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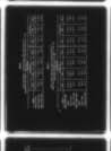

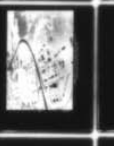




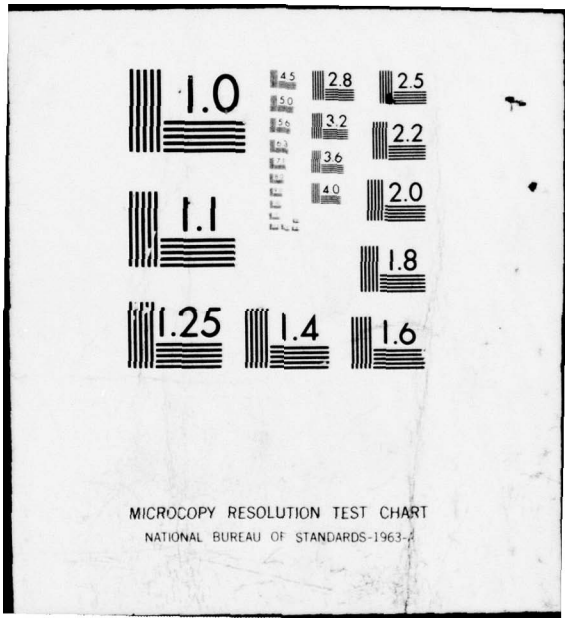
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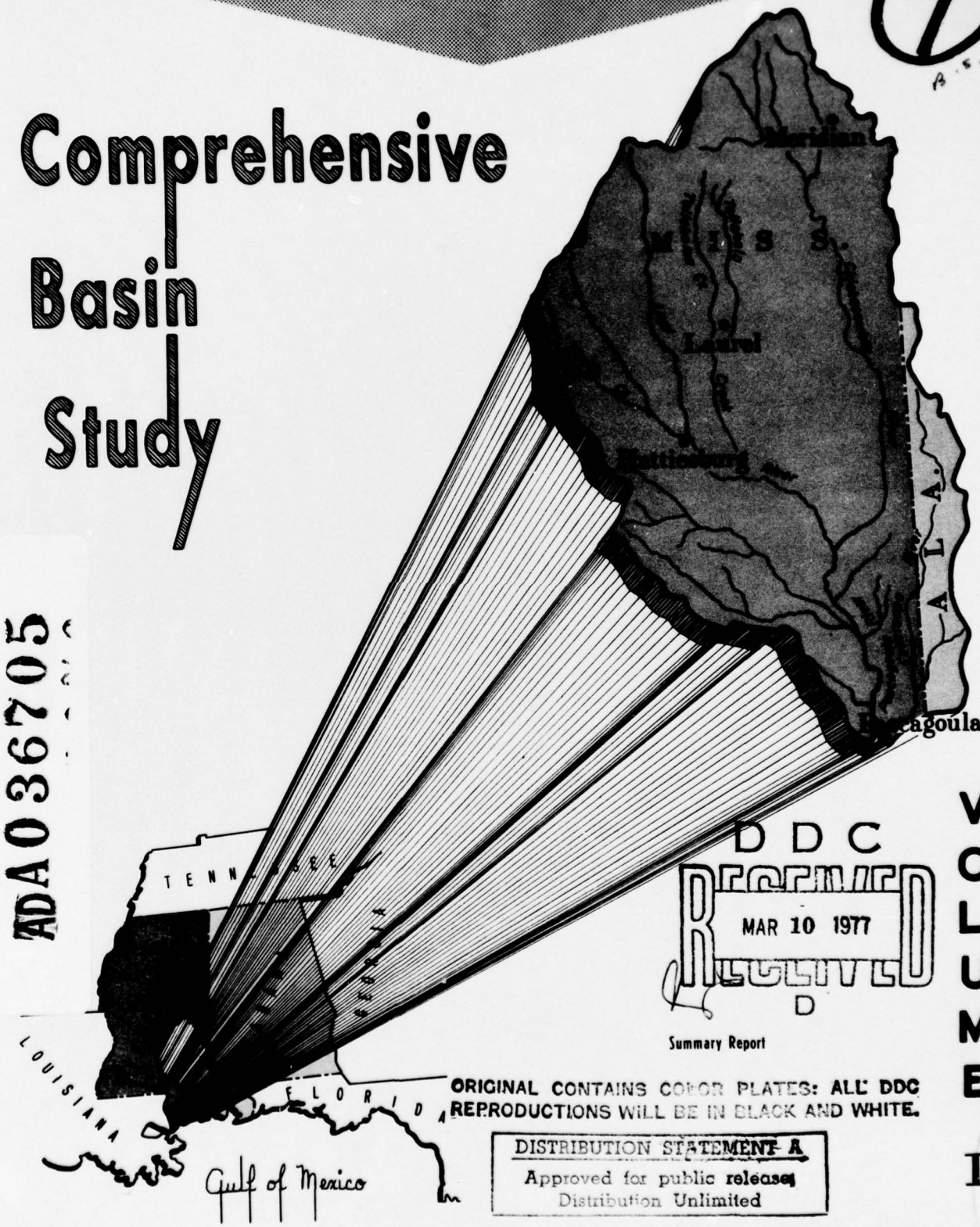
PASCAGOULA RIVER

Comprehensive Basin Study



Summary Report

VOLUME I

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PASCAGOULA RIVER COMPREHENSIVE BASIN STUDY

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PASCAGOULA RIVER COMPREHENSIVE BASIN STUDY.

Volume I.

SUMMARY REPORT.

(11) 29 Feb 68

(12) 138 p.

Prepared for the Coordinating Committee by
the Mobile District, Corps of Engineers, Mobile, Ala
Department of the Army

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FEBRUARY 29, 1968 H10084

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This report of the Coordinating Committee for the Pascagoula River Comprehensive Basin Study was prepared at field level and presents a proposed plan for the development and management of the water and related land resources of the Pascagoula River Basin. This report is subject to review by the interested Federal agencies at the departmental level, by the Governors of the affected States, and by the Water Resources Council prior to its transmittal to the President of the United States for his review and ultimate transmittal to the Congress for its consideration in authorizing Federal participation in implementing the plan.

SYLLABUS

This report presents the consolidated results of the comprehensive study of the water and related land resources of the Pascagoula River Basin. The basic objective was the formulation of a plan of development to provide the best use, or combination of uses, of these resources to meet the foreseeable short- and long-term needs. Requirements were based on a projection of the basin economy to the years 1980 and 2015.

The principal needs are for flood protection, water quality control, municipal and industrial water supply, recreation, fish and wildlife enhancement, and agricultural land and water management. The most practicable means to provide for these and other needs of the basin is through a comprehensive plan of structural and nonstructural measures.

Structural measures are divided into two categories:

- The early-action program, consisting of those projects found necessary to meet immediate and near future needs of the basin and to be economically feasible for construction within the next 10 to 15 years.

- The framework for future planning, consisting of those projects that are not economically feasible for construction in the next 10 to 15 years but which could help meet future needs of the basin and are potentially feasible for development or are strongly supported by local interests.

Nonstructural measures include:

- Land treatment and critical land area stabilization measures.

- Management programs for controlling and regulating the economic use and development of flood plains and for reducing flood losses to existing developments in areas where flood control is not economically feasible.

- Continuation and acceleration of current land management and conservation programs.

- Maintenance of an adequate water hygiene program by the States.

- Preservation of streams or stream reaches as free-flowing float-fishing streams.

- Protection of valuable estuarine habitat areas through pollution control and operation of reservoir projects to prevent adverse changes in stream discharges.

- Establishment of a refuge for the preservation and possible increase of a remnant flock of the Florida sandhill crane.

- Acquisition or lease of wildlife habitat acres for addition to the present basin wildlife management program.

- Preservation of areas of unique natural beauty and historical and scientific interest.

- Maintenance of open space, green space, and wild areas of rivers, lakes, beaches and related land areas.

- Requirements for maximum practicable treatment of all wastes entering the basin's streams.

The early-action program includes 11 multiple-purpose reservoirs, 17 upstream watershed projects, and stabilization of critical land areas throughout the basin. Within the 17 upstream watershed projects there are 133 floodwater retarding structures, 20 multiple-purpose structures, 852 miles of channel improvement, and land treatment measures for watershed protection. The total cost of the program is estimated at $193,129,000, including $24,101,000 for land treatment and stabilization of critical land areas. Excluding land treatment and stabilization of critical land areas, annual charges are $7,027,000 and annual benefits are $18,406,000, giving an overall benefit-to-cost ratio of 2.6.

The framework for future planning includes 11 multiple-purpose reservoirs, 30 upstream watershed projects including 10 multiple-purpose structures, and a barge navigation project.

The Coordinating Committee recommends:

1. That the comprehensive plan of structural and nonstructural measures be adopted as the basic plan for development and beneficial use of the water and related land resources of the Pascagoula River Basin.

2. That the early-action program be implemented as follows:

a. That authorization by the Congress for reservoirs designated as Taylorsville, Bowie, Mize and Harleston be sought by the Corps of Engineers. Estimated total costs for construction are $121,647,000; annual charges, $4,750,000; and annual benefits, $14,482,000. The benefit-to-cost ratio is 3.0.

b. That reservoirs designated as Little Black Creek, Big Creek, Archusa Creek, Kittrell Creek, Thompson Creek, West Tiger Creek, and Whetstone Creek be implemented by the Pat Harrison Waterway District as State of Mississippi projects with Federal aid. Estimated total costs for construction are $14,008,000; annual charges, $576,000; and annual benefits, $1,463,000. The benefit-to-cost ratio is 2.5.

c. That land treatment measures, 133 floodwater retarding structures, 20 multiple-purpose structures, and 852 miles of channel improvement in 17 upstream watersheds and critical land area stabilization for the remainder of the basin be implemented by the Department of Agriculture. Works of improvement and land treatment measures in 8 watersheds will be implemented through going programs (Public Law 566). Special basin-wide Congressional authorization would be sought for works of improvement and land treatment measures in the remaining 9 watersheds and critical land area stabilization in the remaining portion of the basin. The estimated total cost for these measures is $57,474,000, of which $24,101,000 is for land treatment and critical land area stabilization. Excluding land treatment and critical land area stabilization, annual charges are $1,701,000 and annual benefits are $2,461,000, giving an overall benefit-to-cost ratio of 1.4.

3. That the States adopt such legislation as may be required and take appropriate action utilizing available Federal assistance and programs, to permit implementation of the various nonstructural measures.

4. That the comprehensive plan be reviewed and updated periodically.

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CHAPTER 1

AUTHORITY AND BACKGROUND

INTRODUCTION

The Pascagoula River Comprehensive Basin Study is part of the national comprehensive river basin planning program that has developed from recommendations in the 1961 report of the Senate Select Committee on National Water Resources and subsequent actions of the Executive Branch and the Congress. The basic objective of this program is to plan for the best use, or combination of uses, of water and related land resources to meet all foreseeable short- and long-term needs.

The study has been directed towards developing an understanding of the existing and future needs of the Pascagoula River Basin; providing a sound basis for, and recommendation of, an early-action program of measures that should be undertaken within the next 10 to 15 years; and establishing a framework for future planning for the basin. It has been conducted as a coordinated State-Federal interagency investigation and the findings have been incorporated in this summary report and supporting appendixes, in accordance with guidelines for comprehensive river basin reports (Type 2) issued by the Water Resources Council.

