsiding and disappearing at the rate of 16.5 square miles per year. It is also evident that fish landings in the Gulf of Mexico are declining either in absolute numbers with respect to certain species or in terms of effort per unit catch with respect to other species. Up until very recently, the Louisiana coastal area was an expanding deltaic area. These natural processes have suddenly reversed. It is the reversal of these natural processes which is contributing, in our view, not only to coastal subsidence and declines in the productivity of the Gulf fisheries along the Louisiana coast, but also to flood control problems.

What is therefore needed in order to confront these basic problems of coastal Louisiana is a comprehensive study of all of the natural and man-made forces which are interferring with and reversing the natural processes of coastal development and deltaic growth and the productivity of the coastal areas. It is also essential that all channelization and flood control projects in the upper Mississippi be properly coordinated with your own efforts. In such a study, the Corps of Engineers could consider what kinds of human uses of the coastal area are compatible on the long term with the biological productivity of the entire area. Efforts to deal with flood control problems in coastal Louisiana through more engineering works, dredging and channelization and navigation projects may only lead to frustration and degradation.

Thus, what distresses us about your proposed study is that it is a study of "flood problems." A study of "flood problems" suggests an emphasis on engineering flood control solutions to an extraordinarily complex problem. Your study should therefore not be so limited for fear that the results of the study will be prejudged and predetermined. Similarly, the DEIS looks upon the lower Mississippi Deep draft access problem simply as a "navigation" problem, not as an environmental management problem.

As an example of the kind of environmental management approach which makes sense to us and which will in the long run do more to take care of flood problems with disastrous consequences for human life and property, we refer you to the report entitled "An Environmental Approach to Multi-Use Management of the Louisiana Coastal Zone" by Dr. Sherwood Gagliano. Although we cannot necessarily vouch for all of his conclusions and don't necessarily endorse all of his suggestions, at the very least he is asking the right questions. He is analyzing the natural forces at work, how those natural forces can be used for beneficial purposes, how the biological productivity of the area can be enhanced and restored and what kinds of human uses of the area are compatible with maintenance of the biological productivity of the area.

The DEIS also fails to consider adequately the impact of the projects described in the Mississippi River Levees and Channel Improvement DEIS of the Vicksburg office.

Flood problems inevitably result from the improper use of flood plain areas. The Flood Disaster Protection Act of 1973 speaks to this problem. That Act requires that the uses of flood prone areas be compatible with the natural conditions which exist on flood plains. This Act underscores Congressional support for an extensive land use study in an area subject to periodic inundation like coastal Louisiana. Thus, your study should be a land use study considering what uses of this area are compatible with natural flood conditions. We would therefore suggest that you coordinate this study with HUD, which is responsible for the administration of the Flood Disaster Protection Act of 1973. We would further support the establishment of a Section 208 planning agency in coastal Louisiana under the 1972 Federal Water Pollution Control Act Amendments.

In this connection, we would request that, from the earliest stages, the Corps of Engineers work on and draft an Environmental Impact Statement analyzing the environmental impacts of a variety of alternate land use programs in coastal Louisiana. This study is clearly a massive federal action. The programs which the Corps develops through this study will have enormous environmental impacts. Here is an opportunity for the Corps to use NEPA as Congress intended -- to develop a program of action for a biologically extraordinarily productive region.

Our views on proper planning in Atchafalaya Bay and the lower and upper Basin are well known to you through correspondence and litigation. We would request that this material be incorporated herein by reference.

Yours very truly,

James T.B. Tripp

James T.B. Tripp
Counsel

cc:
General Morris, U.S. Army Corps of Engineers, Vicksburg, Miss.
George Gardner, DOI
Harold Kibby, EPA
Robert Smythe, CEQ

Sierra Club
Ozark Chapter
P.O. Box 12424
Olivette, Mo. 63132

December 5, 1974

Department of the Army
Vicksburg District, Corps of Engineers
P.O. Box 60
Vicksburg, Mississippi 39180

Attn: LMKED-PQ
Re: Draft - Environmental Impact Statement

Gentlemen:

Thank you very much for your letter of September 30, 1974, soliciting our views and comments in relation to the above. We have the following comments and questions:

P.6 - p. Why have such significant reductions occurred?

