

THE ATCHAFALAYA RIVER AND ITS BASIN

A FIELD TRIP

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This field trip comprises an overview of the geologic setting and history of the Atchafalaya River and its basin and includes archaeological and cultural details. Flood control structures will be visited and the measures taken to contain flood waters will be explained. The Atchafalaya River diversion problem will be discussed. There will also be an opportunity to see the site of a hydroelectric plant now under construction. A major excavation into a point bar deposit should be available for viewing. An important archaeological site at Marksville, Louisiana (now a state commemorative museum) will be visited. The route of the trip is shown on figure 1.

Miles

- 0.0 Begin at the south entrance to Louisiana State University (LSU) on Highland Road.
- 0.1 Turn left at "Y."
- 0.1+ Descend from Prairie Terrace to flat Holocene floodplain of the Mississippi alluvial valley.
- 0.9 Turn right (north) on Nicholson Drive.
- 2.0 Magnolia Mound, antebellum home.
- 3.1 Junction of Interstate 10 (I-10) and Nicholson Drive. Turn right to the Mississippi River bridge. Proceed west on I-10.
- 4.4 Town of Port Allen. South of the bridge, to the left, is the Port Allen Lock and Canal (a part of the Intracoastal Waterway). The lock was opened to navigation in July of 1961. It has a channel 3.7 m (12 ft) deep by 38.1 m (125 ft) wide and shortens the distance from the Mississippi River to the western branch of the Intracoastal Waterway by about 257.4 km (160 mi). By 1974, the traffic through the lock had reached 16.3 million tons annually.
- 6.4 Turn right on La. 415 leading to U.S. 190.
- 10.1 Cross under U.S. 190 overpass and turn left to U.S. 190, and proceed west on U.S. 190. You will now be traveling on the natural levee of the Mississippi River.
- 19.7 Town of Erwinville at junction with La. 413.

*This is the original version of a guide used for a field trip at the Gulf Coast Association of Geological Societies meeting in Baton Rouge, Louisiana, on October 21, 1986.

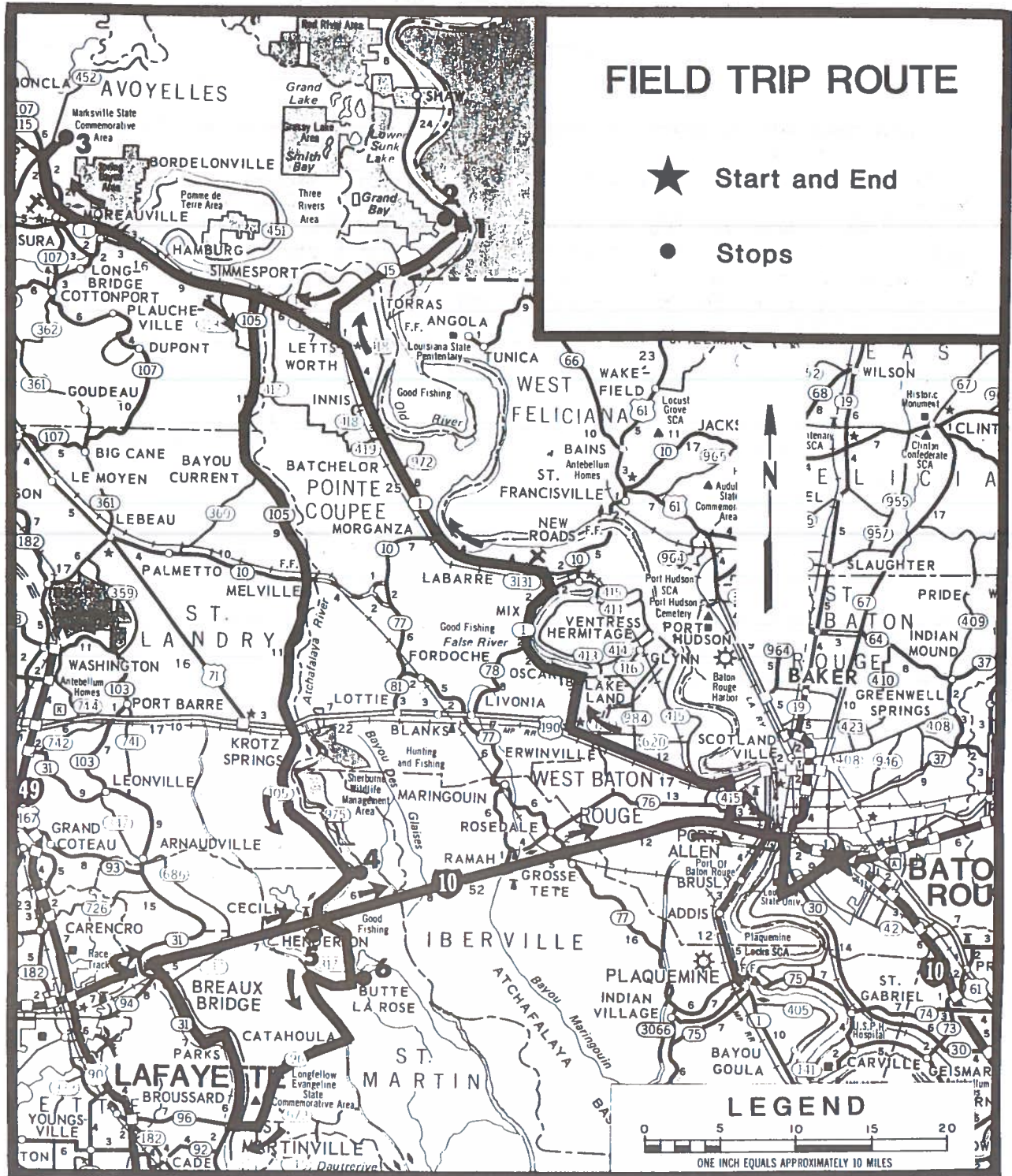


Figure 1. Field trip route. (Base map from Louisiana Department of Transportation and Development 1986.)

- 20.2 Big River Industries, Inc., which is an expanded clay lightweight aggregate plant.
- 21.6 Turn right (north) on La. 1.
- 23.5 Gas wells. All of these are associated with the spectacular production of the Tuscaloosa Formation of the Tuscaloosa Trend, which is a band about 48.3 km (30 mi) wide and 321.8 km (200 mi) long extending from the Texas-Louisiana state line past Lake Pontchartrain on the east. The discovery well, the Chevron/Alma Plantation, was completed in May 1975 for 20 million cubic feet per day, from a depth of 6,035 m (19,800 ft). This well led to the development of the False River field (Funkhouser et al. 1981). According to Funkhouser et al. the cumulative production from all deep Tuscaloosa fields through May 1981 was 198 billion cubic feet (bcf) of gas and 6.4 million barrels of condensate. Their estimate of proven and potential reserves at that time was about 5 trillion cubic feet of gas.
- 26.6 False River. The farthest downriver of all ox-bow meander cutoffs, this lake was formed around 1722 (see figure 2).
- 27.9 Pleasant View plantation home. A raised cottage of Louisiana colonial style and antebellum construction.



