COMPREHENSIVE STUDY OF THE EAST FORK OF THE TOMBIGBEE RESOURCE ISSUES BY THE CORPS OF ENGINEERS AND SOIL CONSERVATION SERVICE

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Introduction

The East Fork Basin Study is being conducted as part of the U.S. Army Corps of Engineers, Mobile District (Corps) and U.S. Department of the Agriculture, Soil Conservation Service (SCS) joint study of the Tombigbee River Basin, Alabama and Mississippi. The joint study is being conducted in response to a September 19, 1984, Congressional Resolution (under the authority of Public Law 87-639), which authorized "joint investigations and surveys of the Tombigbee River Basin, Mississippi and Alabama ..., in the interests of flood prevention and control, soil erosion and siltation control, water quality control, water supply, recreation, fish and wildlife, environmental quality, watershed protection and allied purposes." Late in the overall study process a number of significant resource issues were identified in the East Fork portion of the Tombigbee River Basin.

The Corps, in coordination with the SCS, U.S. Fish and Wildlife Service (FWS), Mississippi Department of Wildlife, Fisheries, and Parks (MDWFP), and Tombigbee River Valley Water Management District (TRVWMD), initiated the East Fork Basin Study in March 1989, to address the identified resource problems in a systematic manner. Since this component was initiated late in the study process, the East Fork study can only be evaluated at a preliminary investigation level of detail. A task force, with representatives from the above agencies, was established to facilitate the conduct and coordination of the study.

Study Area Description

The study area is located in northeast Mississippi and specifically includes the watershed areas of the East Fork of the Tombigbee River above the confluence of Town Creek (also known as the West Fork of the Tombigbee River); Brown Creek; Donivan Creek; Twentymile Creek; and Mantachie/Boguefala Creek (Figure 1). The area is approximately 50 miles long and 12 miles wide, containing an estimated 400,128 acres, and is located principally in Itawamba, Lee, and Prentiss Counties (USDA, 1989). Land use within the basin is dominated by forest (51 percent), followed by pasture/grassland (29 percent), cropland (15 percent), urban (4 percent), and other uses (1 percent). A more detailed breakdown of land use within the study area is presented on Table 1. Since the East Fork Basin is a rural area, with very limited urban or industrial land uses, employment, as well as land use, is dominated by agriculture and forestry. The importance of the well being of the land base in the study area is, therefore, critical to the continuance of these historic rural lifestyles.

Resource Issues

The major resource issues identified in the East Fork Basin Study area are related to sedimentation. A list of all issues identified include:

a. Significant quantities of eroding farmland within the East Fork Basin.

b. Unstable stream channels and banks along reaches of the East Fork tributaries.

c. Sediment and debris accumulation in the lower end of the tributaries and in reaches of the East Fork, including the adjacent flood plain forest. This flood plain area includes the John Bell Williams Wildlife Management Area, which contains a sizeable quantity of Corps land dedicated to intensive wildlife management as part of the Tennessee-Tombigbee Waterway (TTW) Wildlife Mitigation Program.

d. Declining populations of endangered mussel species in the East Fork.

e. Permitted and unpermitted gravel mining in the East Fork and adjacent flood plain.

f. Water supply withdrawal from the East Fork.

g. Sedimentation in the navigation channel of Aberdeen Lake at the mouth of the Tombigbee River.

h. Flooding along portions of the tributaries and on the East Fork.

This paper deals primarily with the sedimentation issues. Several of these issues result from competing interests for the land and water resources of the East Fork Basin study area. Others are related to the long-term misuse of the land and consequences from previous drainage and channelization work (Shields et al. 1990).

The existing erosion and sedimentation situation in the study area is the cumulative product of both manmade activities and natural circumstances that have occurred over an extended timeframe. For example, the land surface has been extensively altered over time by intensive, and at times abusive, forestry and agricultural practices. Rather extensive measures have been undertaken by locals and through Federal projects and initiatives to improve drainage and the availability of additional tillable lands. The erodibility of the soil and the dynamic hydrologic cycle, which exhibits both droughts and periods of extensive flooding, complicated and exacerbated the situation. Failures or degradation of drainage facilities led to additional measures. The additional "improvements" were generally done in a "band-aid" fashion to address localized situations with insufficient attention paid to the overall impacts and synergistic and cumulative effects.