P.7 - d. Why is there no logical method to assign values and why was the premise adopted that a balanced plan exists, etc.?

P.14- a. Is production from cut off an authorized purpose?

b. Specific reference to Osceola Harbor authorization should be given.

P.16 - 1.09 Computations resulting in benefit-cost ratio should be given.

P.32 -a. Should there not be mention made of the fact that Louisiana is losing land at the delta and the reasons for such loss.

P.47-(3) What is the cause of the wave action?

P.61-(2) There should be a more detailed explanation of the term "major flyway".

P.62-(3) There must be consideration given to the effect on such marsh/estuary system.

P.68-b.(1) Why are the terrestrial communities measured only between the levees?

P. 73 - e. Why have bats been excluded?

P. 87 -(c) The source of the opinion on water quality should be given.

P. 127 - Blank.

P. 137 - b.How can the E.I.S. ignore the fact that often a consensus does exist in respect to aesthetics.

P. 140-(4) It would be interesting to know how an over-head utility can be aesthetically pleasing. Much more definition is needed in this section.

P. 140-(5) How as the judgment arrived at regarding visual monotony?

P. 148-(1) The basis for the propositions contained must be given for the propositions to be adequately con-considered.

P. 150-(1) Certainly some information should be given as to the maintenance of productivity due to flooding.

P. 152- g. Recent studies indicate that barges are not so energy effective, thus in order to make a judgment on this stated assumption, a basis for the assumption must be expressly given. We would be interested in knowing if all energy use relating to annual dredging is included in the computations.

P. 153- 3. Should not some consideration be given to the national policy of limiting development in flood plains?

P. 156 - c.(1) What are the increased chances of pollution due to "spills" due to "improved navigation", resulting from increased traffic?

P. 163-1.3. What is a properly aligned channel for various considerations?

P. 164 -(6) Doesn't such production stimulate flood plain development contrary to national policy?

P. 192 - b. The greater visual diversity should be adequately explained.

P. 194 - f. Again there is a need for facts and figures on the basis for such assumption that less total energy will be used.

P. 194 - h. Doesn't this lead to the conclusion that flood plain development will be encouraged?

P. 196 - b.(2) What about spills and prop wash?

P. 203 -(2) Is continued growth and development being advocated?

P. 212 - b.(2) Why would levees be overtopped and breached and is the proposed alternative the least costly alternative?

P. 213 - d.(1) Why would some lands be abandoned and to what extent?

P. 214 - (5) Same assumption is noted regarding energy consumption without a proper foundation having been laid.

P. 222 - c. What will be the energy cost due to such maintenance increase?

P. 231 - h. Would this result in an increase or decrease in soil fertility?

P. 234 - d. Same as h.

P. 235 - f. How much and computations behind such amounts must be furnished.

Further, we would like to state that the alternative of flood plain acquisition has not been considered. Likewise, all alternatives should be stated in comparison with the plan, such as with 6.08d. Moreover, costs are never stated and in order to make valid judgments computations should be furnished. Finally, must not the entire Mississippi River be considered in consideration of the lower Mississippi project.

Very truly yours,

Charles E. Kopman,
Chairman

CEK/js

NORTHEAST MISSOURI STATE UNIVERSITY

KIRKSVILLE, 63501

November 11, 1974

Colonel G. E. Galloway
District Engineer
U. S. Army Corps of Engineers
P. O. Box 60
Vicksburg, Mississippi 39180

Dear Colonel Galloway

RE: Mississippi River and Tributaries Levees and Channel Improvement Draft Environmental Statement.

The Missouri Chapter of the American Fisheries Society would like to make the following comments and questions part of the record for the EIS on Improvement of the Mississippi River and Tributaries.

General Criticisms:

1. No external costs are computed or estimated. Many strong negative environmental effects.

2. Missouri stretches of the river are hard hit!

3. The river is dynamic and in many instances inadequate data are available to draw rational conclusions.

4. From one place to another various arguments seem inconsistent. See below.

5. This proposal is not directed at true maintenance but at reconstructing a river.

6. The project will increase the cost of flood protection, encourage flood-plain development and consequently continue to increase the cost of federal disaster relief . . . up from 52 million in 1953 to 2.5 billion in 1973! As stated (Para. 6.036) "This is not to say that any recommended plan can absolutely guarantee complete protection . . ."