AUTHORITY

The comprehensive study for the Pascagoula River Basin, Mississippi and Alabama, is one of the original 16, later reduced to 15, Type 2 studies for the United States which were selected by the Interdepartmental Staff Committee of the Ad Hoc Water Resources Council for completion by 1970. Subsequently, the Water Resources Council was made a permanent body by the Water Resources Planning Act, Public Law 89-80, approved July 22, 1965. Members of the Council are: the Secretary of the Interior, Chairman; the Secretary of Agriculture; the Secretary of the Army; the Secretary of Health, Education, and Welfare; the Secretary of Transportation; and the Chairman of the Federal Power Commission.

Since all water and related land resource needs were to be considered, the direct participation and contributions of a number of Federal agencies were required. Therefore, concerned agencies of the Department of Agriculture, Department of the Army, Department of Commerce, Department of Health, Education, and Welfare, Department of the Interior, Department of Transportation and Federal Power Commission joined in the study. The Corps of Engineers, Department of the Army, was designated as study leader; a plan of investigation was developed, outlining scope, agency responsibilities, and

schedules; and coordinated budget estimates were submitted through the Water Resources Council.

Federal agencies participated in accordance with their pertinent statutory responsibilities. Authorities are cited in the individual agency appendixes to this report. All agencies worked closely with their State counterparts in conducting their studies.

PRIOR REPORTS

There have been 15 reports prepared on all or parts of the Pascagoula River system, all by the Corps of Engineers. Those pertinent to this study are described briefly in Appendix D.

OBJECTIVES AND SCOPE OF INVESTIGATION

This report presents the results of the comprehensive study of the water and related land resources of the Pascagoula River Basin. The purpose, as previously indicated, was to determine the best use, or combination of uses, of the water and related land resources to meet all foreseeable short- and long-term needs in the basin. Specific objectives, contained in general guidelines and criteria for comprehensive studies, were to provide:

- A sound basis for necessary current and near-future action programs, including construction, and

- An appraisal of longer-range water and related land resource development needs and alternative solutions and a framework for future planning and action programs, including construction.

To accomplish these objectives in an orderly and efficient manner, guidelines were established as follows:

- Identify the general nature and scope of existing water and related land resource development needs and those which will be encountered in future periods.

- Identify the resources and alternative means for dealing with those needs.

- Define and evaluate the projects for which Federal authorization will be required to permit necessary construction to be initiated in the next 10 to 15 years, in sufficient detail to comprise a basis for authorization.

- Identify the general nature and scope of the measures which should be undertaken under non-Federal or other Federal programs to supplement or utilize the projects for which authorization is sought.

The investigations for this report were carried only to the point where reasonable conclusions could be reached in satisfying the outlined objectives.

Comprehensive planning to achieve the above objectives for the Pascagoula River Basin was guided by Senate Document No. 97, 87th Congress, 2nd Session, "Policies, Standards, and Procedures in the Formulation, Evaluation, and Review of Plans for Use and Development of Water and Related Land Resources." This document states that planning for use and development of water and related land resources shall be on a fully comprehensive basis so as to consider the needs and possibilities for all significant resource uses and purposes. It stresses that planning must consider viewpoints at all levels, but that regional, state, and local objectives shall be considered and evaluated within a framework of national public objectives and available projections of future national conditions and needs. In pursuit of the basic conservation objective to provide the best use, or combination of uses, of water and related land resources to meet all foreseeable short- and long-term needs, full consideration should be given to each of the following objectives and reasoned choices made between them when they conflict: development, preservation, and well-being of people. Well-being of all of the people is to be the overriding determinant in considering the best use, with care being taken to avoid development for the benefit of a few or the disadvantage of many. Planning is to be based on the expectation of a full and expanding national economy in which timely development of water and related land resources will occur in such a manner as to avoid being a constraint to economic growth.

Thus, comprehensive water and related land resource planning involves appropriate consideration of alternative objectives, both first level alternatives – broad social and economic objectives – and second level alternatives or the technical and administrative means which may be employed to achieve the broad objectives.

The broad objective alternatives may be categorized as (a) economic efficiency; i.e., satisfying identifiable needs to the extent that each is justified by national benefits; (b) regional development; i.e., satisfying identifiable needs to the extent that each is economically justified by inclusion of expansion benefits; and (c) environmental quality; i.e., satisfying identifiable needs to the extent that each can be met by projects and measures that enhance, preserve, or do not adversely affect the general quality of the environment.

In accord with the objectives of Senate Document 97, an economic base study of the Pascagoula River Basin was made, as described in Chapter 3 and Appendix E. This study projected the economy of the basin to the years 1965, 1980, and 2015, within the framework of a

full and expanding national economy depicted in "National Economic Growth Projections 1980, 2000, 2020," a preliminary report of the Economic Task Group of the Ad Hoc Water Resources Council Staff, July 1963. The projected growth rates of population, labor force, total personal income, and per capita income for the basin as a whole are greater than the national rates but the per capita income in 2015 would remain below the national average at about 64 percent.

Planning for the development of the water and related land resources of the Pascagoula River Basin was based on identified needs, related to the economy as projected in the economic base study. Consideration was given to the broad objectives of economic efficiency and environmental quality, taking into account the strong desire of the people of the basin for maximum physical development of the water resources in support of their growing economy and for their enjoyment. As a powerful means to further that end, the State of Mississippi in 1962 created the Pat Harrison Waterway District, a legal entity with broad powers to promote the objectives of "conservation, utilization, development, and regulation of the waterways and water resources of the Pascagoula River Basin to insure adequate flood control and soil erosion programs, a sanitary water supply, a satisfactory development of recreation facilities related to water, and improvement of navigability of streams to the extent feasible."

Adequate consideration of the broad objective of regional development requires the evaluation of expansion benefits which is beyond the scope of this report. Procedures for such evaluation are being developed in the current Appalachia study and should be applied, as appropriate, in future planning for the Pascagoula River Basin.

Planning for the development of the water and related land resources of the Pascagoula River Basin also took account of the second-level objectives, the alternative means or measures for meeting specific needs. For example, flood control may be dealt with by structural measures – reservoirs, diversion, local protection works – or by nonstructural measures – land treatment, flood plain management, evacuation.

ORGANIZATION FOR CONDUCTING THE STUDY

Studies, investigations, and preparation of the Pascagoula Comprehensive Report were performed through joint efforts of participating agencies. A Basin Coordinating Committee was formed with representatives from the States of Mississippi and Alabama, Department of the Army, Department of Agriculture, Department of the Interior, Department of Health, Education, and Welfare, Department of Commerce, Department of Transportation, and Federal Power Commission. The members of this Committee are listed on the following page.

State of Mississippi	Mr. Swep T. Davis Executive Director-Secretary Pat Harrison Waterway District Hattiesburg, Mississippi
State of Alabama	Mr. Claude D. Kelley Director of Conservation Department of Conservation State of Alabama Montgomery, Alabama
Department of the Army	* Colonel Robert E. Snetzer District Engineer Corps of Engineers Mobile, Alabama
Department of Agriculture	Mr. W. L. Heard State Conservationist Soil Conservation Service Jackson, Mississippi
Department of the Interior	Mr. Kenneth D. McCall Regional Coordinator, Southwest Region Muskogee, Oklahoma
Department of Health, Education, and Welfare	‡ Mr. Howard W. Chapman Associate Regional Health Director for Environmental Health Services Department of Health, Education, and Welfare Atlanta, Georgia
Department of Commerce and Department of Transportation	Mr. Douglas E. Schneible Hydraulic Engineer Bureau of Public Roads, Region 3 Atlanta, Georgia
Federal Power Commission	Mr. Robert C. Price Regional Engineer Federal Power Commission Atlanta, Georgia

* Relieved Colonel Robert C. Marshall, June 1, 1967.

‡ Relieved Mr. Herbert H. Rogers, May 1966.

Under the chairmanship of the District Engineer, Mobile District, Corps of Engineers, this Committee, collectively and individually, has served as a means of achieving coordination in conducting the specific studies applicable to each agency, in exploring and formulating plans of development, and in reviewing drafts of the report.

All studies were coordinated with the appropriate State agencies concerned with water resources development through the State member of the Basin Coordinating Committee. In addition, county and municipal agencies, private firms, and industrial concerns were consulted and gave freely of their time, experience and data. Most of this was done through the Pat Harrison Waterway District, the local sponsoring agency in the Pascagoula River Basin for the State of Mississippi, which contains nearly all of the basin. The Basin Coordinating Committee met at intervals throughout the course of the study to discuss developments and resolve any problems encountered. In addition, some 60 work-level conferences were held between cooperating agencies to insure effective prosecution of the study.

All of the Federal agencies have been equal partners in the study and have participated and contributed to the planning in the area of water resources in which they have the best knowledge and bear the primary responsibility. The principal Federal agencies worked closely with their State counterparts. The Pat Harrison Waterway District and the Alabama Department of Conservation coordinated the study for the States of Mississippi and Alabama.

Participation by agencies has been generally as follows:

THE DEPARTMENT OF AGRICULTURE, through the Soil Conservation Service, Forest Service, and Economic Research Service furnished special studies covering the agricultural economy of the basin, land use, cover, irrigation, rural water supply, sedimentation and upstream watershed control, including land treatment measures and multiple-purpose structures.

THE CORPS OF ENGINEERS has had the principal responsibility of conducting and coordinating the study and the plan formulation, consolidating information from studies and other agencies and processing the Committee report. The Corps investigated potential reservoir sites and determined the magnitude of present and future requirements for and the value of flood control measures and navigation facilities along the main streams and principal tributaries. Hydroelectric power studies were also made at potential sites. Plans were formulated for major multiple-purpose projects to help satisfy the needs of the basin.

THE DEPARTMENT OF COMMERCE, through the Environmental Science Services Administration, Weather Bureau, furnished hydrologic and climatic data for use in the comprehensive study. The Bureau of the Census furnished statistical data.

THE DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE, through the Public Health Service, conducted a study on the public health aspects of water and related land resource development in the basin. Health evaluation aspects covered water supply, recreation, shellfishery and vector control.

Seven agencies of the DEPARTMENT OF THE INTERIOR have participated in the basin study. They are: the Federal Water Pollution Control Administration, the Bureau of Outdoor Recreation, the Bureau of Sport Fisheries and Wildlife, the National Park Service, the U. S. Geological Survey, the Bureau of Mines, and the Southeastern Power Administration.

The Federal Water Pollution Control Administration made studies of the municipal and industrial water supply needs and flow requirements for water quality control to meet all proposed water uses in the basin. The monetary benefits were calculated for these two uses, both present and projected.

The Bureau of Outdoor Recreation made studies of the recreation aspects of existing and potential water resource development within the basin. The studies included a comprehensive inventory of existing and potential recreation developments, present and projected recreational needs and facilities to meet those needs, estimates of the amount and cost of recreational facilities required at the studied reservoirs and multiple-purpose upstream watershed structures to sustain the projected utilization, and estimates of benefits that could be expected to result from such utilization.

The Bureau of Sport Fisheries and Wildlife made an inventory of existing and potential fish and wildlife resources in the basin. Studies were also made of the expected loss of wildlife habitat at reservoirs and upstream watershed structures and of measures for mitigating these losses. Measures were recommended to gain maximum fish and wildlife benefits at the studied reservoir sites and upstream watershed structures, and the monetary value of these benefits was estimated. An early-action plan to satisfy the diversified fishing and hunting needs was also proposed.

The National Park Service investigated the historical, archeological and natural science aspects which would be affected by potential and proposed developments in the basin.

The U. S. Geological Survey provided a general description of the geology of the basin, and the location, extent and hydrological characteristics of the main groundwater sources.