The pattern of agricultural production in the study area has been characterized by constant change. The Indians originally inhabited the Tombigbee Basin. Settlement by the white man began during the early 19th century (USDA, 1964). In the early 1800's the uplands were farmed. Vast acreages of timberland were cleared for cropland and pastureland. Cotton was the major cash agricultural crop, but this crop depleted the soil quickly. As the uplands soils were depleted, the old fields were abandoned. New fields were cleared and farming of the bottomlands began. The abandoned fields quickly deteriorated with the formation of gullies. Sediment from the eroding fields filled natural stream channels and lakes. In time, much of the land once farmed was allowed to revegetate into native tree species. Landowners began to plant and improve forests, and some farmers incorporated sound conservation practices in their farming programs. Sediment discharges were reduced considerably as erosion was controlled. However, a great deal of damage had already occurred with the sediment deposits in the natural channels and flooding became more of a problem. Initially, channels to convey the flood waters were built by farmers on an individual basis, but these channels proved to be inadequate.

The upland erosion and subsequent sedimentation resulted in deterioration of the soil resource base, both short and long term, caused by excessive sheet, rill, and ephemeral gully erosion. These forms of erosion are causing productivity losses on 16,314 acres of cropland, 8,642 acres of grassland, and 90 acres of forest land in the East Fork Basin.

Drainage District laws were enacted in Mississippi in 1886. These laws were organized based upon community needs rather than watershed requirements. The modifications usually started in the upper reaches of the streams, so larger ditches flowed into smaller ditches, which emptied into unmodified, badly congested outlets downstream. The streambed and bank erosion problems primarily are associated with previously channelized streams in the East Fork Basin. The initial channelization on these streams was done by local drainage districts during the late 1800's and early 1900's to improve drainage. Streambed degradation and bank erosion were immediate, as evidenced by the cross-section comparisons on Twentymile Creek (near Baldwyn, Mississippi) for 1910, 1913, 1918, and 1983 (Figure 2). Many of these local drainage projects were expanded by the Corps and SCS in the 1920's and 1930's. They were expanded again in the 1960's, by the Corps as part of the Flood Control Act of 1958 (Public Law 85-500). Each of these expansions have been accompanied by upstream channel response of degradation and bank erosion.

Erosion/Sedimentation Problem Quantification

The first step in development of measures to address the sedimentation issues was the delineation of the major erosion problem areas. This task was accomplished jointly by the Corps and SCS. The SCS conducted sediment analyses to quantify sediment from overland sources. The gross soil loss from the upland areas in the study area is estimated to be 1,755,484 tons per year.

The average annual sediment load for the streams within the basin was determined by the Corps at all sediment stations by integrating the sediment rating with the duration curves (Corps 1989). Figure 3 is a sediment budget schematic of the basin with the width reflecting the magnitude of the average annual sediment load for the streams. While this figure indicates the sediment budget for the East Fork prior to the TTW, the current conditions would be the same except the eastern tributaries do not supply any (negligible) sediment to the system. The proportion of sediment supplied by the eastern streams historically was very small and their loss to the system would not likely be significant. An important point to note in Figure 3 is the large amount of sediment which is apparently deposited in the system between the confluence with Twentymile Creek and Fulton. This indicates a potential for progressive geomorphic change in the system in the areas of heavy deposition. Such changes would likely be reflected by changes in the energy gradient, channel width, and sinuosity (the ratio of the river channel length to the length of the flood plain).

Subtracting SCS computed data for amount of sediment being eroded from overland sources from the Corps' computed average annual sediment load being carried from the respective tributary drainage basins indicates that approximately 80 percent of the sediment being transported by the tributary streams comes from streambed and bank erosion. The computations for Brown Creek, Twentymile and Donivan Creeks combined, and Mantachie and Boguefala Creeks combined are presented on Table 2.

While sediments from the streambed and banks produce the majority of the material causing the downstream problems, the remaining approximate 20 percent being generated from agricultural and forest lands cannot be ignored. Sediments from these nonpoint sources are finer grained material and can also cause significant downstream problems though transport of pollutants such as agricultural chemicals. Therefore, for this study efforts were made to develop measures to control erosion from upland sources, as well as stream channel erosion.