7. We believe we have a series of serious questions here. We will send the corps postage if they will inform us of meetings on levees and channel improvement on the Mississippi River in the future. We will attempt to join their meetings (Sec. 9. Public Participation p. 236 DREIS).

DREIS - Mississippi River and Tributaries
Mississippi River Levees and Channel Improvement

Specific Criticisms:

1. The proposed action includes reconstruction "450 miles of levee must be raised", channelization, dike and revetment construction: "River Training", bank protection: "articulated concrete mattress underwater . . .20 concrete blocks . . . each 4 feet long, 14 inches wide, and 3 inches thick . . ." (1.29 ft^3) to cover 5.17 ft^2 . . . 1 mile^2 = 27878400 sq. ft. or 5392340 mattresses or 6956118 cubic feet of concrete or 257,634 yeards of concrete/mile or at 4.00/yard is 1,030,536 dollars/mile. How many miles of this is required? Our copy of the EIS lacked your economics sheet but this alone is staggering! Isn't this more than maintenance? See cover sheet, <u>Description of Action</u> (paragraph 2).

2. Construction would cause the loss of 2,500 acres of cropland and 30,000 acres of woodland and . . . wildlife habitat (cover sheet 3b, Adverse Environmental Impacts). Does this cropland yield as well as some on the Chariton bottom - up to 200 bushels of corn per acre? What is its real value for crop yield in the next 15 or 20 years?

3. If the flood of 1927 (1.1.02.n.) indicated the need for flood control--and the flood of 1973 (1.102 p) indicated serious reductions have occurred in the flood capacity of the river, we believe that some attention needs to be directed here to How and Why. The EIS doesn't do this! Why has the flood capacity of the river decreased?

4. With regard to 1.06 c . . . Did the river straighten itself into " . . . excessively straight reaches in which no definite concentration of flow exists."?

5. We doubt 1.06d . . . flood protection is a valid reason for the project. Won't some of the floodway be filled? Further what about the data cited in our specific comment No. 2?

6. Why don't you indicate which maps have relationships to several paragraphs 1.06b, 1.06c, 1.07a, etc. Map 1-8(1) shows authorized, underconstruction and completed structures, as does 1-8(2) and so does 1-9. 1-11(1) shows existing revetments as does 1-11(2). 1-11-1(1) and 1-11-1(2) show existing dikes. 2.5 shows authorized navigation channel. The 2.7 series shows projects under special authorization. The 1-2 map seems to say we dredge everywhere. Do any of the maps really show the work locations? Or will the plan be to redoe the whole river? Of what value is a map labelled "proposed dredging . . . not indicated . . ." and still calling the map " . . . channel improvement dredging"? This wastes money and paper.

7. Does paragraph 1.07a relate to figure 2-7.4? Mile 889? Exactly what is proposed? How will it be accomplished? What costs?

8. How are the projected tonnages computed - e.g. 209,000 per annum in paragraph 1.07b for the Osceola harbor?

9. Is Figure 1 the proposed completely trained river?

10. Would it be possible to see the economic data that went into the benefit-cost ratio calculation? Did this include any value for the crop or forest land affected except acquisition? What benefits are included?

11. Table 1 proposes to build twice as many levees as already in existence! To nearly double the revetments and increase by 60% the foreshore protection. Again we ask, isn't this a great deal more than maintenance?

12. Figure 2 shows 240,000 cfs flow as the "Project design flood". This is rather low. Last year's flood (and 1844, 1892, 1903, 1908, 1909, 1927) carried more than 850,000 cfs. Does this design then seem adequate?

13. 2.06b levees and 2.06c(1)d. harbors suggest that spoils are regularly dumped into the river. If this is the general case then can't local effects ultimately destroy any remaining natural river fauna because dredging is done wherever needed?

14. p 54 2.06e floodways (2) The third paragraph of this sequence . . . "Operation of the floodway is expected to severely disrupt the brotic community . . ." Have these external costs been included in the B/c accounting? How great is the impact o n the economic status of the local area?