The Bureau of Mines made an inventory of the nature and extent of mineral industry in the basin, both current and in the projected future, and an estimate of the amount of mineral products, present and future, that could be moved over a considered inland waterway system. The Bureau also reviewed the existing and potential development of mineral resources in areas of proposed major reservoir project sites.

The Southeastern Power Administration served as a review agency for hydroelectric power studies made by the Corps of Engineers.

THE DEPARTMENT OF TRANSPORTATION, through the Federal Highway Administration, Bureau of Public Roads, cooperated with the State Highway Departments to assure that proper road relocation or reconstruction costs were included for Federal-aid roads affected by proposed major reservoirs. The U. S. Coast Guard did not participate actively in the study but reviewed the report as an interested agency concerned with boating and navigation.

THE FEDERAL POWER COMMISSION furnished power values and load projections for potential hydroelectric projects in the basin and reviewed the hydroelectric power possibilities of projects selected for the early-action program.

Various State agencies also participated in the study. Most of this was done through the Pat Harrison Waterway District, the local sponsoring agency in the Pascagoula River Basin for the STATE of MISSISSIPPI, which contains nearly all of the basin. The Alabama Department of Conservation provided coordination for that portion of the basin located in ALABAMA.

FORMAT OF THE REPORT

In the interest of clarity of presentation and reference, the report has been arranged into a Summary Report and 14 appendixes.

This Summary Report presents the consolidated results of the comprehensive study of the Pascagoula River Basin. Included are a physical description of the basin and the present state of water and related land resource development; its past, present, and projected future economy; its present and future needs for water and related land resource development; alternatives for meeting those needs; a comprehensive plan including a framework for long-range planning and an early-action program for development of projects that are needed

now and are economically justified and should be built within the next 10 to 15 years; and recommendations for implementing the comprehensive plan.

The 14 appendixes to this Summary Report present details covering specific disciplines and features of the Pascagoula River Basin study. They have been given a letter designation and are outlined in the following paragraphs.

APPENDIX A contains the views of the various Federal and State agencies on the comprehensive plan for the Pascagoula River Basin.

APPENDIX B contains assurances that the required local participation will be provided if the proposed early-action program is undertaken.

APPENDIX C contains a resumé of public hearings held in the Pascagoula River Basin.

APPENDIX D contains engineering studies performed primarily by the MOBILE DISTRICT, CORPS OF ENGINEERS, for major reservoirs. These studies include hydrology studies concerning water availability, storm types, previous storms and floods, low flow and flood flow frequencies; flood damage studies; general design criteria; project formulation studies and descriptions of proposed early-action major reservoir projects; studies of navigation possibilities; and studies of hydroelectric power possibilities. Sedimentation studies performed by the Department of Agriculture for the Corps of Engineers are also included in this appendix.

APPENDIX E, prepared jointly by the U. S. DEPARTMENT OF AGRICULTURE and the MOBILE DISTRICT, CORPS OF ENGINEERS, is an economic base study of the Pascagoula River Basin Study Area. Data for this appendix were taken from (a) "Economic Base Study of the Pascagoula, Pearl and Big Black River Basins Study Area," prepared under private contract to the Corps of Engineers, and (b) "Agricultural Economic Base Study of the Pascagoula River Basin Study Area," prepared by the ECONOMIC RESEARCH SERVICE and the FOREST SERVICE of the U. S. DEPARTMENT OF AGRICULTURE. This appendix shows past trends and future projections of population and economic growth indicators such as employment, personal income, and value added by manufacturing. It also compares the economic projections of the Pascagoula River Basin and its sub-regions with those for the Nation as a whole.

APPENDIX F, prepared by the U. S. DEPARTMENT OF AGRICULTURE, contains information and data on the agricultural economy in the basin, water and related land resource problems and needs, water and land resource development potential, opportunities for meeting some

of the basin's needs, and some aspects of the plan to help meet the basin's needs for 1980.

APPENDIXES G through L contain reports by the agencies of the U. S. DEPARTMENT OF THE INTERIOR as follows:

APPENDIX G, prepared by the FEDERAL WATER POLLUTION CONTROL ADMINISTRATION, presents studies of the water supply (municipal and industrial) and water quality control needs of the basin, flow requirements at all major centers of need to meet water quality requirements for all present and projected uses, and the monetary benefits for these services for all alternative development plans.

APPENDIX H, prepared by the BUREAU OF OUTDOOR RECREATION, contains studies of the recreation aspects of existing and potential water resource development within the Pascagoula River Basin. These studies include a comprehensive inventory of existing and potential recreation developments, present and projected recreational needs and facilities required to meet those needs, estimates of the amount and cost of recreational facilities required at the studied reservoirs and multiple-purpose upstream watershed structures to sustain the projected utilization, and estimates of benefits that could be expected to result from such utilization.

APPENDIX I, prepared by the BUREAU OF SPORT FISHERIES AND WILDLIFE in cooperation with the BUREAU OF COMMERCIAL FISHERIES and state fish and game agencies, contains an inventory of existing and potential fish and wildlife resources in the basin, expected losses of wildlife habitat at the studied reservoirs and upstream watershed structures, measures for mitigating these losses, recommended measures to gain maximum fish and wildlife benefits at proposed developments, and estimates of the monetary value of these benefits. An early-action plan proposed to satisfy the diversified fishing and hunting needs in the Pascagoula River Basin is also presented.

APPENDIX J is a report from the NATIONAL PARK SERVICE containing comments on the historical, archeological and natural science aspects which would be affected by potential and proposed developments in the basin.

APPENDIX K, prepared by the U. S. GEOLOGICAL SURVEY, contains a report on geology and groundwater resources of the Pascagoula River Basin.

APPENDIX L is a report from the BUREAU OF MINES which contains an inventory of the nature and extent of mineral resources and industry in the basin, both current and in the projected future. In addition, the Bureau of Mines made an estimate of the amount of

mineral products, present and future, that could be moved over a considered inland waterway system and reviewed the existing and potential development of mineral resources in areas of proposed major reservoir project sites. These studies are contained in the files of the Mobile District, Corps of Engineers.

APPENDIX M, prepared by the PUBLIC HEALTH SERVICE of the DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE, contains a report on the public health aspects of water and related land resource development in the basin. Health evaluation aspects included in the report are water supply, recreation, shellfishery, and vector control.

APPENDIX N contains information on the laws and programs of the STATES of MISSISSIPPI and ALABAMA pertaining to the development of water and related land resources in the Pascagoula River Basin and shows the role of each State in the comprehensive study. The STATE of MISSISSIPPI portion of the appendix was prepared by the PAT HARRISON WATERWAY DISTRICT and the ALABAMA portion by the ALABAMA DEPARTMENT OF CONSERVATION.

PUBLIC HEARINGS

To insure that full consideration was given to all views and area requirements during the course of this study, two public hearings were held, at which expression of the desires of local interests were solicited. The hearings were held in Hattiesburg, Mississippi, on May 8, 1962, and Laurel, Mississippi, on April 13, 1965.

At the conclusion of the study, a public hearing was held to explain the proposed early-action program for the development of the basin and to determine the attitude of local interests toward this program. This hearing was held in Hattiesburg on November 28, 1967.

Resumés of all the public hearings are contained in APPENDIX C. The transcripts of all official hearings, including written statements submitted for inclusion in the hearing records, are available for inspection at the office of the Mobile District, Corps of Engineers, Mobile, Alabama.

CHAPTER 2

DESCRIPTION OF BASIN

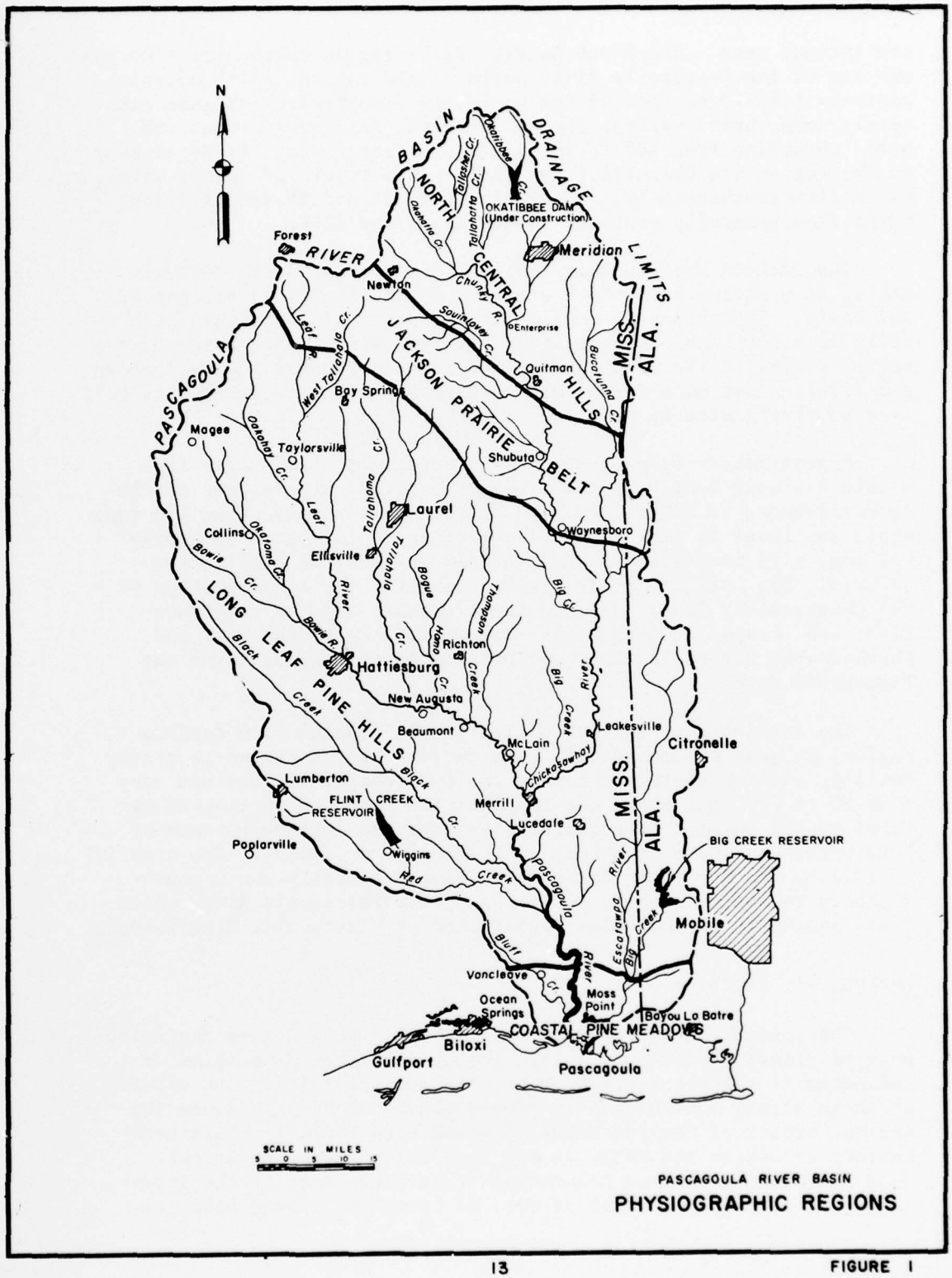
GENERAL

The Pascagoula River Basin, as shown on Plate 1 in the back of this volume, comprises most of southeastern Mississippi and a small part of southwestern Alabama. The Pascagoula River system drains an area of 9,700 square miles, of which the main headwater streams, the Leaf and Chickasawhay Rivers, drain 3,580 and 2,970 square miles, respectively. The basin is bounded on the north and west by the Pearl River watershed, on the east by the Mobile River watershed, and on the south by the Mississippi Sound, an arm of the Gulf of Mexico. There are numerous small lakes within the basin but only a few of any significant size. The largest of these, Big Creek Lake, located on Big Creek, a tributary of the Escatawpa River, is a 3,600 acre lake near the Mississippi-Alabama State line. This lake was constructed as a municipal water supply source for the City of Mobile and has approximately 59,500 acre-feet of storage. Bogue Homo Lake near Laurel, Mississippi, has a surface area of approximately 1,200 acres. The lake is under the management of the Mississippi Game and Fish Commission. The Flint Creek Reservoir, constructed in 1966 by the Pat Harrison Waterway District in the southern portion of the basin near Wiggins, Mississippi, has approximately 9,600 acre-feet of storage and a surface area of 600 acres. The authorized Okatibbee Reservoir, presently under construction by the Corps of Engineers about 7 miles northwest of Meridian, Mississippi, in the northernmost portion of the basin, will impound approximately 110,000 acre-feet of water and have a surface area of about 3,200 acres at normal summer pool.