Biological Resource Significance

While the erosion and sedimentation impacts have affected much of the western tributaries and portions of the East Fork, the environmental resources of the East Fork and adjacent flood plain have retained much of their former significance. The East Fork stream and adjacent flood plain are a productive and diverse ecosystem, recognized on a regional and national level (Daniel Dunn 1990, pers. comm., U.S. Fish and Wildlife Service, Daphne, AL). Despite channelization of the western drainages and some channel modifications to the main stem, the East Fork has maintained the characteristics and productivity of a natural free-flowing stream. The East Fork Basin supports 98 of the 115 species of freshwater fish found in the upper Tombigbee drainage (Boschung 1989). With a total of 40 species of unionid mollusks, the East Fork ranks in the top 10 percent for diversity of streams in North America (Stansberry 1989, pers. comm., Ohio State University, Columbus, Ohio). The habitat for three species of endangered mollusks, Epioblasma penita, Pleurobema curtum, and Pleurobema taitianum, is found in the East Fork. In addition to these significant aquatic habitats, the flood plain forest along the East Fork provides habitat for a diverse wildlife community. The bottomland hardwoods support high densities of white-tailed deer, turkey, grey fox, swamp rabbit, raccoon, mink, and many species of raptors and passerine birds. The East Fork flood plain supports a large breeding population of wood duck. It also provides important wintering habitat for other migratory waterfowl. Much of this flood plain habitat is owned by the Corps and is managed for wildlife as part of the TTW Wildlife Mitigation Program.

Erosion/Sedimentation Control Measure Development

The Corps and SCS have developed measures that would address the erosion and sedimentation problems in the East Fork Basin. To avoid duplication of effort, the interagency task force agreed that the Corps should develop measures for the stream channel erosion of the main tributaries of the East Fork and that the SCS should develop measures in the upper headwaters of these tributaries and on the agricultural and forest land in the basin (hereafter referred to as upper watershed measures). The measures have been systematically developed to address the total basin area. The measures include stream channel grade control structures, bank protection, land treatment, flood and sediment control structures, minor grade control structures, and filter strips. The effectiveness of these type measures has been demonstrated through the stabilization work on portions of Twentymile Creek (authorized in 1980 by Congress in Public Law 96-304) (Shields et al. 1990) and by the Demonstration Erosion Control (DEC) Project in the Yazoo River Basin (USDA, 1989a).

The East Fork Basin sedimentation problems are very similar to those also being experienced in the headwater tributaries of the Yazoo River. These problems are being addressed through the DEC Project, jointly conducted by the Corps (Vicksburg District) and SCS (UDSA, 1989a). The DEC Project was initiated in 1984 and directs the Corps and SCS to work cooperatively on an erosion control program for several specifically named streams in the Yazoo River Basin. Due to the similarities between many of the Yazoo Basin tributaries and the East Fork tributaries, coordination with DEC Project staff has been an integral part of the East Fork Basin Study. DEC Project representatives from the Vicksburg District; SCS, Oxford, Mississippi; and Agricultural Research Service participated in an interagency meeting and field reconnaissance of the East Fork Basin study area in May 1989 and have been coordinated with frequently during the course of this study.

Description of Erosion/Sedimentation Control Measures

As described above, approximately 80 percent of the average annual sediment load contributed to the East Fork from tributary streams has a source originating from the bed and banks of the tributary streams. Therefore, if significant reductions are to be made to the sediment inflow to the East Fork, this reduction must come from reductions in tributary streambed and bank erosion.

The Corps employed the services of Water Engineering and Technology, Inc. (WET) to assess erosion problems and develop preliminary corrective measures for the entire Tombigbee River Basin as part of the overall Joint Basin Study (WET 1988). This engineering company has been involved heavily in the DEC Project work and has an international reputation in the field of stream channel erosion. Through examination of existing survey data, field reconnaissance, aerial overflight, and discussions with local SCS and TRVWMD personnel a preliminary stabilization plan was developed: 1) Twentymile Creek, 19 drop structures and 5,000 feet of bank protection, 2) Brown Creek, 19 drop structures and 3,700 feet of bank protection, 3) Donivan Creek, 15 drop structures and 2,400 feet of bank protection, and 4) Mantachie Creek, 6 drop structures and 3,100 feet of bank protection. In addition, in recent years the section of Twentymile Creek between River Miles 9.1 and 11.7 has suffered excessive bank erosion which cannot be controlled within the limits of normal maintenance. A bank protection plan has been developed for 21,400 feet of this actively eroding reach. Other components dealing with the stream channel are recommendations to modify the vegetation control and mowing frequency on the existing Corps flood control projects on these tributary streams, plus deauthorization of the downstream severed portion of the channelized Standifer Creek flood control project. This eastern tributary was severed by construction the Tenn-Tom.