15. The general statement of Biological overview is weak. The Mississippi is the heart of one of the major flyways for water fowl and some kinds of destruction of flooded land will tend to reduce success of migratory flocks.

16. If the project is to take parts of the delta then why haven't these delta lands been given "detailed study"? Why take the delta?

17. Is paragraph 2.07a(3) a summary of table 5? How did the river get deep and fast up north? What is "good aquatic habitat"? If all channel and "local spoil areas" were removed what would be left?

18. In order to put the logic of helping the land creatures with the project against the logic of retarding the fishes paragraph 2.07a(5), we wonder just how much data is available on either side of the argument? We feel this report does not provide enough information to use these strawmen as guides.

19. 2.07c(5) Lakes and borrow pits are restocked and sometimes have their diversity enhanced by flood waters. Local fishermen have found this good in oxbow lakes on the Chariton River. Detritus can be a food source.

20. Table 7 and the related summary statement cannot be supported by looking at preferred habitat lists or even the lists of migratory birds given. More than 400 species of birds are listed in Table 14 of appendix C, while only 120 or so are included in the habitat list (1.4). The bulk of the summary paragraph is not true. Many aquatic, especially migratory birds, will be found in the swamp areas.

21. Some of the most valuable wildlife land (Table 8), the swamp forest makes up less than 1% of the land in the project area. What does the project do to this land?

22. How can nitrate citations be discussed p. 87, 2.07gl(c) when no specific data are given in section 2.03? What is the BOD at several stations? Why are so many stations left out of the table 2? When and where was D.O. measured to be generally above 7 ppm?

23. Even if man is not polluting, rivers and swamps are valuable. Who are Levin and Read? Your reference list is poor! What other values are there in river swamps?

24. Table 13 contains literature citations not included in the reference lists!

25. What about Missouri fisheries for table 12?

26. Very little data is given to support the paragraph on p101 on swamps and sloughs. Photosynthesis can occur at relatively low light intensitives. Further the trees and higher vegetation make significant contribution to the food chains and webs that are developed in swampy areas. Who has measured the relative value of either for you?

27. How does the project affect any animals or plants now designated by federal or state law as endangered or rare?

28. Should the Mississippi Kile be added to table 17?

29. If the population is 9,000 in the project area, will these people be relocated?

30. Are not all of the gross agricultural statistics appear low--p. 150?

31. What is the source of energy estimates for rail and barge transport. Railroads have disputed these. Waterways are more circuitous and still require off-loading and handling by railroad or truck. Where is environmental protection mentioned in the national priorities section of this report? (p. 152 Sec. g.)?

32. Paragraph 4.01a ends with a sentence suggesting that flooding over levees may occur " . . . river stages may undergo a larger range of fluctuation . . .". Is it just possible that this is precisely the problem illuminated by the 1973 flood at St. Louis?

33. How is it that floods will not cause siltation in all lakes (paragraph 4.01b(2) instead of just small ones? Isn't it true that it will just take longer to fill larger lakes as compared to small ones?

34. What kind of rates of sedimentation have been measured for small lakes and borrow pits in similar relationship of those in the project area to the river? What is the projected life of the project features? Paragraph 4.01b(2).

35. "The majority of the project . . . " Which features may potentially affect the row of tributaries of the Mississippi River?

36. 4.07d(2) says that sedimentation will increase. Doesn't this speak directly to our comment 33 above because sand and silt would be added to backwaters? The paragraph continues "subsequently reduce maintenance dredging . . ." and ends " . . . not expected to significantly increase . . . " dredging. Isn't this trying to cover two bases with the same player?

37. If levees and dikes were permitted to be built to maintain the " . . . natural alignment of the river . . . 574 dikes . . ." How many miles is this relative to the project? The project calls for 160 miles of neat dike (165 locations), 325.5 miles of Revetment (141 locations) and 93.9 miles of foreshore protection (52 locations): Table 1. How does this jive with 4.07d(3)?

38. How can construction of the channel fail to raise the flood level at some ports along the river while reducing its carrying capacity.