TOPOGRAPHY AND PHYSIOGRAPHY

The Pascagoula River Basin is roughly oval in shape with a maximum length of 164 miles and a maximum width of 84 miles. It lies entirely within a physiographic province known as the Gulf Coastal Plain. This province is further divided into four physiographic regions as follows: North Central Hills, Jackson Prairie Belt, Long Leaf Pine Hills, and Coastal Pine Meadows. Elevations in the basin range from sea level in the Coastal Pine Meadows region to about 700 feet above mean sea level in the North Central Hills region. Topography is rugged in the northeast corner of the basin, but gently rolling to flat in the remainder of the area.

The physiographic regions, shown on Figure 1, cross the basin in a northwesterly direction approximately parallel with the shores of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NORTH CENTRAL DRAINAGE BASIN
OKATIBBEE DAM (Under Construction)
Okatibbee Cr.
Tallahaha Cr.
Okanatta Cr.
Forest
RIVER
Newton
Meridian
Chunky R.
Enterprise
Quitman
Bucatunna Cr.
MISS. ALA. LIMITS
Leaf R.
West Tallahala Cr.
Bay Springs
JACKSON PRAIRIE BELT
HILLS
PASCAGOULA
Magee
Oakohay Cr.
Taylorsville
Shubuta
Tallahoma Cr.
Laurel
Waynesboro
Collins
Oktoma Cr.
Ellisville
Bowie Cr.
Leaf River
Tallahala Creek
Bogue Homo Cr.
Thompson Creek
Big Cr.
Big Creek
River
LONG LEAF PINE HILLS
Bowie R.
Hattiesburg
Richton
New Augusta
Beaumont
McLain
Leakesville
Citronelle
Black Creek
Lumberton
FLINT CREEK RESERVOIR
Merrill
Chickasawhay
Lucedale
MISS. ALA.
Poplarville
Wiggins
Red Creek
Pascagoula River
BIG CREEK RESERVOIR
Escatawpa River
Big Creek
Mobile
Bluff Cr.
Vancleave
Ocean Springs
Moss Point
Bayou La Batre
COASTAL PINE MEADOWS
Biloxi
Gulfport
Pascagoula
SCALE IN MILES
5 0 5 10 15
PASCAGOULA RIVER BASIN
PHYSIOGRAPHIC REGIONS

FIGURE 1

the ancient seas. The North Central Hills region embraces the northern tip of the Pascagoula River Basin. This region, which occupies approximately 17 percent of the basin, is dissected by streams with fairly deep, broad valleys flanked by high, soft-rock ridges and hills extending from 400 to 700 feet above sea level. Major streams in the region are Okahatta Creek, Tallahatta Creek and Chunky River, which flow southeasterly, and Okatibbee Creek and Bucatunna Creek, which flow generally south to the Chickasawhay River.

The Jackson Prairie Belt region, south of the North Central Hills, is a narrow belt which occupies approximately 13 percent of the basin. Topography in this region consists of moderately high hills with numerous small prairies interspersed. The surface of the region slopes to the south and varies between 200 and 500 feet above sea level. Bucatunna Creek and Chickasawhay River traverse this belt in a southerly direction.

Approximately 67 percent of the Pascagoula River Basin lies within the Long Leaf Pine Hills region. This region slopes gently from altitudes of 200 to 400 feet in the north to less than 100 feet above sea level in the south. The surface of this area is gently rolling, with moderately rugged divides between the deep stream valleys. The Leaf River and its tributaries, the lower portion of the Chickasawhay River, Red and Black Creeks, and the Escatawpa River are located in this area. The confluence of the Leaf and Chickasawhay Rivers in the lower portion of the region forms the Pascagoula River.

The remainder of the basin lies in the Coastal Pine Meadows region, an area of low relief. The surface of the region is gently rolling, sloping southward toward the Gulf coast. Elevations vary from 50 to 100 feet above sea level in the northern portion to sea level on the coast. Groundwater lies near the surface in much of this region and wide expanses are in marshes or swamps. The area is drained by the Escatawpa River which flows generally south-southwesterly to the Pascagoula River and by the Pascagoula River which flows southerly to the Mississippi Sound at Pascagoula, Mississippi.

GEOLOGY AND SOILS

Characteristic of the Gulf Coastal Plain province is the existence of strata formed during late geologic ages by deposition of sediments in and along inland seas. Subsequent tilting and erosion of these strata and changes in ground elevation have produced the present aspect of physiography. Exposed rock formations are sedimentary in origin and range in age from early Eocene to Recent. Sand and clay in various proportions constitute most of the formations. A few units consist of marl or limestone. Sand beds are

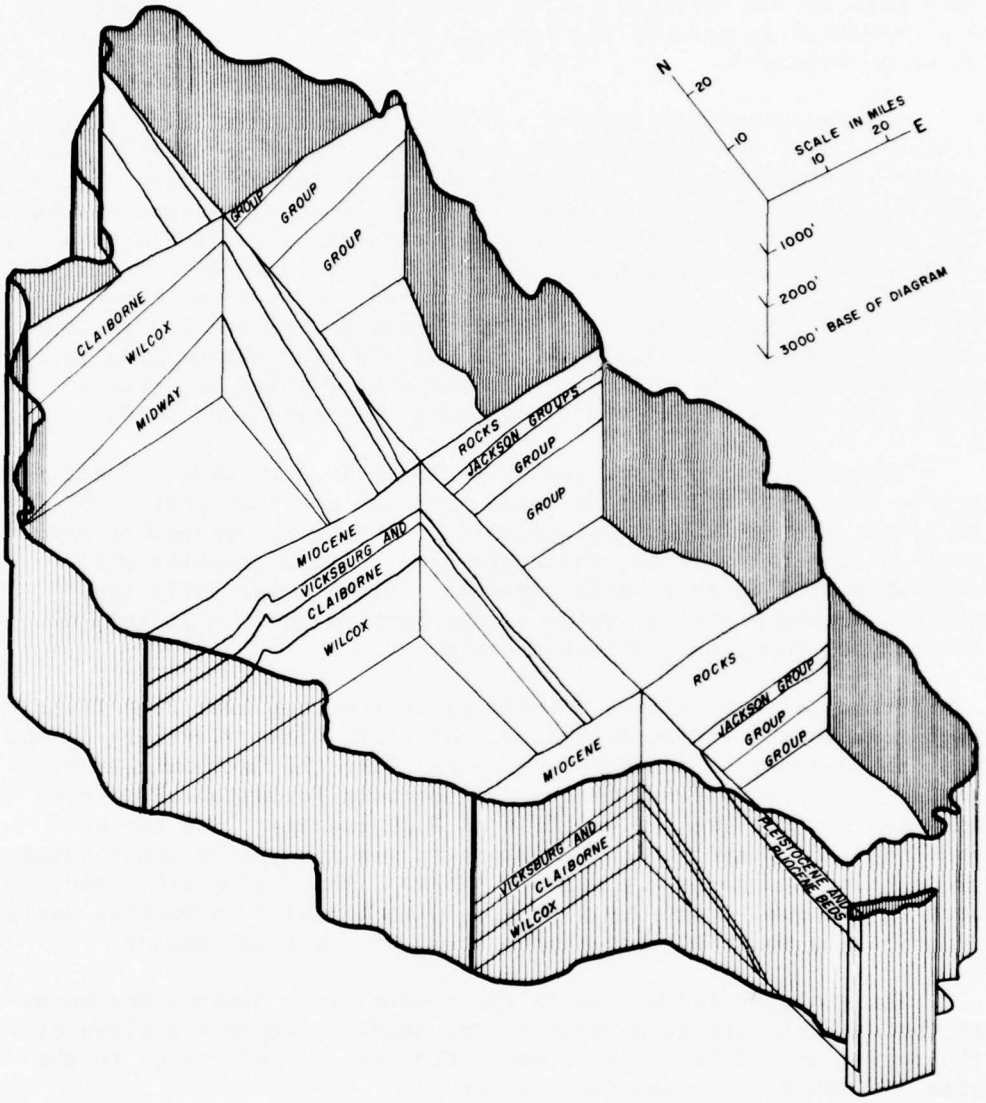
irregular in thickness and few can be traced with assurance more than a few miles. However, sandy zones, as differentiated from clayey zones, are readily correlated over substantial areas in the basin. The beds dip south-southwestward at 25 to 80 feet per mile. The steepest dip is across the extreme southern portion of the basin where the weight of deltaic sediments that accumulated during the late part of the Tertiary Period caused the greatest downwarping. A perspective diagram of the geologic structure of the basin is shown on Figure 2.

The physiographic regions within the Pascagoula River Basin differ in geologic characteristics and soil types as well as physiographic characteristics. Soils in the North Central Hills region have been derived from the weathering of Eocene Age formations in the Claiborne and Wilcox Groups which consist of sands, sandstones, clays, claystones and gravel. The soils vary in texture from fine sands to clays, and range in color through red, yellow, brown, gray and black. Typical upland soils are grayish with red and yellow subsoils and include Ruston, Orangeburg and Susquehanna fine sandy loams and clays. Ocklocknee, Bibb and Myatt, which are gray to brown fine sandy loams, are found among the bottomland soils.

The principal exposed geologic strata in the Jackson Prairie region belong to the Jackson Group (Eocene Age) and consist chiefly of clays. The principal upland soils are Ruston, Orangeburg and Norfolk fine sandy loams, which are gray friable topsoils with reddish or yellowish friable subsoils. Black Gumbo soils are typical of the prairies, while stream bottoms consist largely of Ocklocknee, Thompson and Meadow soils.

Principal outcropping formations in the Long Leaf Pine Hills region include: Forest Hill Sand, Red Bluff Clay, Vicksburg Group, and Chickasawhay Limestone of Oligocene Age; the Catahoula Sandstone, Hattiesburg Formation, and Pascagoula Formation of Miocene Age; and the Citronelle Formation of Pliocene Age. The typical soils of the uplands in this region are red and yellow sandy loams, and the lowland soils are alluvial loams. The Ruston fine sandy loam is the most common upland type, with alluvial bottomland soils comprising a somewhat larger proportion of the total region.

The geologic formations in the Coastal Pine Meadows are known as the coastal terrace deposits. The sands, gravels and clays of the region are of Pleistocene and Recent Ages. Soil types in the area are the Norfolk and the Plummer.