The upper watershed measures provide for technical and financial assistance for the implementation of watershed protection (land treatment), flood and sediment control structures, minor grade stabilization structures, and filter strips. All of these components would reduce sediment entering the East Fork if installed.

The watershed protection plan (accelerated land treatment) for the East Fork Basin was expanded from the land treatment measures developed for the overall Tombigbee River Basin Joint Study. To encourage the treatment of more acres than specified in the overall joint study, a higher cost share rate is proposed for the East Fork Basin than for the remainder of the Tombigbee Basin. The interagency task force proposes a 90-10 cost share for the East Fork Basin and a 65-35 cost share rate for the remainder of the Tombigbee Basin. The watershed protection component provides for treatment on 10,960 acres of cropland, 1,955 acres of grassland, and 90 acres of forest land (logging roads). Treatment on these areas will reduce erosion rates and sediment yields and improve water quality. The total estimated reduction in erosion will amount to 1,014,390 tons annually.

The flood and sediment control structure component includes the construction of 22 flood and sediment control structures in the Brown Creek and Mantachie Creek Watersheds. These structures are designed for the detention of sediment as well as floodwater. More detailed planning of these facilities will include an evaluation of their water supply and low flow augmentation potential. These structures are included in work plans which have been approved under the authority of Public Law 83-566 (USDA 1967 and 1975). This flood control plan provides an estimated average annual benefit, from the reduction in flooding of $609,500 which includes $96,600 for intensification of agriculture land. The 22 structures will, over their expected 100 year lives, trap a total of 144,900 tons of sediment annually.

Erosion of cropland due to concentrated flow is a significant problem in the East Fork Basin. In order to control on-site land voiding (land washed away through gully formation) and depreciation (land around a gully with reduced productivity) and to reduce downstream sedimentation, the task force has developed a system of minor grade control structures (drop pipe inlets and/or overfall pipes). Based on aerial photography, past experiences, and input from SCS personnel within the basin, SCS estimates that approximately 100 miles of channels have this problem and will require approximately 600 structures. It is estimated that the gross annual erosion rates from these 600 sites is 30,000 tons. With the installation of the 600 structures, the gross annual erosion will be reduced by 29,700 tons.

The task force also studied the feasibility of filter strips to reduce sediment entering waterways. The filter strip component provides for the installation of filter strips along tributaries of the East Fork and will reduce sediment entering the East Fork Basin and improve wildlife habitat. The filter strips would be located in cropland fields only. Four scenarios of filter strips were evaluated. The most efficient filter strip scenario provides for the installation of 414 miles of filter strips. The filter strips would be 99 feet wide along the main tributaries and 33 feet wide along small tributaries and field drains. The 99 foot wide strips would consist of 33 feet of grass along the field side which would serve as a filter for sediment leaving the field and could be also used as turn rows for farm machinery. The remaining 66 feet, located adjacent to the watercourse, would consist of woody vegetation. The 33 foot wide strips would consist of all grassed area. Total sediment reaching streams will be reduced by 21,340 tons annually.

The optimum approach would be to address the entire basin in a comprehensive fashion. However, incremental improvement could be realized by phasing implementation in a prioritized manner, addressing the most severe situations as funds are made available. A DEC-type project is especially amenable to a phased approach. For example, with the majority of sediments resulting from streambed and bank erosion, the measures to reduce stream channel erosion could be implemented prior to the measures for upper watershed erosion control. Based on the sediment loads of the streams within the basin, prioritization for the stream channel erosion measures shows a ranking of first, second, and third for Twentymile-Donivan, Mantachie-Boguefala, and Brown Creeks, respectively. In addition, upper watershed erosion control measures could be prioritized based on cost per ton of sediment reduced, resulting in the following order for installation (highest to lowest): land treatment, flood and sediment control structures, minor grade control structures, and filter strips.

Gravel mining and water supply withdrawal issues are currently less pressing than the sedimentation concern. At the present, there are no active instream gravel mining permits, however, reported sporadic illegal mining remains a problem in the East Fork near Amory, Mississippi. The future demand for more surface water withdrawal, such as recently permitted for the City of Tupelo, is likely due to decreasing groundwater levels throughout the study area. It was determined that the gravel mining and water supply issues could be addressed through existing Federal and State regulatory programs.