39. Section 4.02, paragraph 2 proposes quantifying effects. Paragraph 3 seems to be backpeddling. Paragraph 3(a) does not conclude with an evaluation. If deer are worth no more than a $5.00 stamp each, the one year data on the numbers taken by hunters suggests a minimum value of 180 thousand dollars.

40. The presentation in table 25 at first glance has 247 marks indicating affects on game species ignoring the main river stem--of these that are filled in 42 are labelled not applicable. Ten are labelled no significant effect. Ninety-three times species will be negatively affected significantly. Nineteen positive minor affects. Thirty times some significant positive influence is suggested. Nearly 60% of the times game organisms occur or could occur in the area they will be negatively affected. For non-game species, the second is the same or worse. What method does the corps use to compute this external cost in its Benefit/cost analysis?

41. We believe that the strong losses to paddlefish, sturgeon, walleye, sauger, catfish and drum will in no way be offset by the addition of borrow pit habitat. These fishes do not do as well in borrow pits as buffalo and carp. Again we ask, because this table is principally negative effect how are these valued in the benefit/cost analysis?

42. The report says " . . . significant negative impacts . . . " miles 955 to 900 but that recovery is rapid. It does not make it clear from what development will occur. Where will replacement habitat develop? Will it? Once more we wonder how much in dollars the corps has assigned this negative impact.

43. On these significant impact paragraphs, 4.02b(1),(2),(3), where is mention of the game species or their economic value?

44. In Table 22 and Figure 11 an addition of 39,400 acres of "other" land will be added by the project. Added to what? The report suggests cropland losses such that 2,500 acres will be lost. How are these details reconciled in paragraph 4.02b(5)(a). I don't believe cropland can be included here.

45. Won't the greatest effect on the fish community likely be destruction of food sources, 4.02c.

46. How can you judge the overall affect of filling chutes as positive. If productivity is higher here some of the fishes are surely feeding and breeding here. Loss of these areas may significantly damage what remains of the fishery.

47. Again paragraph 4.02c(2). We wonder about efficiency of water flow relative to data colledted in 1973 flood at St. Louis. See 4.02c(3). How can these be reconciled? Even if we miss some logic here what dollars and cents values are applied here as external cost?

48. Paragraph 4.03a suggests increase of 17,000 acres of sand bar! Is this from former aquatic habitat?

49. Is 4.03e a serious proposal that grass will be grazed in the project area?

50. Section 4 gives a long list of significant negative affects and then section 5 says there is no way to assess which changes are adverse or beneficial. See comments 45 and 46 in specific list and 4 in general comments!

51. Your section 5.02d fails to place economic value of losses to fisheries, to game, to mining. It is a wholly inadequate appraisal!

52. Section 6.01c does not direct itself to biology at all. It is a defense of this proposal. Reread sections 2.07 and 4.03. Even here we see that the river has some biology.

53. We sincerely doubt that the evaluation of impact trade-offs is accurate. See #3 above! River flowline is now higher--a negative impact perhaps because part of the project is complete! The table itself suggests that true maintenance--not described here!--would have the least negative impact on brota. We doubt that National defense goes in this table.

54. We cannot really predict frequency of damage from here but we suspect that simply viewing flow cross sections at various points would give telling evidence that the flood carrying capacity is reduced significantly by this project.

55. We doubt 6.02d that lands would be abandoned if a true maintenance posture were adopted. Farmers still farm bottoms profitably.

56. In the event of project failure . . . ?

57. People seem to be moving to population center any way. What's 6.02d(4)?

58. What year is projected for the river to be transport traffic saturated? What are the bases for the estimate? Why isn't this expanded here?

Sincerely yours

Donald A. Kangas

Donald A. Kangas, Ph.D.
Chairman of the Environmental Impact
Review Committee for the Missouri
Chapter of the American Fisheries
Society

pg

c - Dr. James Shaddy
Mr. William Dieffenbach
Dr. Dean Rosebery, President, Mo. Chapter
American Fisheries Society

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1114½ ROYAL ST.
NEW ORLEANS, LA. 70116

December 23, 1974

St. Clair Thompson, Chief
Vicksburg Engineer District
U.S. Army Corps of Engineers
Vicksburg, Mississippi

Re: Draft Environmental Impact Statement for Mississippi River and Tributaries Project

Dear Mr. Thompson:

As I explained to you in our phone conversation of December 6, I represent individuals who live in Port Sulphur, Louisiana, and whose interest in the above-named project is in that portion of it identified as Item No. M-41.7-R, Port Sulphur Levee Enlargement and Setback. The New Orleans District Office of the Corps has advised us that they will rely on the EIS prepared by your office as a basis for its activities in implementing Item No. M-41.7-R.