Figure 2. False River, Louisiana: an oxbow lake.

- 28.9 Austerlitz. This home, built in 1865, was named in honor of Napoleon Bonaparte's brilliant victory at Austerlitz (Czechoslovakia).
- 30.1 Parlange. At junction of La. 1 and La. 78. This home, built around 1750, has remained in the same family since then. The discovery well for the Judge Digby field in the Tuscaloosa Trend was about 2,438.4 m (8,000 ft) behind the house (see Adams 1981).
- 31.8 Bonnie Glen was built sometime in the first quarter of the 19th century. It is occupied now by a fifth-generation descendant of the builder.
- 33.1 Randall Oak. This is where the lyrics to "Maryland, My Maryland," the best-loved of all Civil War songs, were written in 1861.
- 33.5 Across the river is "the island," the interior land of the meander, which remained unsettled almost until the 20th century.
- 35.0 New Roads. A new road built in 1847 to a Mississippi River landing gave the town its name.
- 36.2 Turn left on La. 1.
- 36.6 Cross the railroad track on La. 1 on the north side of New Roads.
- 36.8 Turn left on La. 1 at the traffic light.
- 47.7 Cross lower guide (south) levee of the Morganza Floodway.
- 49.6 Morganza Spillway. This control structure, which leads into the Morganza Floodway, consists of 125 bays, each 8.5 m 7.6 cm (28 ft 3 in.) wide. They are operated by a gantry crane. In times of flood, this spillway can discharge 600,000 cubic feet per second (cfs) into the East Atchafalaya Floodway. This flow merges with that from the Atchafalaya River about 6.4 km (4 mi) north of I-10. From this point, the waters eventually discharge into the Gulf of Mexico. The control structure was completed in 1954 at a cost of \$20,680,000. Other associated work was finished in 1956. The Morganza Floodway was placed in partial operation for the first and only time so far on April 17, 1973 (see figure 3).
- 51.3 Monks Mound South. The large earth mound on the right was a temple mound of the Coles Creek period, roughly 700 A.D. to 1100 A.D.. An earth structure of this type served as a foundation for a ceremonial building.
- 52.1 Cross the upper guide (north) levee of the Morganza Floodway.
- 63.2 Junction of La. 15 and La. 1. Turn right on La. 15.
- 68.2 Cross south levee of Old River.
- 69.0 Old River Lock. This lock provides for river traffic between the Mississippi and the Atchafalaya, Ouachita-Black and Red rivers. It

is 22.9 m (75 ft) wide, 362.7 m (1190 ft) long with a sill at -3.4 m (-11 ft). The lock was placed in operation in 1963 and this roadway was completed in 1965.



Figure 3. Morganza Spillway in operation during the 1973 flood.

77.3 Old River Auxiliary Structure, nearing completion. This facility provides an emergency alternative to the Old River Low-Sill Control Structure. When completed it will carry 40% of the flow to the Atchafalaya and the low-sill structure will carry 60% (Lancaster and Renau 1983). The estimated cost of the auxiliary structure was approximately \$200 million in 1984.

78.4
STOP NO. 1 Old River Low-Sill Control Structure. This structure and its related components (figures 4 and 5), completed in 1960, were built in response to predictions that the Mississippi River would probably change its course to that of the Old and Atchafalaya rivers between 1965 and 1975, if no action was taken. A 1981 estimate of its total cost in 1978 dollars was close to \$2.4 billion. The Low-Sill and Overbank Control structures were designed to maintain the flow from the Mississippi River to the Atchafalaya River at approximately 30% of the flow of the Mississippi and to limit it to that amount under flood conditions.

The predicted diversion of the Mississippi River through the Atchafalaya Basin is certainly not without precedent. Fisk et al.