PERSPECTIVE DIAGRAM OF GEOLOGIC STRUCTURE OF THE PASCAGOULA RIVER BASIN

FIGURE 2

STREAM CHARACTERISTICS

The Pascagoula River is formed by the confluence of the Leaf and Chickasawhay Rivers near Merrill in George County, Mississippi. It flows south 81 miles from this confluence to enter Mississippi Sound. About 37 miles above its mouth, the river is joined by Red and Black Creeks to form what is known as Dead Lake. The river enters the lower coastal plain at this juncture and is generally deep and sluggish. The width of the channel from the mouth to Dead Lake varies from 300 to 800 feet. Banks in this reach are low, varying rather uniformly from submergence level at the mouth to a height near Dead Lake of about 15 feet above low water. Upstream from Dead Lake to the confluence of the headwaters, the banks vary in height between 10 and 25 feet and the width of the stream varies from 400 to 800 feet. The river has an average fall of 0.4-foot per mile at low water. Bankful capacity of the stream is about 51,000 c.f.s. at the Merrill gage. Tidal effects during low water are felt upstream from the mouth for a distance of about 42 miles. Other large tributaries to the Pascagoula River, in addition to the headwater streams, are the Escatawpa River, with a drainage area of 1,060 square miles, and Red and Black Creeks, with a combined drainage area of 1,242 square miles. Profiles of the principal streams in the basin are shown on Figure 3.

The Leaf River rises a few miles south of the town of Forest in Scott County and flows generally southerly about 90 miles to its confluence with Bowie River at Hattiesburg. It then flows southeasterly about 70 miles to its mouth near Merrill and joins the Chickasawhay River. The channel, which ranges in width from 150 feet near Taylorsville in the upper reach of the stream to 500 feet at the mouth, has banks that vary from 20 to 30 feet above low water. The bankful capacity at the Hattiesburg gage is about 25,000 c.f.s. The principal streams tributary to the Leaf River are Bowie River and Oakohay, Tallahala, Bogue Homo, and Thompson Creeks.

The Chickasawhay River, which is formed by the confluence of Chunky River and Okatibbee Creek in Clarke County, flows southerly for 164 miles to join the Leaf River near Merrill. The stream has an average low water slope of about 1.1 feet per mile and varies in width from 100 to 500 feet. Between Enterprise and Quitman, the banks are rather low, varying in height from 15 to 30 feet above low water. However, between Quitman and Waynesboro, which is a more hilly and deeply eroded region, the river has banks 20 to 50 feet high. South of Waynesboro, the river cuts through low hills to form fairly uniform banks 10 to 25 feet in height. The bankful capacity of the stream at the Leakesville gage is approximately 18,600 c.f.s. Principal tributaries of the stream, in addition to the headwaters, are Bucatunna Creek near Waynesboro and Big Creek near Leakesville.

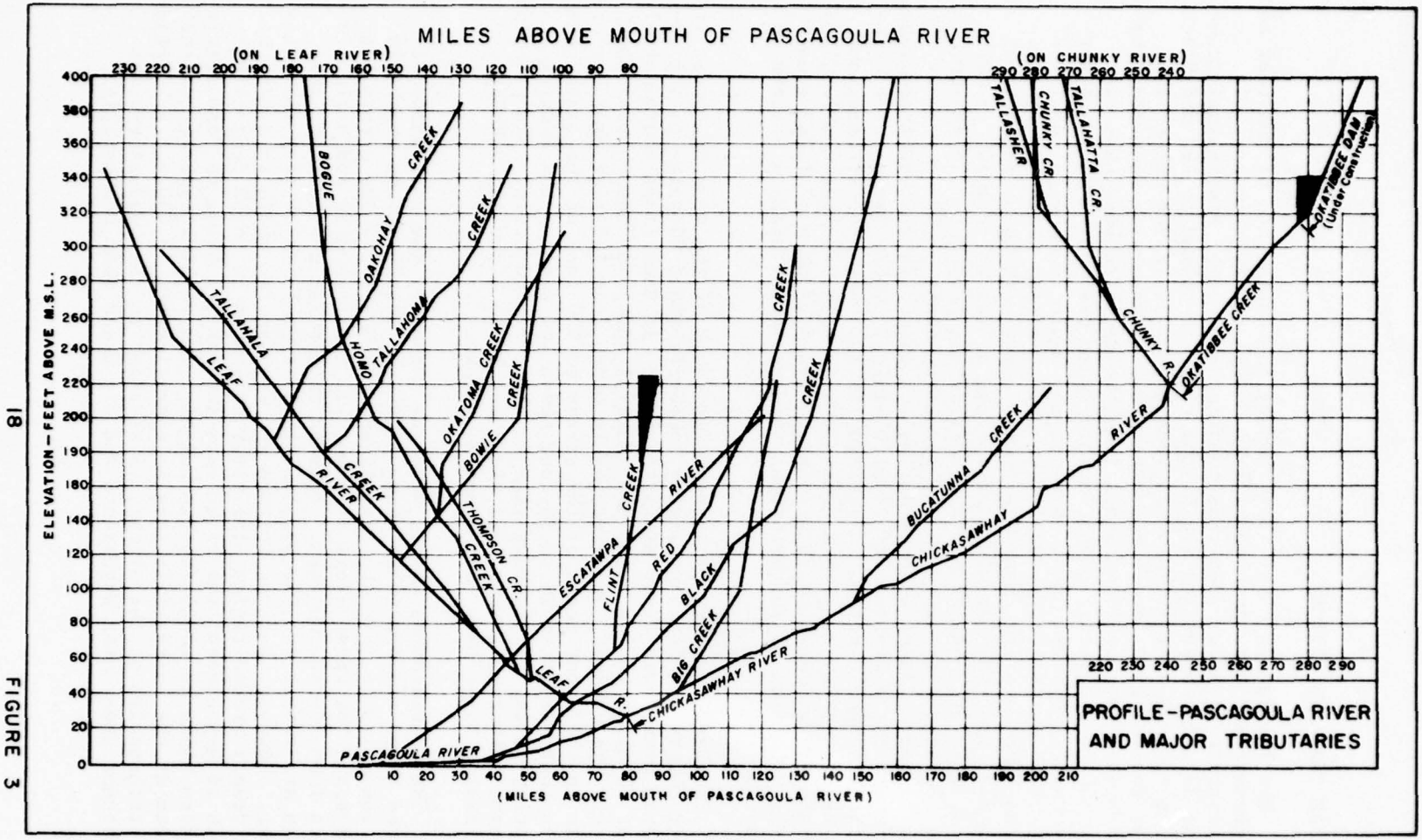

MILES ABOVE MOUTH OF PASCAGOULA RIVER
(ON LEAF RIVER)
(ON CHUNKY RIVER)
ELEVATION – FEET ABOVE M.S.L.
(MILES ABOVE MOUTH OF PASCAGOULA RIVER)
BOGUE
OAKOHAY CREEK
HOMO
TALLAHOMA CREEK
TALLAHALA
LEAF
RIVER
CREEK
OKATOMA CREEK
BOWIE CREEK
THOMPSON CR.
ESCATAWPA
FLINT CREEK
RED
BLACK
CREEK
BIG CREEK
LEAF R.
CHICKASAWHAY RIVER
PASCAGOULA RIVER
TALLASHER
CHUNKY CR.
TALLAHATTA CR.
CHUNKY R.
OKATIBBEE DAM
(Under Construction)
OKATIBBEE CREEK
BUCATUNNA CREEK
CHICKASAWHAY RIVER
PROFILE – PASCAGOULA RIVER
AND MAJOR TRIBUTARIES

FIGURE 3

Drainage characteristics of the Pascagoula River tributaries are representative of streams indigenous to the Southern region. They vary in character from those with relatively steep gradients and narrow valleys in the North Central Hills region to the more moderate streams of the lower Long Leaf Pine Hills and Coastal Plain regions. The main stem of the Pascagoula River located in the Coastal Plain region is relatively flat and is affected to some extent by tides. Table 1 lists drainage characteristics of the principal streams within the Pascagoula River Basin.

Table 1

Drainage characteristics of principal streams in the Pascagoula River Basin

Stream	Drainage area (sq.mi.)	Length (miles)	Average fall (ft./mi.)	Distance above mouth of river (miles)
PASCAGOULA RIVER TRIBUTARIES				
PASCAGOULA RIVER				
Escatawpa River	1,060	114	1.75	6.0
Red Creek	478	93	3.20	37.0
Black Creek	764	122	3.23	37.0
Leaf River	3,580	160	2.10	81.0
Chickasawhay River	2,970	164	1.20	81.0
HEADWATER TRIBUTARIES				
LEAF RIVER				
Thompson Creek	236	45	6.22	28.8
Bogue Homo Creek	422	63	5.49	31.7
Tallahala Creek	649	105	2.28	44.5
*Bowie River	665	47	4.94	67.0
Oakohay Creek	250	57	3.44	104.7
CHICKASAWHAY RIVER				
Bucatunna Creek	591	59	2.14	66.3
Chunky Creek	544	41	4.39	159.5
Okatibbee Creek	371	56	3.21	159.5

* Length includes 14.0 miles on Bowie River and 33 miles on Bowie Creek.

Flow characteristics of the basin streams are definitely related to sub-basin location and topography. The flow in the small upstream tributaries ranges from very low to large flood flows of short duration. Due to the broken nature of the upland terrain, runoff in these areas is translated rapidly downstream. The rapid runoff from the numerous small streams of relatively steep gradient which feed the Leaf and Chickasawhay Rivers and their principal tributaries, causes sudden rising stages in the upper reaches. However, flows are more sustained in the lower reaches of the streams and in the Pascagoula River due to the flatter gradients, the additional drainage area involved, and the timing of the tributary peak flows.

The sediment discharge of streams in the Pascagoula River Basin varies widely and depends chiefly upon land use. Generally, as a result of changes in the agricultural economy over the past 20 years, a relatively low amount of sediment enters the stream system. Under present conditions, the estimated average annual sediment discharge of the Pascagoula River at the Merrill gage is about 3.6 million tons (equivalent to 2,759 acre-feet or 0.4180 acre-feet per square mile). The sediment concentration in the river is related more to the manner in which the river stage is changing than to the volume of water being discharged. Rising stages are accompanied by a larger sediment concentration than are the falling stages. The average annual sediment discharge of Pascagoula River Basin streams studied by the Department of Agriculture ranges from 150 to 940 tons (or 0.12 to 0.72 acre-feet) per square mile of drainage area. Probable annual sedimentation rates for the major reservoir projects investigated range from 0.14 to 0.53 acre-feet per square mile of drainage area. The sedimentation report prepared by the Soil Conservation Service of the Department of Agriculture is contained in Appendix D.

Surface water in the Pascagoula River Basin is generally of suitable chemical quality for use in irrigation, and for most industrial applications. Additional water quality characteristics should be determined on streams where reservoirs which will include water supply storage are proposed. Under natural conditions, surface waters in the area above the zones of saltwater intrusion are low in dissolved solids, and the chemical constituents remain fairly constant at all rates of streamflow. As a result of drainage from swampy areas, waters in most of the extreme southerly tributary streams have high color and, in some instances, a low pH-value. In order for most of these waters to meet the general requirements for industrial-process water, treatment would be necessary to remove color and suspended materials and to adjust the pH-value. Seepage from the abundant groundwater resources which underlie the basin sustains the base flows of the Leaf, Chickasawhay, Pascagoula and

Escatawpa Rivers and their tributaries. A report on the groundwater resources of the Pascagoula River Basin by the U. S. Geological Survey is presented in Appendix K.