The findings of this interagency preliminary investigation for the East Fork Basin have been developed into a draft report which is currently being reviewed as a part of the overall Tombigbee River Basin Joint Study by the Corps South Atlantic Division office in Atlanta, Georgia. A final report is scheduled for September 1990.

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TABLE 1: GENERAL LAND USE ACREAGE EAST FORK - TOMBIGBEE RIVER HYDROLOGIC UNIT

LAND USE	BROWN CREEK		TWENTYMILE-DONIVAN CREEK		MANTACHIE CREEK		TOTAL HYDROLOGIC UNIT	
	ACREAGE	%	ACREAGE	%	ACREAGE	%	ACREAGE	%
CROPLAND	17206	4.30	24088	6.02	20367	5.09	61660	15.41
PASTURE/ GRASSLAND	32050	8.01	44894	11.22	37972	9.49	114917	28.72
FOREST	56578	14.14	79305	19.82	66981	16.74	202865	50.7
WATER	1520	0.38	2161	0.54	1801	0.45	5482	1.37
URBAN	4121	1.03	5802	1.45	4882	1.22	14805	3.7
OTHER LAND	120	0.03	160	0.04	120	0.03	400	0.1

TABLE 2: EAST FORK BASIN SEDIMENT SOURCE DISTRIBUTION

WATERSHED	DRAINAGE AREA (SQ.MI.)	AVERAGE ANNUAL SEDIMENT LOAD (TONS/YR)	SEDIMENT FROM OVERLAND SOURCES (TONS/YR)	OVERLAND SOURCES %TOTAL	SEDIMENT FROM STREAM BANKS (TONS/YR)	STREAM BANK %TOTAL
BROWN CREEK	174.4	425,000	112,000	26%	313,000	74%
TWENTYMILE & DONIVAN CREEKS	244.4	1,198,000	201,000	17%	997,000	83%
MANTACHIE & BOGUEFALA CREEKS	206.4	531,000	105,000	20%	426,000	80%