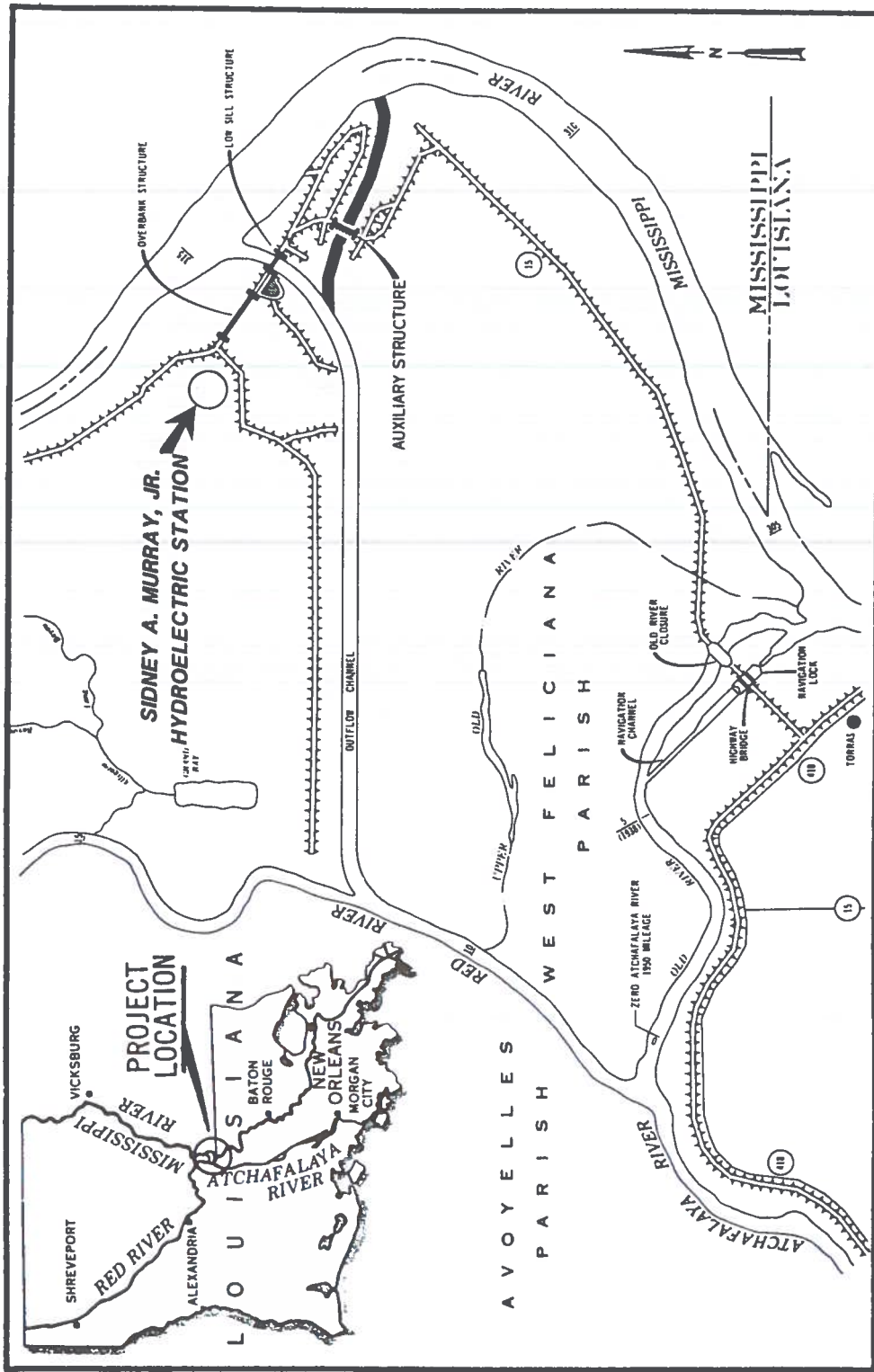


Figure 4. Old River Control Structure. (Reprinted from U.S. Army Corps of Engineers 1981a.)

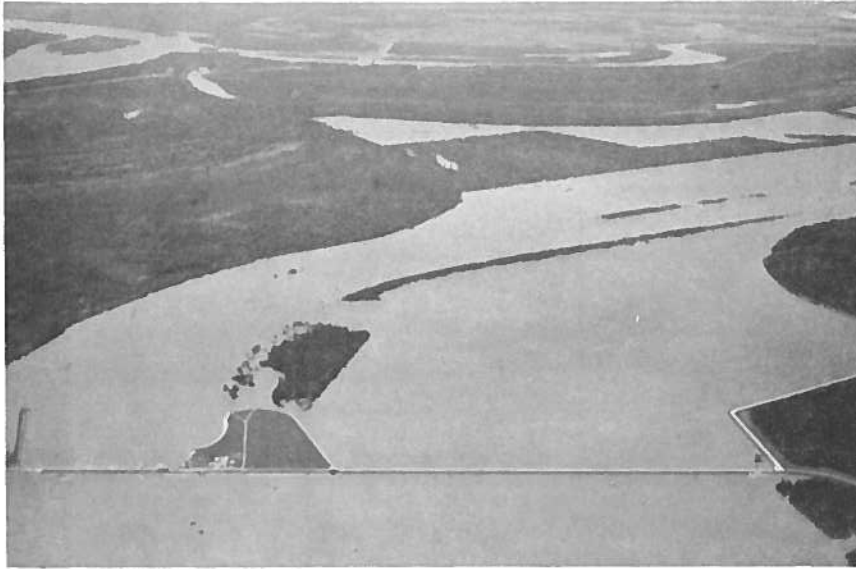


Figure 5. View to the southwest across the Low Sill Structure (at left) and the Overbank Structure (to right) at high water.

(1952) showed four abandoned Mississippi River courses (figure 6) which resulted from diversions during the past several thousand years, according to their chronology. Kolb and Van Lopik (1958) identified deltas associated with these and downstream diversions, showing them to have been built and abandoned during the past 5,000 to 6,000 years (Kolb 1980). Frazier (1967) considered the oldest of these diversions to have been initiated about 7,200 years ago. The U.S. Army Corps of Engineers recognized that a diversion of the Mississippi by the Atchafalaya would have extremely adverse consequences. At times of low water New Orleans and other communities would be left with insufficient fresh water for domestic needs. The industrial complex south of Baton Rouge would also be deprived of fresh water. Brackish water would move upstream as far as Baton Rouge. Flood control and navigation works would be threatened and many would be lost. Planning for flood control below Old River would have to be redone and the facilities reconstructed (U.S. Army Corps of Engineers 1981b).

The Old River Control Structure functioned satisfactorily until the major flood of 1973. During this flood, the southern wingwall in front of the low-sill structure failed. Surveys after the flood waters receded showed severe damage to the structure and a permanent solution to the Old River diversion problem was once again sought (Bragg 1977). It was eventually decided to construct the Old River Auxiliary Structure, previously described.

Meanwhile, Kazmann and Johnson (1980) predicted that catastrophic results would inevitably occur from a future failure of the Old

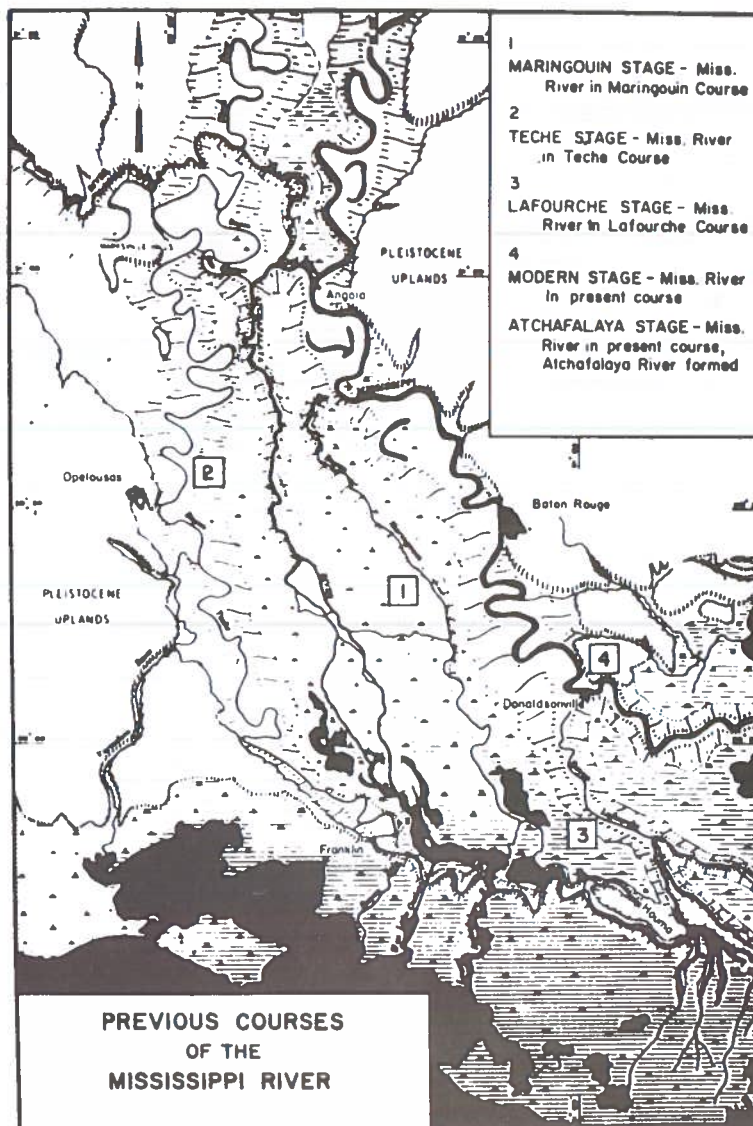


Figure 6. Previous courses of the Mississippi River. (Modified from Fisk et al. 1952:61.)