Our first concern with the draft statement is that it makes no mention of the Port Sulphur Project specifically, nor does it devote any discussion to the various environmental impacts of this project on the local area. There are a number of impacts unique to Port Sulphur that are not adequately addressed by the proposed EIS, nor even mentioned by the document. I am enclosing a copy of pleadings filed in regard to this project; they discuss in some detail the environmental and social concerns of my clients. We also prepared at an early stage of the case an informational booklet which--while since found inaccurate in some minor respects--still conveys a good overall picture of the project and its impacts.

The Corps' regulations governing preparation of impact statements assert that separate statements should be prepared where "activities are unique or where known substantial environmental conflicts presently exist or can reasonably be anticipated to exist." Other sections of the regulations specify that supplemental EIS data may be needed where there has been filed an "umbrella statement" addressing a continuing program of activities. We feel that circumstances in the Port Sulphur area are uniquely different from those which pertain elsewhere, because of the following factors (discussed more fully in the enclosed materials):

1) The predominant crop in this area is oranges (nowhere mentioned in the draft EIS, which discusses soybeans). This crop can only be grown in the southernmost reaches of the Mississippi, and the proposed project threatens a substantial portion of that crop.

2) The most fertile grpund for cultivation of oranges is next to the river levee, and because of the narrow strip of land on which residents of this area live, loss of that portion required for Item No. M-41.7-R will be an irreplaceable and irreversible commitment of an invaluable resource.

3) Geographic considerations unique to Port Sulphur will result in a substantial alteration of the social and economic character of the community if M-41.7-R is implemented as presently planned.

4) The plans of parish and highway officials to relocate the area's main traffic artery next to the river levee is a direct outgrowth of the proposed project and should be considered in preparing the more detailed supplementary EIS for this project.

Because of these factors and others, we feel that a supplementary EIS is needed, discussing this project separately and assessing its impacts in far more detail than the proposed statement does.

Highway and parish planning for the fourlaning of the river road is a matter of particular concern to my clients and one which we feel should be treated as a "related project" requiring some discussion and consideration in the EIS. Paragraph 9(g)(2) of the regulations requires that the EIS discuss links between a proposed project and others (both public and private) likely to impact the environment; some consideration should be given to federal, state and local land use plans for the Port Sulphur vicinity in light of the Corps' project. Paragraph 9(g)(1) calls for consideration of both primary and secondary effects, both economic and social.

We are concerned that no notice of filing the EIS for this project was given to us, except well after the fact by indirect means. I should be included on the project mailing list to receive copies of all materials related to this work. We should have been included on the mailing list much earlier, as a consequence of our repeated verbal and written requests for such information and certainly as a result of litigation having been filed in the matter. More time for detailed comment on the draft EIS would allow for a more definite picture of our objections to it, though this letter and the accompanying materials should convey some of our more serious concerns.

I would like to receive some indication of the specific type of project we are dealing with according to the Corps' analysis of Item No. M-41.7-R. Is this a continuing construction project, a new project, or one authorized but not yet started? This categorization will determine precisely which regulations govern the project, so please indicate the regulatory scheme the New Orleans Office should be following.

In considering man-made structures affected by the project, the draft EIS makes no mention of homes and other structures involved in its implementation. This impact is quite substantial in the Port Sulphur community.

The draft EIS deals inadequately with the project's impact on endangered species of plant, fish, and other forms of life. This data should be assembled prior to implementation activities and included in the final EIS, so that project planning can take account of such considerations.

Various alternatives should be considered in the implementation of Item No. M-41.7-R. The adverse effects of this project could be minimized by consideration of construction and other alternatives. In view of the fact that floodwall construction at New Orleans has protected the historic French Quarter for many years, the rejection of alternative construction methods in a single paragraph on page 228 of the draft EIS is too negative and ill-considered a conclusion.