NATURAL RESOURCES

In addition to water and soils, the natural resources of the basin include forests, which cover more than one-half of its entire area, wildlife for recreational hunting and enjoyment, commercial and sport fisheries, and mineral resources. Minerals found in the area include petroleum and oil reserves, salt deposits, sandstone and limestone deposits, bauxite, bentonite, sand, gravel and clays. Recent explorations have revealed that large quantities of sulphur may exist in the vicinity of Merrill.

TEMPERATURE

The Pascagoula River Basin has a temperate, humid climate with short, usually mild winters and long, warm summers typical of the Gulf Coast region. The normal annual temperature for the basin is 66 degrees Fahrenheit, varying from 64 degrees in the upper portions to 68 degrees near the coast. The mean temperature for the basin during January, the coldest month, is 51 degrees and during July, the warmest month, 82 degrees. The average frost-free season ranges from 227 days in the northern portion of the basin to 270 days in the coastal section. Severe cold spells are infrequent and freezing temperatures, although they occur often, are of short duration. Extreme temperatures recorded in the basin are a high of 109 degrees and a low of -5 degrees.

PRECIPITATION

Rainfall in the Pascagoula River Basin in general is abundant and well distributed throughout the year. There is some seasonal variation, with the heaviest rains usually occurring in the winter and spring and the lightest during the fall. The average annual precipitation over the basin is about 58 inches, of which 26 percent occurs in the winter, 29 percent in the spring, 27 percent in the summer, and 18 percent in the fall. Normally, the period of greatest monthly precipitation occurs in July and the least in October.

Light snowfall in the basin is not unusual. However, it forms only a small part of the annual precipitation.

Prolonged droughts seldom occur in the basin, excessive rather than insufficient rainfall being more common. The year 1954, with

an average rainfall of 38.10 inches, was the most extreme of record in terms of basin-wide rainfall deficiency. The outstanding wet year was 1961 when the annual basin rainfall was 84.57 inches.

The daily amounts of precipitation observed at climatic stations are published monthly in the Climatological Bulletins of the Weather Bureau. At the present time, 49 of the stations in or immediately adjacent to the basin are equipped to record precipitation amounts continuously. Records for these and 15 discontinued stations are available for periods of 1 to 77 years. Data on these stations are given in Appendix D.

STORM CHARACTERISTICS

Storms which occur in the Pascagoula River Basin include local thunderstorms, or cloudbursts, and general disturbances of the hurricane and frontal types. Summer storms are generally of the thunderstorm type with high intensities over small areas. Flood-producing storms in the winter and spring are usually of the frontal type, covering large areas and lasting from two to four days. Past records indicate that winter storms are likely to be more intense in the northern part of the basin and the summer storms more intense in the southern portion. In addition, the southern portion of the basin usually bears the brunt of the occasional tropical and equinoctial storms which sweep in from the Gulf of Mexico; for example, the major hurricane storm of July 1916.

An important characteristic of the extreme flood-producing storms is that each culminated in a period of very intense rainfall extending over an interval of 24 hours or less. This high-intensity rainfall was usually preceded by a period of less intense precipitation which saturated the ground. Due to the rapid rate of runoff in the basin, the severity of a flood is frequently determined by the high-intensity rainfall in the 24-hour period. Maximum 24-hour rainfalls recorded at various stations in the basin, based on published records of the Weather Bureau, range from 5 to 10 inches.

Thunderstorms and cloudbursts usually occur in the summer months as a consequence of the rapid rise of warm, moist air. Most of the water is precipitated in a period of five or six hours over a small area. The precipitation intensity can be high, however, and these storms are critical for small watersheds in the basin.

RUNOFF AND STREAMFLOW

The average annual runoff in the basin is 19.6 inches at Merrill, near the confluence of the Leaf and Chickasawhay Rivers; 20.0 inches at Hattiesburg along the Leaf River; 17.1 inches near Meridian in the headwaters of the Chickasawhay River; and 26.3 inches on the Escatawpa River near Wilmer. Records from the gage at Merrill show that the average annual runoff in that portion of the basin is about 31 percent of the average annual precipitation.

The runoff varies greatly during the year, being high during winter and early spring and low in late summer and early fall. About 59 percent of the annual runoff of the basin occurs during the four-month period from January through April. Minimum runoff occurs during the three-month period from August through October and averages only about 10 percent of the annual runoff.

Average rates of streamflow range from about 1.1 to almost 2.9 cubic feet per second per square mile, with the maximum values occurring along the tributary streams near the coast. The average rate of flow along the Pascagoula River is about 1.4 cubic feet per second per square mile, and for the headwater streams, the Leaf and Chickasawhay Rivers, 1.5 and 1.4 cubic feet per second per square mile, respectively.

Runoff data for this report were obtained primarily from records of gage height and discharge collected by the U. S. Geological Survey and supplemented with those obtained by the Weather Bureau and the Corps of Engineers. There are presently 65 stream gage sites in service throughout the Pascagoula River Basin. In addition to these, data from staff gages and discontinued recording gages were used where pertinent. The gages and their locations are discussed in Appendix D.

FLOOD CHARACTERISTICS

Flood-producing storms may occur in the basin at any season but are more prevalent in the winter and spring when runoff conditions are more favorable. Storms at that time are usually of the frontal-type which last from two to four days and produce general flooding, often aggravated by favorable antecedent conditions. Local flooding occurs in the summer due to storms of the thunderstorm variety, with high intensities over small areas. However, general floods in the summer and early fall may occur as a result of severe hurricane-type storms. Under normal runoff conditions, an intense and general rainfall of 5 to 6 inches over the basin will result in widespread flooding while 3 to 4 inches are sufficient to produce local flooding on most of the small tributaries.

The flood of February 1961, with a peak discharge at Merrill of 178,000 cubic feet per second (c.f.s.) was the greatest of record along the Pascagoula River. The major flood of record along the Leaf River at Hattiesburg and the Chickasawhay River at Enterprise also occurred in February 1961. The peak discharge of these floods at the above locations was 72,200 and 61,700 c.f.s., respectively. Other major floods on various streams in the basin occurred in April 1900, July 1916, December 1919 and April 1938. The maximum floods at various locations in the basin are listed in Table 5 of Appendix D.

The peak rates of flow during the maximum floods of record on the Pascagoula River and the headwater streams vary from about 27 c.f.s. per square mile at Merrill in the lower portion of the basin to 41 c.f.s. per square mile along the Leaf River at Hattiesburg and 68 c.f.s. per square mile along the Chickasawhay River at Enterprise. Peak recorded rates of flow on smaller drainage areas vary from about 84 to over 300 c.f.s. per square mile.

DEPENDABLE FLOW

The dependable flow is that amount of streamflow which can reasonably be counted on to be available in drought periods. The flows during the droughts of 1954 and 1963 were the lowest of record at most of the gaging stations in the basin. Other significant periods of widespread low flow conditions occurred in 1904, 1914, 1924 and 1936. The minimum recorded rate of flow since 1930 at the Merrill gage on the Pascagoula River was 696 c.f.s., or 0.11 c.f.s. per square mile on November 3, 1936. A steady flow of 707 c.f.s. was recorded during the six-day period October 21-26, 1963. These flows are approximately 7 percent of the average discharge of the Pascagoula River system at this point. During the 1963 drought, minimum flow rates in the basin varied from 0.02 to 0.65 c.f.s. per square mile. Minimum flow data for active gaging stations in the basin are shown in Table 5 of Appendix D.

LOW FLOW FREQUENCY

Low flow volume data are essential for many water utilization design problems because they determine the dependable flow available without stream regulation. In order to apply these data to practical problems of design at specific locations, further information is required concerning the frequency of various low flow volumes. This was developed in the form of frequency-flow curves for the various durations applicable to the problem.

Low flow volume-duration-frequency estimates were made for selected stream gaging stations in the Pascagoula River Basin based on

data from the Water Supply Papers of the U. S. Geological Survey. Base curves prepared by the U. S. Geological Survey were used to correlate short-record values and provide the means for estimating low flow frequencies for locations where data were not available.

The low flow-frequency analysis is based on the minimum flows of a stream for various durations. These durations are usually established in multiples of days, such as 7 days, 15 days, or 30 days. Table 2 includes a tabulation of 7-day flows with a 10-year recurrence interval for a number of selected stations. A tabulation of low flow frequency data for periods of 7, 15, 30, 60, 120, and 183 days and recurrence intervals of 1.03, 1.2, 2.5, 10, 20, and 30 years is given in Table 9 of Appendix D. Low flow data for the Pascagoula River at Merrill are shown as a family of curves on Figure 4. As shown on the figure, the lowest 7-day flow in a year probably will be less than 774 c.f.s. at average intervals of 20 years.

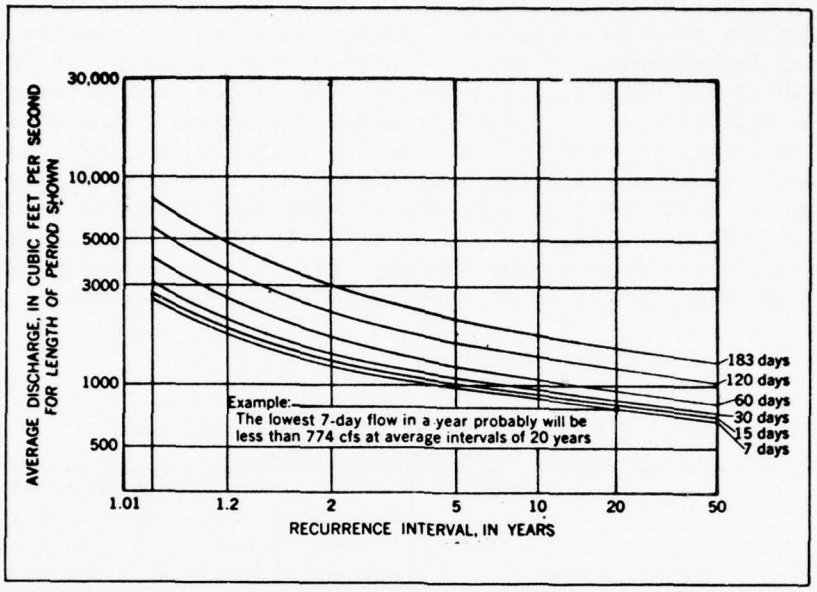
Table 2

Minimum flow data for selected gaging stations
(Adjusted to base period, 1929-57)

Station No.	Station name	Drainage area (sq.mi.)	Minimum of record (c.f.s.)	Minimum avg.7-day flow—10-yr.recurrence interval (c.f.s.)
4720	Leaf River near Collins	752	55	63
4725	Bowie Creek near Hattiesburg	304	83	91
4730	Leaf River at Hattiesburg	1,760	318	340
4735	Tallahala Creek at Laurel	233	1.8	2.8
4745	Tallahala Creek near Runnelstown	612	29	38
4750	Leaf River near McLain	3,510	478	550
4775	Chickasawhay River near Waynesboro	1,660	94	102
4780	Bucatunna Creek at Denham	468	6.2	11
4785	Chickasawhay River at Leakesville	2,680	160	212
4790	Pascagoula River at Merrill	6,600	696	861
4795	Escatawpa River near Wilmer, Ala.	506	37	50

Figure 4

Magnitude and frequency of annual low flows
for the Pascagoula River at Merrill
(Based on data adjusted to period 1929-1957)



FLOOD FREQUENCY

The analysis of flood problem areas was based upon the frequency at which floods of various magnitudes may be expected to occur. The determination of flood frequency depends on stream gaging records. Since these records are relatively short, general accumulated knowledge as well as statistical procedures must be employed in frequency studies. Therefore, historical flood data were used to adjust statistics at the longest-term gaging station at Merrill. Frequency statistics of other stations were then adjusted to the Merrill station. Also, a regional flood frequency analysis was made to provide a means for estimating frequencies for locations where data were not available. Table 3 gives the estimated frequency of occurrence of various flows at selected stations in the basin. Details of the analysis are discussed in Appendix D.