River structure. They estimated losses in transportation facilities, flood damage, and from pipeline failure would range from \$1.562 to \$4.025 billion.

An alternative response to the diversion problem was suggested by Kolb (1980). He proposed a controlled and managed diversion of substantial duration (up to 75% of the Mississippi flow).

Martinez (1986) offered still another option which involved a significant shortening (32%) of the present 407-km (253-mi) path of the Mississippi River from Profit Island, near Baton Rouge, to Head of Passes.

The Old River Low-Sill Control Structure consists of 11 gate bays, each with a width of 13.4 m (44 ft). The three center bays have a weir crest of -1.5 m (-5.0 ft) NGVD for passing low flows and the other bays have a weir crest of 3.0 m (10.0 ft) NGVD. (Note: 0.0 m (0.0 ft) NGVD is about 0.07 m (0.25 ft) below mean sea level, MSL.) The total length of the structure is 172.5 m (566 ft) between abutments. The vertical-lift steel gates are operated by two traveling gantry cranes. The Overbank Control Structure consists of 73 gate bays, each 13.4 m (44 ft) wide. The weir crest is 15.9 m (52.0 ft) NGVD. Its total length is 1,022.9 m (3,356 ft) between abutments. The flow is controlled by hinged timber panels operated by two traveling gantry cranes (U.S. Army Corps of Engineers 1981b).

79.9

STOP NO. 2

Site of the Sidney A. Murray, Jr. Hydroelectric Station. The hydroelectric power plant under construction here will have eight bulb-turbine units with a total installed capacity of 192 megawatts. The available head averages 4.3 m (14 ft) with the mean differential head varying from 2.4 to 5.2 m (8 to 17 ft). This low head requires the use of special bulb turbines (used for tidal power generation). Each of these turbines will have a capacity of 24 megawatts. A section through one unit (figure 7) shows the construction details. Notice that both the propeller and the generator are in line and in the flow path of the water. The mean flow available for generation varies from 10,000 to 300,000 cfs. The total investment cost is expected to be \$472,321,000 (Lancaster and Renau 1983).

Of particular interest to the geologist is an excavation required for construction of this project which will be approximately 30.5 m (100 ft) deep in a point bar deposit. This open pit should be available for viewing by the participants of the field trip.

80.0 Turn around and retrace route to the junction of La. 15 and La. 1.

80.5 North spillway levee (north end of Overbank Control Structure).

90.9 North side of Old River Lock.

97.0 Junction of La. 115 and La. 1. Turn right on La. 1 to Simmesport.

East Atchafalaya River levee.

West Atchafalaya River levee.

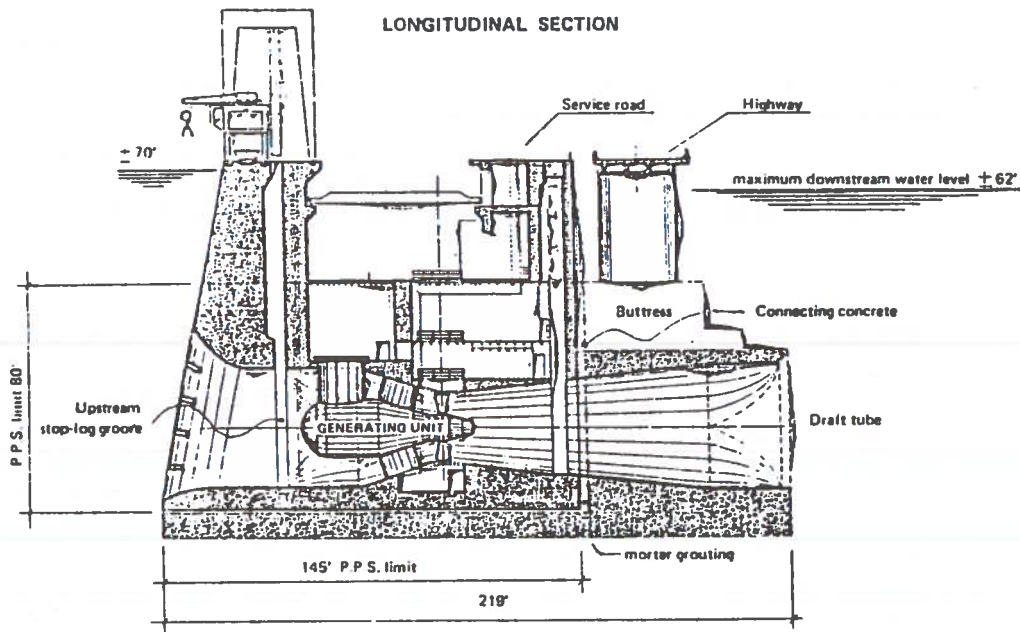


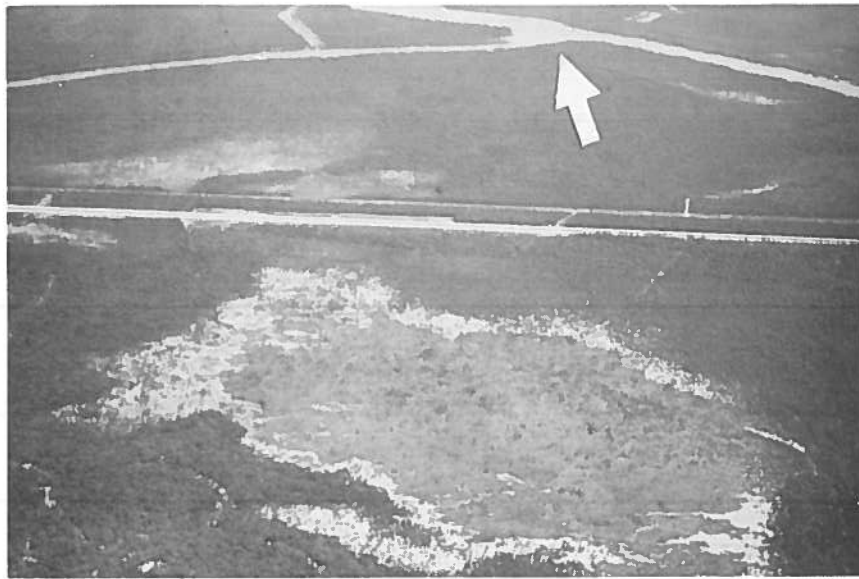
Figure 7. Cross section through a hydroelectric generating unit of the Sidney A. Murray, Jr. hydroelectric station at Old River. (Reprinted from Lancaster and Renau 1983:6.)