We strongly disagree with the conclusion expressed on page 237, that "no major environmental issue concerning the levees and channel improvement on the Mississippi River between Cairo and Venice has been identified . . . ." If in fact no such issues have been identified, this may indicate the inadequacy of the public participation process that has been followed.

This letter communicates some of our concerns about the way in which M-41.7-R has been reviewed by the Corps. We do not feel that the draft EIS adequately addresses our concerns--nor is it likely ever to adequately address such concerns, since it deals with a huge geographic area. We believe a separate EIS should be prepared on Item No. M-41.7-R and cite in further support of this belief the CEQ guidelines relative to preparation of impact statements and their requirement that controversial actions be fully assessed. The National Environmental Policy Act intended that environmental data be gathered and used in the planning process as a means of assuring the public that environmental damage would be thoroughly considered, and this assurance the residents of Port Sulphur do not have.

I look forward to hearing more from you regarding the preparation of this EIS. I will be happy to supply you with further information and comments about the project, which time constraints prevent at this time.

Very truly yours,

David A. Marcello

David A. Marcello

Enclosures

DAM/dl

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE
Southeastern Area, State and Private Forestry
1720 Peachtree Road, N.W.
Atlanta, Georgia 30309

April 8, 1975

Col. Gerald E. Galloway
Corps of Engineers
Vicksburg District
Vicksburg, MS 39180

Dear Col. Galloway:

Reference is made to our letter of November 14, 1974 containing comments on the draft environmental impact statement entitled Mississippi River and Tributaries, Mississippi River Levees and Channel Improvement.

Subsequent local comments received by this office indicate that the authorized project measures covered by the statement may be generally insufficiently identified, analyzed and discussed to guage local impacts and their effects on local environments. For example: The Tiptonville-Obion Levee Extension and Obion River Diversion Channel projects cut through a hardwood bottom. Yet, the impact chart on page 176 (Figure 8) shows no loss of bottomland hardwoods between mile 900 and 500 of the River.

By means of this letter, we amend our former comments on the draft statement to include a recommendation that a separate EIS be prepared for the combined Tiptonville-Obion Levee Extension and Obion River Diversion Channel projects and for other major project actions significantly affecting the quality of the human environment.

Thank you for your cooperation in this matter.

Sincerely.

Paul E. Buffam

PAUL E. BUFFAM
Area Environmental Coordinator

6200 - 11b (4/74)

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE
Southeastern Area, State and Private Forestry
1720 Peachtree Road, N.W.
Atlanta, Georgia 30309

April 7, 1975

Mr. Jackson W. Moore
Martin, Tate, Morrow & Marston, P. C.
705 Union Planters National Bank Building
Memphis, Tennessee 38103

Dear Mr. Moore:

We appreciate your letter of February 11, 1975 to Dr. Kenneth Knauer expressing concern over a proposed Corps of Engineers' project designated as the Tiptonville-Obion Levee Extension and Obion River Diversion Channel Project in Lauderdale County, Tennessee. We have delayed our reply in order to search out additional information on this project.

This project is one of many discussed in a draft environmental impact statement prepared by the U. S. Army Engineer District, Vicksburg, Mississippi, entitled "Mississippi River and Tributaries, Mississippi River Levees and Channel Improvement." This EIS was dated September 1974 and covered an area of the Mississippi River between Cairo, Illinois and Venice, Louisiana.

We reviewed this EIS but were unable to determine from its contents that loss of hardwood forest would occur in the areas of your concern as a result of the proposed action.

We suggest that you inform the U. S. Army Engineer District, Vicksburg, Mississippi and the Division of Forestry, Tennessee Department of Conservation, Nashville, Tennessee of your reservations on the project. Your comments should be considered during preparation of the final environmental impact statement. We would appreciate reviewing a copy of these comments, so that we can keep abreast of the situation.

Thanks again for your letter. If we can be of further assistance, please let us know.