Table 3

Discharge frequency for selected stations in the Pascagoula River Basin

Station	Drainage area (sq.mi.)	Discharge in c.f.s.						
Frequency,	in years:	1	2	5	10	25	50	100
Leaf River at Hattiesburg	1,760	21,400	31,200	46,500	60,000	79,500	95,500	112,000
Chickasawhay R. at Enterprise	913	14,200	21,400	32,300	42,100	56,500	69,000	84,000
Pascagoula R. at Merrill	6,600	53,700	74,800	106,500	133,000	171,000	204,000	240,000

GROUNDWATER

The greatest portion of groundwater is derived from precipitation and reaches the water table through infiltration and percolation. In general, groundwater is relatively free from man-made pollution and more uniform in quality and temperature than surface water. The abundant groundwater resources which underlie the Pascagoula River Basin are generally of good to excellent quality; however, some chemical constituents in some aquifers exceed Public Health Service 1962 Drinking Water Standards. Most of the groundwater contains sodium bicarbonate, is usually soft, and has a low to moderate dissolved-solids content. Excessive iron is a problem in places, particularly where water supplies are obtained from shallow aquifers. Salt-water encroachment is a potential problem in the coastal area, but little increase in salinity has been observed in monitored wells in the period 1960-65. Development of the total groundwater resources has not occurred to a great extent due to the excessive depth of many aquifers and the availability, at shallow depths, of supplies adequate for present needs. A large part of any substantial increase in groundwater withdrawal will need to come from wells deeper than those commonly drilled in the region. The U. S. Geological Survey report on groundwater resources is presented in Appendix K. The following paragraphs summarize the groundwater conditions.

Aquifers in the Claiborne Group furnish practically all existing groundwater supplies in the northern third of the basin. Although the underlying Wilcox Group occupies about 1,000 feet of the freshwater section in that area, it is virtually untapped for water supplies.

Beds of Miocene Age constitute sources of groundwater supplies throughout the southern two-thirds of the basin and are the only significant sources in about half of the basin. Pliocene aquifers furnish most supplies in the Jackson County area at the basin's southern extremity.

Total groundwater pumpage in the Pascagoula River Basin was estimated to be 60 million gallons per day in 1965. The centers of heaviest withdrawal are Meridian (5 million gallons per day), Laurel (9 million gallons per day), Hattiesburg (9 million gallons per day) and Pascagoula (11 million gallons per day). Practically all domestic and municipal water supplies and most industrial supplies are obtained from the groundwater reservoir.

Few wells in the basin yield more than 500 gallons per minute. However, yields of 2,000 gallons per minute or more could be reasonably expected from efficiently constructed wells almost anywhere in the basin. Yields of 5,000 gallons per minute are not unreasonable to expect in some places.

CHAPTER 3

ECONOMIC DEVELOPMENT

GENERAL

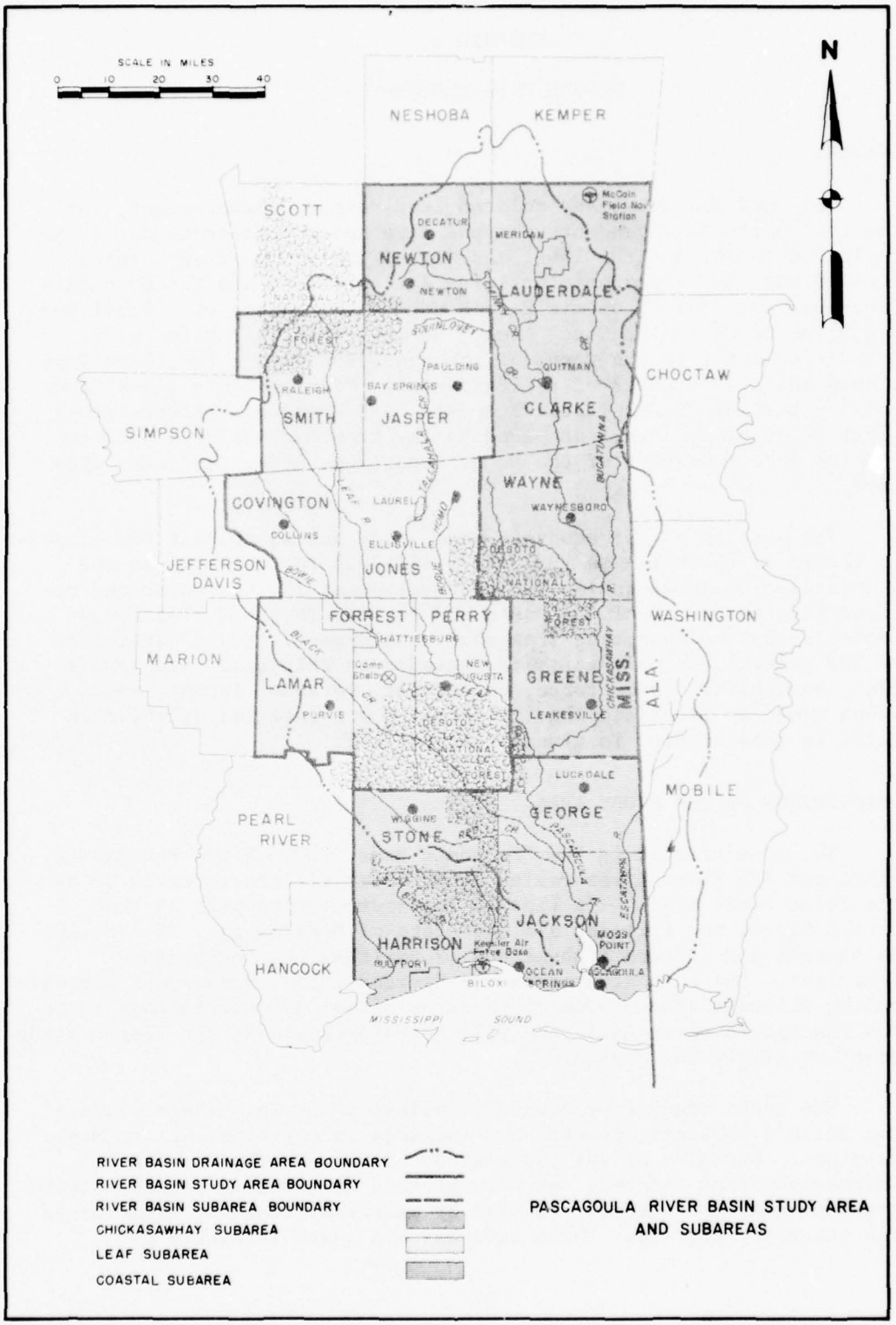
The need for water and related land resource development, for the most part, is dependent upon the size and characteristics of the basin population and the level and mix of the economic activities. The indications of economic activity for the basin are based on data developed in: (a) "Economic Base Study of the Pascagoula, Pearl and Big Black River Basins Study Area," December 1964, prepared under private contract to the Corps of Engineers for use in the three Type 2 comprehensive studies of the Pascagoula, Pearl and Big Black River Basins, and (b) "Agricultural Economic Base Study of the Pascagoula River Basin Study Area," prepared by the Economic Research Service and the Forest Service of the U. S. Department of Agriculture, June 1965.

The purpose of the economic base study was to project the economic growth of the basin to 1965, 1980 and 2015 for guidance in the preparation of an adequate plan of development for the water and related land resources of the basin and for use in the evaluation of benefits that would accrue from such development. Major parameters of the general economic activity included in this study are population, households, labor force, employment, personal income, and value added by manufacturing. A detailed presentation of the data cited in this chapter is given in Appendix E.

DESCRIPTION OF THE STUDY AREA

The area treated in the "Economic Base Study of the Pascagoula, Pearl and Big Black River Basins Study Area" will be referred to as the "base study area." It lies in the southeastern part of the United States and includes all the State of Mississippi, 19 counties in central and western Alabama and 12 parishes in southeastern Louisiana. The base study area was divided into 7 components approximating drainage areas. One of these principal components applies to the Pascagoula River Basin and will be referred to as the "basin study area" or simply the "basin."

The basin study area boundary follows the county lines nearest the basin's physical boundary and includes 16 counties, all in Mississippi. Division of the basin study area into subareas (Leaf, Chickasawhay and Coastal) was accomplished by grouping together those counties that are strongly related by watershed factors, water needs and economic activity. These subareas are shown in Figure 5.



PASCAGOULA RIVER BASIN STUDY AREA AND SUBAREAS

FIGURE 5

POPULATION

One of the primary measures of an area's economy is the number of persons living therein. People reflect the opportunities and problems of the area in which they live and constitute the market for consumer goods and services. They provide the labor force that responds to industrial, commercial and agricultural employment demand, and represent social requirements, such as schools, hospitals, transportation facilities, recreational facilities and other social services. They are also one of the principal factors that determine the needs for water resource development. Effective river basin planning is based upon a full understanding of these needs and is dedicated to satisfying them through the implementation of timely water resource development.

In 1930, the population of the Pascagoula River Basin study area was 339,300. By 1960, it had increased to 500,400, or about 47 percent. This compares favorably with the 46 percent increase achieved by the Nation and far exceeds the growth rate of 31 percent by the base study area for the same period of time. By 2015, the population of the basin is projected to reach 1,290,200, or 2.6 times the 1960 level. This is equal to the national projected rate and exceeds the 2.2 times projected for the base study area, as shown in Table 4.

Urban population more than doubled between 1930 and 1960, increasing from 103,300 to 254,400. Rural non-farm population showed almost as great a rate of growth as urban population, increasing from 78,200 in 1930 to 187,600 in 1960; however, rural farm population decreased from 157,800 to 58,400, resulting in a net increase of only 10,000 in total rural population between 1930 and 1960. By 2015, urban population is expected to more than triple the 1960 level, while rural non-farm almost doubles and rural farm continues to decrease to less than one-half the 1960 level, as shown in Table 5.

TOTAL EMPLOYMENT

The number of potential employees of the basin at a particular time is limited roughly by the size of the labor force which is derived from the population. In turn, the productivity of labor through employment is an indication of the income flow that the basin's economy can generate. In interpreting the economic growth of the basin, consideration was given to the up-grading of the productive capacities of the labor force through development of skills and the transfer into higher value-added industries of large segments of the labor force, freed by declining agricultural employment. The expansion of employment opportunities in urban areas has tended

Table 4

Total population - United States, base study area and Pascagoula River Basin study area, 1930-1960 and projected to 2015
(Thousands)

Area	Historical				Projected		
	1930	1940	1950	1960	1965	1980	2015
United States	122,775.0	131,669.3	150,497.4	179,325.7	197,000.0	254,000.0	461,000.0
Base study area	3,833.7	4,186.2	4,603.2	5,034.2	5,315.5	6,553.6	11,004.4
Basin study area	339.3	377.2	439.5	500.4	536.7	674.1	1,290.2

Table 5

Urban, rural farm and rural non-farm population - Base study area and Pascagoula River Basin study area 1930-1960 and projected to 2015
(Thousands)

Area	Historical				Projected		
	1930	1940	1950	1960	1965	1980	2015
BASE STUDY AREA							
Urban	1,333.9	1,516.8	2,245.9	2,967.4	3,340.2	4,610.8	8,805.4
Rural farm	1,824.6	1,888.7	1,467.3	679.2	549.3	360.0	289.6
Rural non-farm	675.2	781.4	890.0	1,387.6	1,426.0	1,582.8	1,909.4
BASIN STUDY AREA							
Urban	103.3	124.7	193.6	254.4	292.5	421.5	935.1
Rural farm	157.8	169.5	139.0	58.4	47.8	30.6	23.0
Rural non-farm	78.2	83.0	106.9	187.6	196.4	222.0	332.1

to offset losses in agricultural employment and agriculturally related industries. This trend has caused considerable depopulation in rural counties dependent on agriculture as their employment base.