- 102.1 Atchafalaya River bridge.
- 102.8 Simmesport.
- 103.4 Simmesport ring levee. For the next 6.8 miles the Fuse Plug Levee will follow the right side of the highway. It is designed to fail given enough flooding. This would permit 250,000 cubic feet of water to flow down the West Atchafalaya Floodway, where it would merge with the waters from the Atchafalaya River and East Atchafalaya (Morganza) Floodway about 3.2 km (2 mi) below (south of) Butte LaRose.
- 110.2 Cross West Atchafalaya Basin protection levee.
- 116.3 Climbing up onto the Prairie Terrace.
- 122.1 Turn right on La. 452 to Marksville State Commemorative Area.
- 123.7
- STOP NO. 3 Marksville Site. One of the major periods in the prehistory of the Lower Mississippi Valley is the Marksville, named for this, the type site. The Marksville culture, 0-400 A.D., is characterized by conical burial mounds, often occurring in groups of two or three. These mounds served as monuments for select dead and usually contain only a few interments, each accompanied by special artifacts. The pottery vessels of the Marksville period are quite distinctive and enable us to relate the Louisiana Marksville culture

with the Ohio Hopewell Culture. Retrace route to Simmesport. Turn left at "T" on La. 452.

- 125.3 Junction of La. 452 with La. 1. Turn left on La. 1.
- 142.5 Site of the Battle of Yellow Bayou, Civil War.
- 144.4 Junction of La. 1 and La. 105. Turn right on La. 105 and proceed to Krotz Springs and then Butte LaRose. For the next 144.8 km (90 mi), the route follows the narrow natural levee of the Atchafalaya River.
- 144.8 Cross over south ring levee around Simmesport.
- 164.8 Bayou Rouge to right, which crosses Elba oil field about 4.8 km (3 mi) to the northwest.
- 167.0 Cross over north ring levee around Melville.
- 167.3 Melville.
- 168.7 Cross over south ring levee around Melville.
- 171.6 Head of Keith Lake which flows into Bayou Petite, site of Melville gas fields.
- 178.5 Cross over north ring levee around Krotz Springs into the town of Krotz Springs.
- 178.9 Cross under La. 190.
- 180.2 Colonial pipe line, Krotz Springs station.
- 180.4 Hill Petroleum Company.
- 185.2 Cross closed section of Bayou Cortableu which flows through one of the Krotz Springs oil and gas fields about 8 km (5 mi) to the northwest.
- 192.4
- STOP NO. 4** Turn left over the levee and follow dirt road for 1.3 km (0.8 mi) to the head of the Whiskey Bay Pilot Channel on the Atchafalaya River (figure 8). At this point Whiskey Bay, an artificial channel, diverts the main flow of the river into a dredged channel which extends to the main body of Six Mile Lake, near Morgan City. The Atchafalaya Basin Floodway (figure 9) through which this river flows in its natural and artificial courses, is a part of the larger Atchafalaya Basin (figures 10 and 11). This basin owes its origin to the closure of a large low-lying area by the building of small diverging distributary ridges of the Lafourche-Mississippi (3500 B.C.

A



B



Figure 8. (A) View northward across I-10 toward the junction of the Atchafalaya River and the Whiskey Bay Pilot Channel. (B) View from point shown by arrow in (A).