Sincerely,

Paul E. Buffam

PAUL E. BUFFAM
Group Leader
Environmental Quality Evaluation

6200-11b (4/74)

8420 November 14, 1974

Col. Gerald E. Galloway
Corps of Engineers
Vicksburg District
Vicksburg, MS 39180

Dear Col. Galloway:

Here are U. S. Forest Service, State and Private Forestry comments on the draft environmental impact statement prepared for the Mississippi River Levees and Channel Improvement, a feature of the Mississippi Rivers Tributaries Project.

We comment the scope of this environmental assessment covering maintenance and improvement of the main stem of the Mississippi River from its junction with the Ohio to the Gulf of Mexico. However, since proposed and authorized tributary projects will impact the main stem, all authorized and planned tributary improvement works should be fully considered in assessing the environmental impacts of this project. For example: A costly feature of this proposal (both environmentally and in cash) is the raising of approximately 450 miles of levee to provide minimum free board above increased (project flood) floodwaters in the main stem of the Mississippi. Yet, a major proposal in the West Tennessee Tributaries Project is the -channelization of the Obion and Forked Deer Rivers to expedite the flow of floddwaters into the main stem of the Mississippi River. Therefore, with the limited information provided, some of the proposed actions appear to be in conflict.

The report also fails to disclose planned measures to contain flooding on the Ohio River to keep flood discharges into the Mississippi within the limits of the raised Mississippi levees.

Project area "portions" should be better defined. On page 62, the statement is made that the Northern portion of the project area is characterized as agricultural and the central portion as woodlands. Yet, Figure 3, "Distribution of Terrestrial Resources" shows in graph form that woodland resources comprise a greater proportion of the terrestrial resources in the Northern portion (between Mile 955 and 700) and the woodland resources constitute less than half the terrestrial resources in the Central portion (between mile 700 and 400).

The stated expected net annual return of \$10-\$15 per acre from woodlands (page 151) based on 1970 conditions is too conservative. An investment analysis of bottomland hardwood stands conducted by Forest Service Specialists Utz, Balmer and Shropshire in 1973 reveals that the net annual equivalent income from a medium bottomland hardwood site is from \$28 - \$37 per acre depending upon the recognition given to qualify.

The statement on page 133 (1); "The Mississippi River, the largest in the United States offers a wide range of conditions aesthetically attractive to people of various tastes" seem to contradict the statement on page 140 (5), "Although the river is vast, it is nearly featureless.

Thank you for the opportunity to review and comment on this draft environmental impact statement.

Sincerely,

Paul E. Buffam

PAUL E. BUFFAM
Area Environmental Coordinator

RKD RKDodson: ra
cc: NE Area

State Foresters: Arkansas
Mississippi
tennessee
Louisiana

6 cc: WO

SUMMARY

Economic Data
Mississippi River Levees and Channel Improvement

Estimated Federal Construction Cost 1/	$4,085,848,000
Estimated Non-Federal Construction Cost	46,268,000
Annual Cost	151,198,000
Annual Benefit	
Flood Damage Prevented	
Crop	30,260,000
Non-Crop	991,167,000
Subtotal	955,727,000 2/
Increased Returns	
Cleared Land	103,004,000
Wooded Land	298,872,000
Navigation	165,190,000
Recreation	2,700,000
Reduction in Dredging	750,000
Redevelopment	13,580,000
Miscellaneous Flood Control 3/	56,700,000
Total Annual Project Benefits	$1,596,523,000
Benefit-to-Cost Ratio 1/	10.6 to 1

1/ The component features of the Mississippi River and Tributaries - Main Stem are: Mississippi River Levees, Channel Improvement, South Bank Arkansas and South Bank Red River Levees, the Atchafalaya Basin, Old River, and a few miscellaneous items. The contribution of each feature to the overall plan is inseparably related to that made by the others. Therefore, their benefits are inseparable and a composite B/C ratio for the Main Stem components is necessary. The B/C ratio was derived by measuring the total benefits credited to these Main Stem components against their total cost.

2/ Actual total is $1,021,427,000; residual damage of $65,700,000 was deducted.

3/ Miscellaneous Flood Control

Elimination of Levee Setbacks	$	44,950,000
Elimination of Emergency Measures		4,700,000
Reduction of Damage to Riverside Facilities		6,300,000
Reduction of Flood Fighting		750,000
Total	$	56,700,000