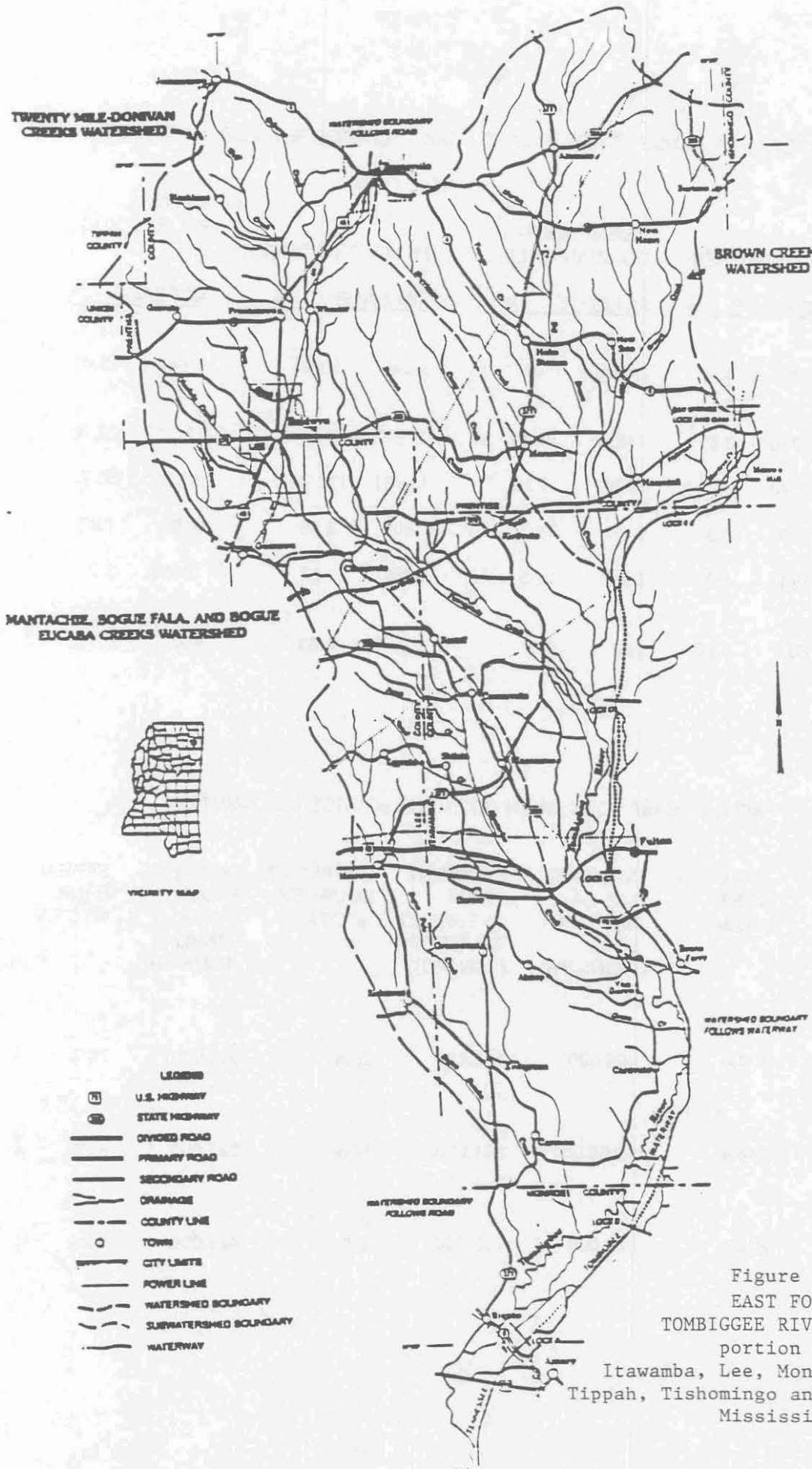
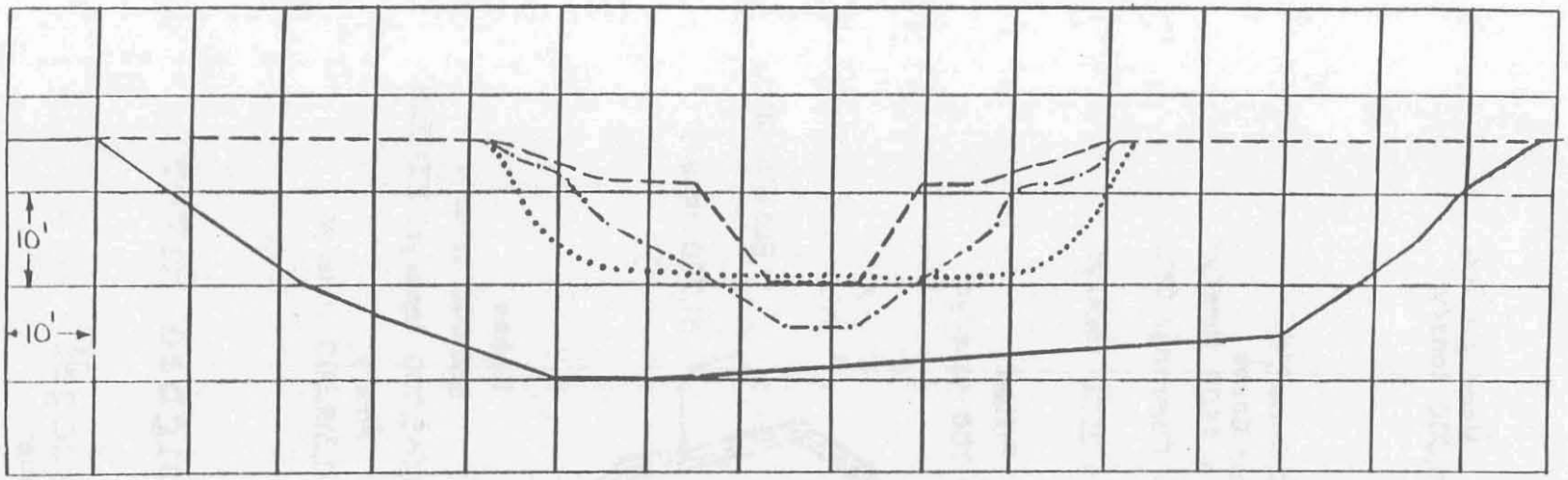


Figure 1
EAST FORK
TOMBIGGEE RIVER BASIN
portion of
Itawamba, Lee, Monroe, Prentiss
Tippah, Tishomingo and Union Counties,
Mississippi



CROSS SECTION OF TWENTYMILE CREEK
APPROXIMATELY 300 FEET DOWNSTREAM
FROM THE HIGHWAY BRIDGE ABOUT 1 MILE
EAST OF BALDWYN, MISSISSIPPI

SCALE: 1" - 20 '

LEGEND	CROSS SECTIONAL AREA
1910 ------	434 SQ. FT.
1913 -·-·-·-	777 SQ. FT.
1918	903 SQ. FT.
1983 ———	3,000 SQ. FT.