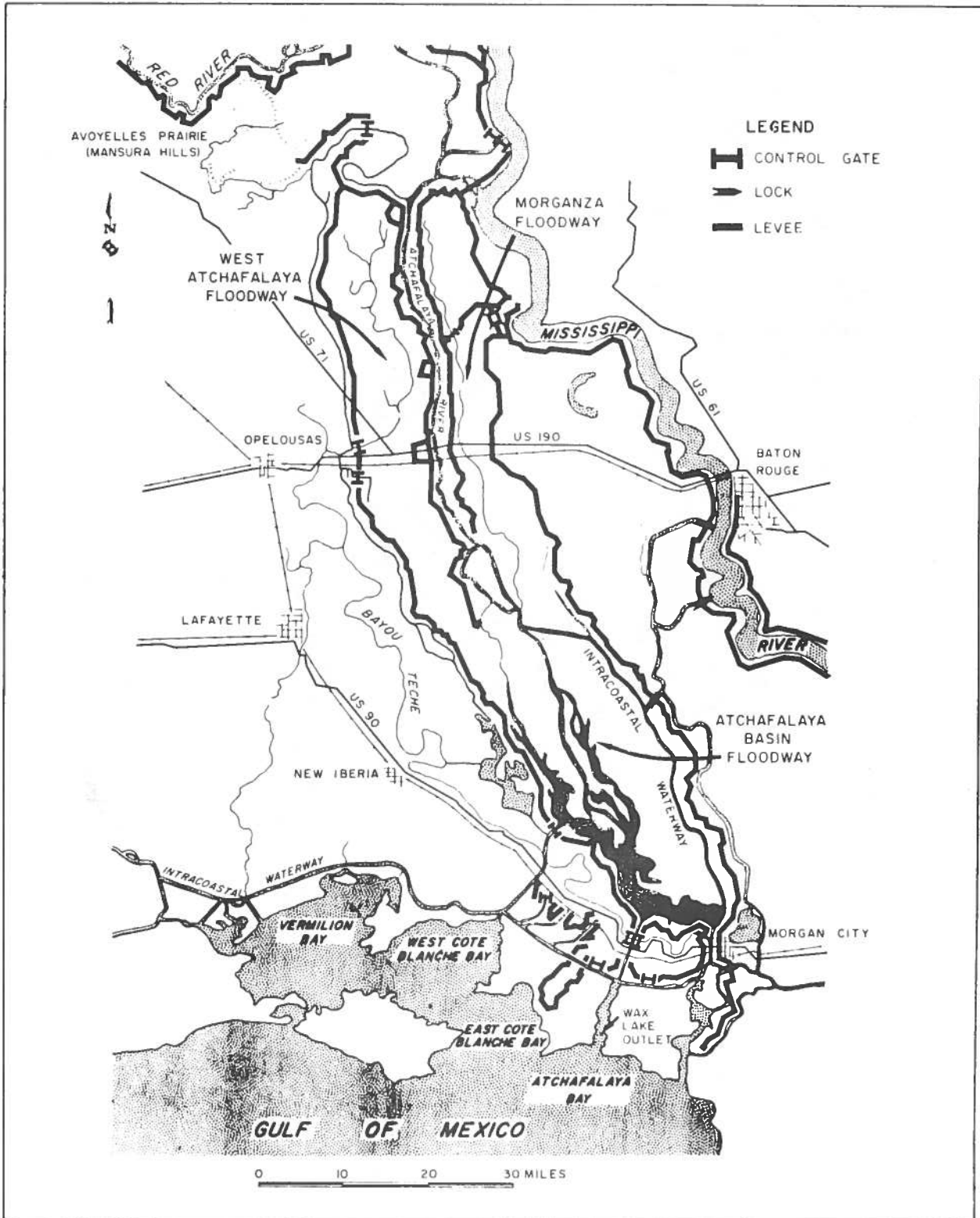


Figure 9. Atchafalaya Basin improvements. (Modified from U.S. Army Corps of Engineers 1981b.)

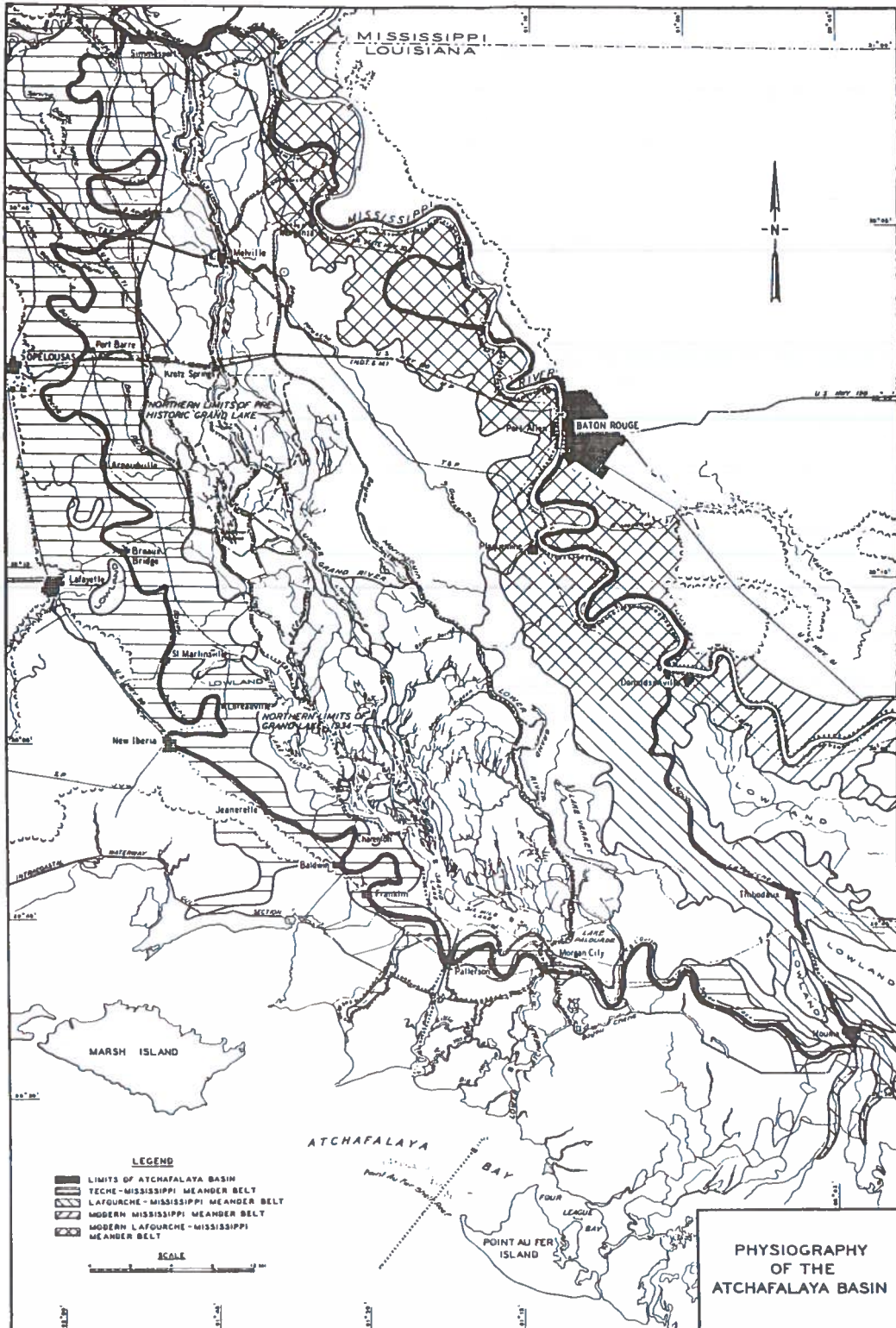


Figure 10. Physiography of the Atchafalaya basin. (Reprinted from Fisk et al. 1952.)



Figure 11. Morgan City, Louisiana during 1973 flood.

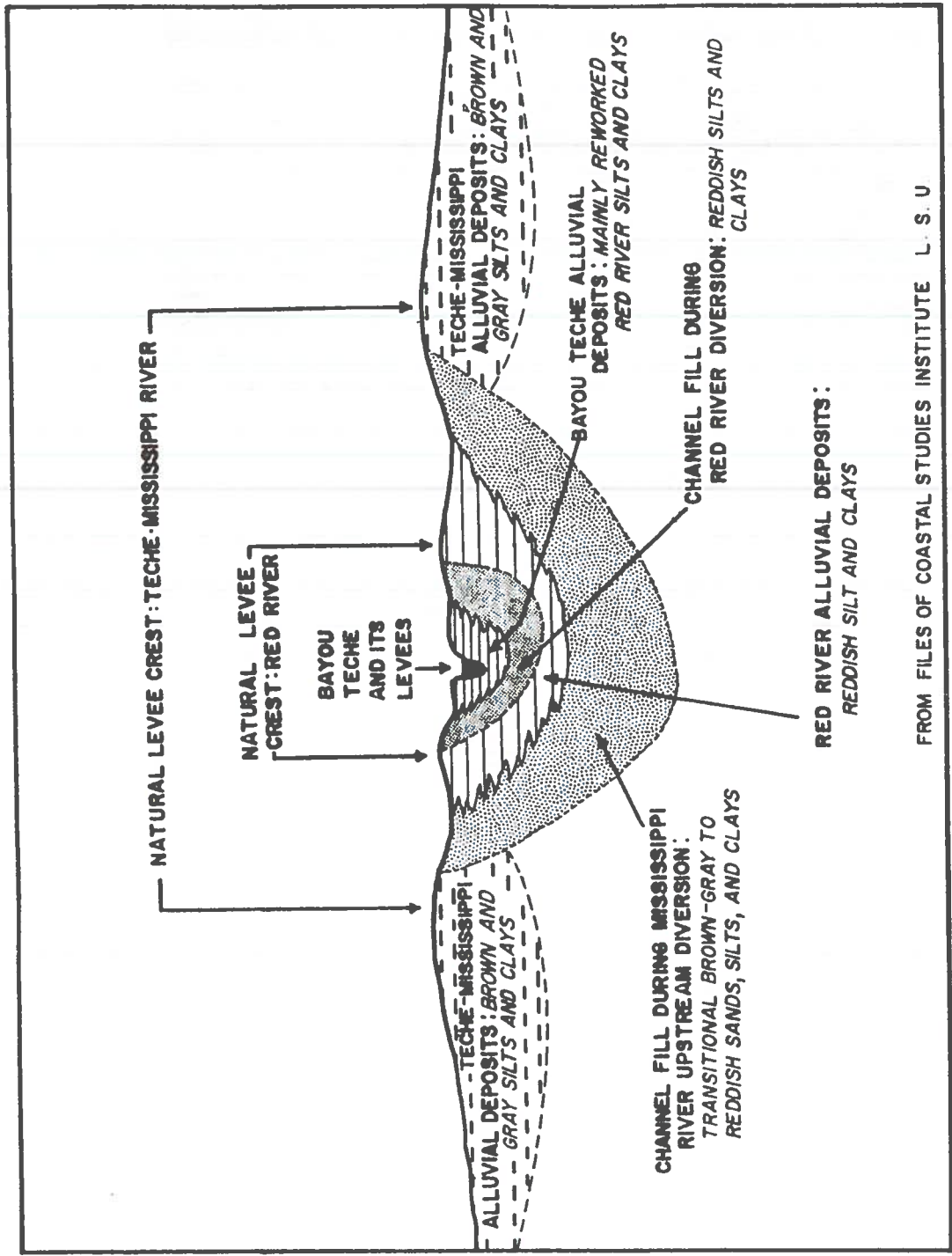
to present)* over those of the older Teche-Mississippi (5700-3900 B.C.)* Because of subsidence and low sedimentation a large lake was formed in the southern part of the basin (Fisk et al. 1952). It was pointed out by these authors that this condition was changed by introduction of the Atchafalaya River into the basin about 1500 A.D.. The large body of water was reduced to the dimensions of Grand and Six Mile lakes in the 1950s by Atchafalaya sedimentation. Since then the increased flow of the Atchafalaya River has built a delta into Grand Lake, further reducing its size.

The Atchafalaya River today is the principal distributary of the Mississippi River. After its origin as a crevasse, its development ceased due to formation of a log raft. Artificial removal of this raft renewed its growth, as reported by Russell (1939), who remarked on the threat to the permanency of discharge past New Orleans. He concluded that the youth of this river is indicated by its channel configuration, its straightness, and the immaturity of its meanders. Russell was sure that it had never been the main channel of either the Mississippi or Red rivers.

196.0

STOP NO. 5 Rest area. Junction of I-10 and La. 105. Continue south to Butte LaRose on La. 3177.

*These dates are from Frazier (1967).



FROM FILES OF COASTAL STUDIES INSTITUTE L. S. U.

Figure 12. Schematic section across Bayou Teche near St. Martinville, Louisiana. (Reprinted from Kolb and Mathy 1981:11.)

- 201.5
STOP NO. 6 Butte LaRose. Another opportunity to view the Atchafalaya River and an example of basin physiography. The stream at this point was formerly the principal channel of the Atchafalaya before it was significantly diverted by the Whiskey Bay Pilot Channel. Continue on La. 3177 to its intersection with the West Atchafalaya guide levee.
- 205.1 Cross bridge and ascend to La. 96 on the top of the West Atchafalaya Basin protection levee (guide levee). Turn left (south).
- 207.5 Henderson Lake freshwater weir to left. This structure controls the level of fresh water entering Henderson Lake to the north (Kolb and Mathy 1981).
- 210.8 Follow La. 96 down to the protected land on the west side of the levee and proceed to the town of Catahoula.
- 211.5 Catahoula Lake in the town of Catahoula.
- 220.5 Louisiana Tourist Commission historical marker indicating site of the Durand oak and pine alley.
- 222.3 St. Martinville. Kolb and Mathy (1981) pointed out the well-preserved natural levees of former courses of the Mississippi and Red rivers on this (east) side of Bayou Teche (figure 12).
- 222.7 Bayou Teche.
- 222.9 Turn right (north) on La. 31 and follow Bayou Teche to Breaux Bridge.
- 227.2 One can observe here the double natural levees of the Mississippi and the Red rivers. On cultivated land the inner set of natural levees of the Red River can be distinguished by the red color of the soil.
- 236.0 Turn right in Breaux Bridge at the red light onto La. 347.
- 236.2 Cross Bayou Teche, then make a sharp left turn onto La. 328.
- 237.9 Turn right (east) on I-10 for return to Baton Rouge.
- 242.8 Cecilia (Henderson exit).
- 245.6 Cross over West Atchafalaya Basin protection levee.
- 247.1 Henderson swamp. The following explanation is quoted directly from Kolb and Mathy (1981:7).

Henderson Swamp with large cut-over cypress forest. Bayou Teche and Atchafalaya River were once alive with steamboats towing red cypress logs from virgin timberlands to sawmills.

Screaming saws and the smell of freshly cut cypress characterized logging towns that stood along the banks of the Teche and the Atchafalaya and other south Louisiana waterways.

A multi-million dollar cypress industry boomed in the Louisiana swamplands from the 1870's to the 1920's.

When the industry was well off the ground, cypress sold for \$30 per 1,000 board-feet. (A board-foot is one square foot, one inch thick). When the industry closed, the price was \$700 per 1,000 board-feet. Today red cypress cannot be bought on the open market. It takes 600-700 years to grow cypress to maturity.