FIGURE 2

HISTORICAL CROSS SECTIONS
OF TWENTYMILE CREEK

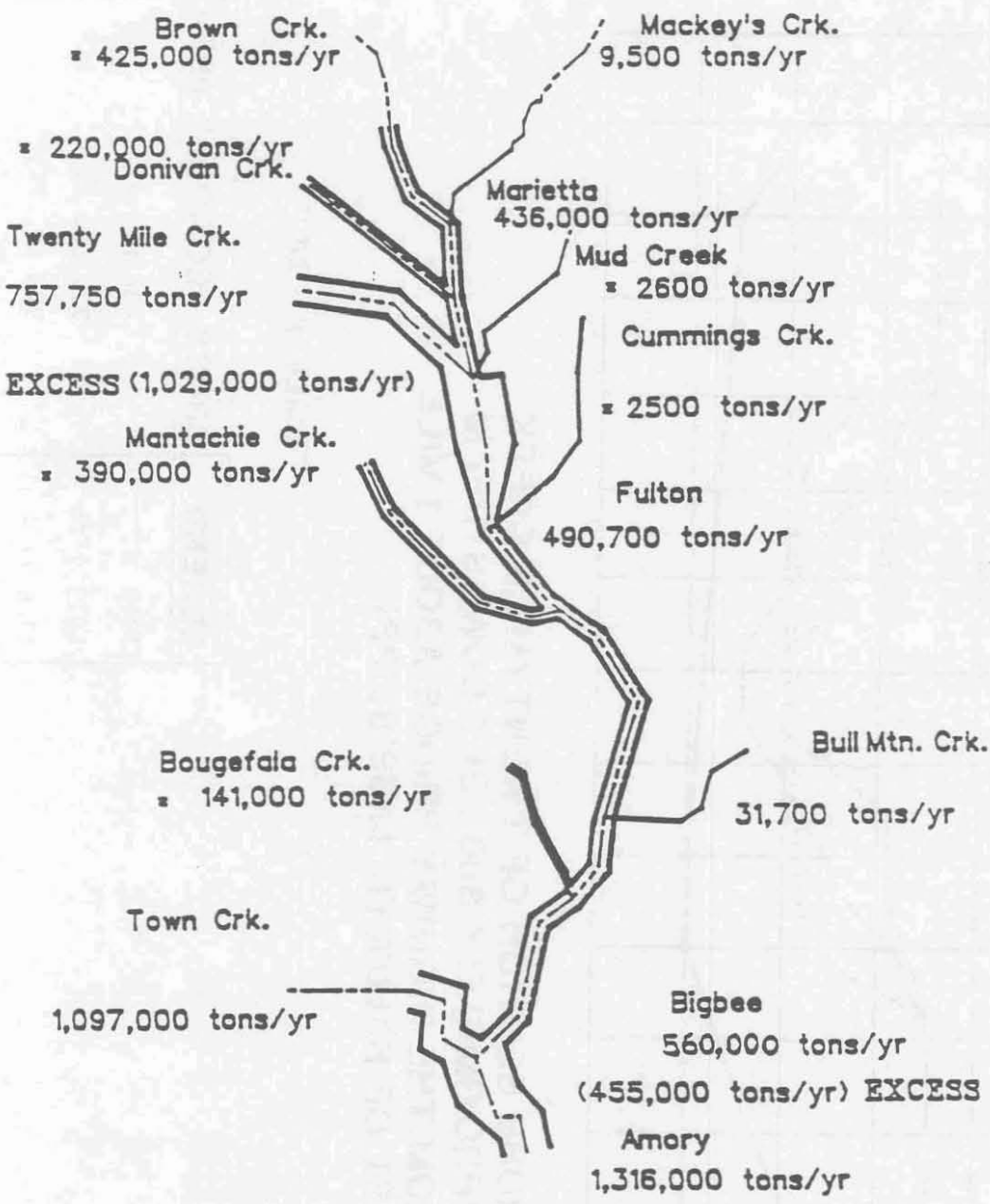


FIGURE 3

East Fork Tombigbee River

Sediment Budget

= estimated value