249.1 Lake Pelba.

249.9 Atchafalaya River (figure 13).

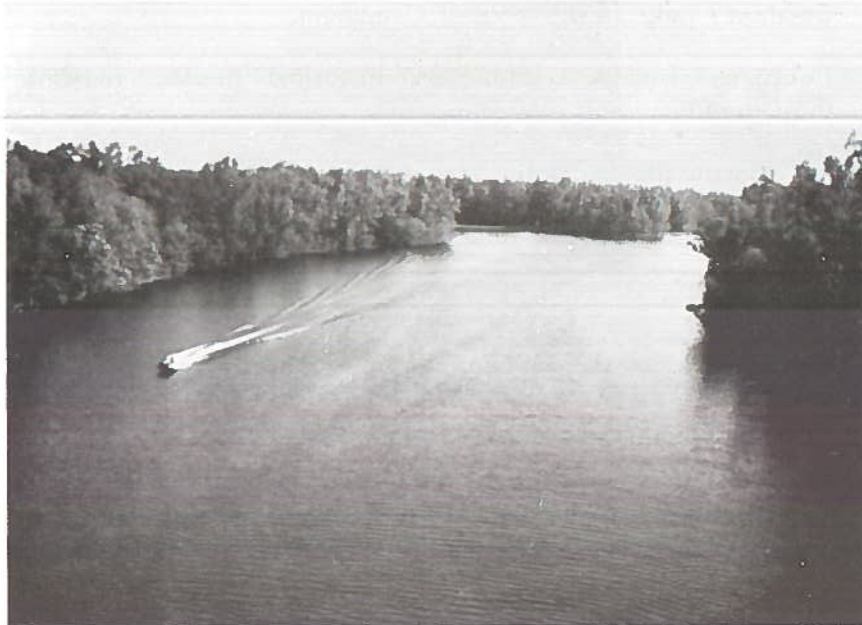


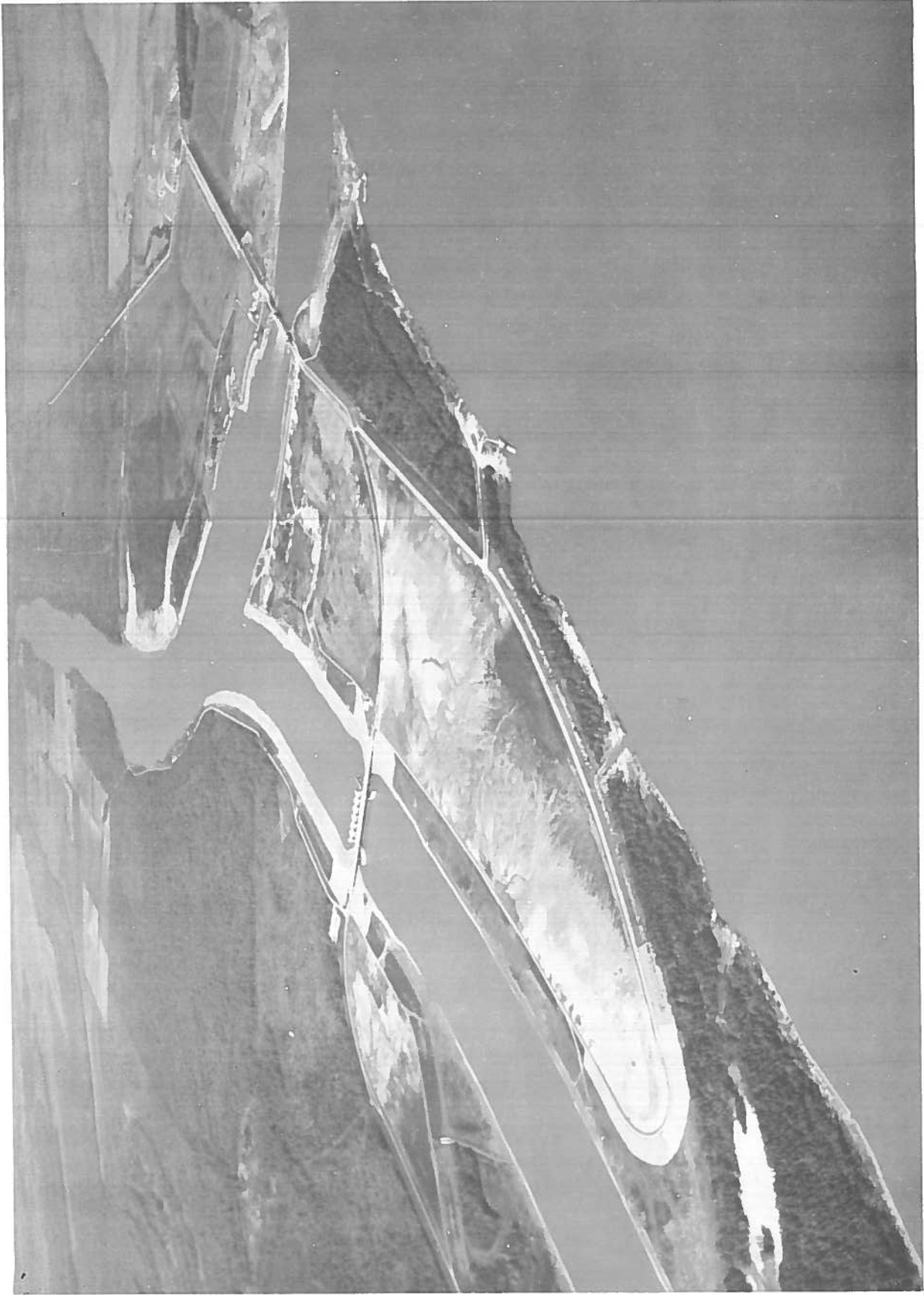
Figure 13. View of Atchafalaya basin from I-10 during 1973 flood.

254.8 Whiskey Bay Pilot Channel, the principal navigation channel of the Atchafalaya (Kolb and Mathy 1981).

262.8 Cross over the East Atchafalaya Basin protection levee (guide levee) into land protected from flooding by this levee and the west levee of the Mississippi River.

263.1 Ramah exit, cross Bayou Maringouin. This stream represents the path of the Mississippi River identified by Fisk et al. (1952). Dated by Frazier (1967) to be 7200 to 6200 B.C.

- 267.3 Grosse Tete exit.
- 267.6 Cross over Bayou Grosse Tete which, according to Russell (1939), was intermediate between a minor crevasse channel and a major distributary of the Mississippi River.
- 281.8 Mississippi River at Baton Rouge.
- 282.6 Turn right on first exit, leading to Highland Road. Travel south on this street to Louisiana State University.
- 284.3 North Gate of LSU. End of trip. Au Revoir et Laissez Les Bon Temps Rouler!



Aerial view of the Old River Auxiliary Structure (left center), which was formally placed in operation May 2, 1987. The Low-Sill Control Structure is visible at the right. (Photo from U.S. Army Corps of Engineers, New Orleans District.)

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