Total employment in the basin rose 27 percent from 1930 to 1960, increasing from 117,100 to 149,100, as shown in Table 6. This is well below the 50 percent increase achieved by the Nation but exceeds the base study area rate of only 9 percent for the 30-year period. Total employment is projected to increase 2.7 times between 1960 and 2015, reaching 405,800. This compares with an increase of 2.6 times for the Nation and 2.3 for the base study area.

TOTAL PERSONAL INCOME

While the assertion is apt to be made that population is the starting point of any economic analysis, it is income to which people gear their efforts and for which they expend their energy. Where there are income-producing opportunities, there will also be people. Personal income is a measure of economic welfare, particularly as a gauge of economic development.

Personal income is derived from wages and salaries earned by the employed labor force, from income-producing property and proprietorships, transfer payments, and from other personal business investments. Growth in personal income is related directly to rising rates of productivity and growth in production. Therefore, inherent in an analysis of personal income and its major components is a consideration of the factors affecting productivity.

Total personal income of the basin more than quadrupled during the historical period, from $151.7 million in 1930 to $680.6 million in 1960, and is projected to continue to increase, reaching $5,372.4 million in 2015, or almost eight times the 1960 level, as shown in Table 7. The rate of growth achieved by the basin between 1930 and 1960 is well above the national increase of 2.9 times or the base study area increase of 3.8 times. Between 1960 and 2015, total personal income in the basin is projected to increase only slightly faster than in the Nation, 7.9 times for the basin compared to 7.4 times for the Nation. This increase reflects both population growth and rising per capita income. In 1930, basin per capita income was only $447; by 1960, this had increased to $1,360 and is projected to be $4,164 by 2015. Wages and salaries accounted for a majority of the total personal income of the basin in the past and are expected to account for an even larger share in the future. In 1960, wages and salaries accounted for 65 percent, compared to 64 percent in 1930. By 2015, they are projected to comprise 66 percent of total personal income of the area. Although the amount of income attributed to

Table 6

Total employment - United States, base study area
and Pascagoula River Basin study area
1930-1960 and projected to 2015
(Thousands)

Area	Historical				Projected		
	1930	1940	1950	1960	1965	1980	2015
United States	45,895.6	48,060.0	61,400.0	69,200.0	75,500.0	100,000.0	181,000.0
Base study area	1,506.3	1,383.3	1,596.9	1,637.0	1,736.0	2,178.2	3,759.5
Basin study area	117.1	111.6	140.8	149.1	160.6	203.3	405.8

Table 7

Total personal income - United States, base study area
and Pascagoula River Basin study area
1930-1960 and projected to 2015

Area	Historical				Projected		
	1930	1940	1950	1960	1965	1980	2015
United States[1]	139.1	169.6	283.6	407.3	492.0	872.0	3,002.0
Base study area[2]	2,126.4	2,934.8	5,788.7	8,113.7	9,657.7	15,701.4	46,603.7
Basin study area[2]	151.7	214.3	441.9	680.6	848.8	1,512.6	5,372.4

[1]In billions of 1962 dollars.

[2]In millions of 1962 dollars.

proprietors has increased in the past, the relative share of total personal income has decreased from 22 percent in 1930 to 16 percent in 1960 and is projected to account for only 12 percent by 2015. With the advent of various retirement pension and welfare programs, including social security, the share of total personal income derived from transfer payments increased from 2.5 percent in 1930 to 10.4 percent in 1960. This trend is expected to continue in the future although at a greatly reduced rate, reaching 12.3 percent by 2015.

LAND USE

The total land resource base was differentiated according to (1) land in farms and (2) land other than in farms. Of the 6,323,300 acres within the basin study area, 2,552,482 acres were classified as "land in farms" and 3,770,818 acres as "land other than in farms" in 1959.

A primary factor affecting future agricultural production is the availability and quality of land. The demand for land for nonagricultural purposes has caused a shift in use. Land is being withdrawn from agricultural use for urban, industrial and other uses related to an increased population. Highway development, airport construction and recreational demands on the land base are notable examples. Reservoirs and other types of water resource developments also require significant quantities of land.

The demand for nonagricultural land is not as great in the basin as the demand that exists in some other areas of the United States. Although the agricultural resource base of the basin is not expected to undergo a reduction by 1980, a relatively small decline is expected to occur by 2015, as shown in Table 8.

AGRICULTURE

Agriculture is an important segment of the basin's economic activity, but its relative importance is lessening as the economy becomes more diversified. The number of farms has decreased from a high of about 32,000 in 1949 to 21,300 in 1959 and is projected to continue this trend, falling to 12,200 in 1980 and 8,500 in 2015. With land in farms remaining virtually unchanged to 1980 and declining only slightly to 2015, the average size of farm is projected to increase from about 120 acres in 1960 to 260 acres in 2015.

Table 8

Major land use - Pascagoula River Basin study area
1959 and projected to 1980 and 2015

Land	Acres		
	1959	1980	2015
IN FARMS	2,552,482	2,571,000	2,245,000
Cropland	648,800	590,000	500,000
Harvested	339,509	250,000	200,000
Used for pasture	203,293	255,000	240,000
Idle	105,998	85,000	60,000
Woodland	1,511,241	1,600,000	1,390,000
Pasture	324,697	321,000	310,000
Other farm land	67,744	60,000	45,000
OTHER THAN IN FARMS	3,770,818	3,752,300	4,078,300
Forest[1]	3,461,918	3,310,900	3,291,500
Federal[2]	40,100	70,100	102,100
Urban	231,600	310,100	593,500
Water	37,200	61,200[3]	91,200[3]
TOTAL APPROXIMATE AREA	6,323,300	6,323,300	6,323,300

[1] Includes National Forest land

[2] Does not include National Forest.

[3] Acreage developed prior to final formulation of comprehensive plan. The structural measures contained in that plan would increase the 1980 water area to 84,651 acres and the 2015 area to 118,593 acres. This increase would result in a like reduction in land area.

The major crops grown are corn, hay and cotton; the principal livestock and livestock products are poultry and poultry products and cattle and calves. In 1959 livestock and livestock products accounted for 79 percent of the cash receipts from farm marketing; by 2015 they will account for 92 percent of total cash receipts.

Net farm income was $30,126,000 in 1959 and is projected to increase over three times by 2015. This increase, coupled with a reduction of 60 percent in the number of farms during the same period, will result in a projected increase in net income per farm in 2015 of eight times the $1,414 earned in 1959.

FORESTRY

The area occupied by forest in the basin is greater than the combined acreage devoted to all other land uses. In 1959, forest acreage accounted for about 5 million acres out of a total of 6.3 million acres. Eighty-four percent of this forest land, or about 4.2 million acres, is in private ownership. Of this 4.2 million acres, 36 percent is farm forest and 64 percent is in other types of ownership. Softwood forest types, which include longleaf-slash pine, loblolly-shortleaf pine and oak-pine, cover 76 percent of the commercial forest land. The basin's wood supply is derived from trees that are now standing on commercial forest land. In 1956 these trees contained 2.1 billion cubic feet of wood classified as forest growing stock. The total net volume of sawtimber on commercial forest lands was 7.4 billion board feet measured by the International one-fourth inch log rule, or about 58 percent of the growing stock.

The growing stock is projected to 5.8 billion cubic feet in 1980 and sawtimber to 18.3 billion board feet. The growing stock and sawtimber inventories will decline by 2015 but will be 74 and 85 percent greater than the 1956 inventories, respectively.

Employment in the basin as a result of the timber resource is classified into two broad categories: (1) those employed in timber-based manufacturing industries, and (2) those employed in timber management and harvesting of timber. The first category is made up of employment in the following SIC (Standard Industrial Classification) major groups:

24 - Lumber and Wood Products
25 - Furniture and Fixtures
26 - Paper and Allied Products

Except for 1950, employment in SIC major groups 24 and 25 has remained fairly constant at about 7,000 and is projected to essentially maintain this level until 2015. Employment in SIC major group 26 has shown steady growth in the past, from 738 employees in 1930 to 5,322 in 1960, and is projected to continue this trend, reaching approximately 17,100 in 2015. Employment in the second category, timber management and harvesting, has decreased from 7,735 in 1954 to 4,873 in 1958 and is projected to continue decreasing to 1980. Beyond 1980, it is projected to increase slightly, reaching a level of about 4,800 workers in 2015.

COMMERCIAL FISHING

There are freshwater commercial fisheries operating in the basin. The latest survey, conducted in 1960-1961, showed that 14 regular and 75 casual fishermen caught 253,100 pounds of finfish worth approximately $70,000 (ex vessel). Buffalo and blue channel catfish make up approximately 83 percent of the catch by both weight and value.

Marine commercial fisheries of Mississippi are important to the State's economy and are supported by the coastal estuarine environments. In 1964, the landings approximated 332 million pounds of finfish and shell fish worth slightly more than $8 million (ex vessel) to the fishermen. The fisheries of menhaden, unclassified industrial fish, shrimp, oyster, red snapper, blue crab, king whiting, grouper, and mullet represent over 99 percent of the catch in pounds and value.

MINERAL RESOURCES

Production of crude oil, natural gas and natural gas liquids generated most of the value of mineral output in the Pascagoula River Basin in 1965, as shown in Table 9. Sand, gravel and clay provided the only significant tonnage and value of solid mineral substances recovered from primary deposits. Items whose individual value cannot be revealed are lime and magnesium compounds manufactured from dolomite obtained outside the basin and sulphur recovered from refinery gases in a refinery in Lamar County.

Table 9

Mineral production in the Pascagoula River Basin in 1965

Commodity	Unit	Quantity	Values in $1,000
Clay	short tons	126,445	604
Natural gas	million cubic feet	49,415	8,457
Natural gas liquids	thousand gallons	10,058	536
Petroleum (crude)	thousand 42-gallon barrels	27,594	72,667
Sand and gravel	thousand short tons	1,308	1,269
Stone	thousand short tons	12	24
Total value of items whose individual values cannot be disclosed:			
Certain nonmentals	---	---	4,339
Total			87,896

Estimates of proven petroleum reserves in Mississippi, as of December 31, 1965, ranged from 359.8 million barrels (American Petroleum Institute) to 531.7 million barrels (Oil and Gas Journal). The Oil and Gas Journal also estimated that reserves for oilfields of the Pascagoula River Basin in Mississippi amounted to 244.5 million barrels on January 1, 1966, or 42.2 percent of the total reserves of the State. The ratio of reserves to 1965 production in the basin was 12.28 to 1.

No adequate estimate of the amount of available sand and gravel, the foremost solid mineral products in 1965, has been published, However, it is a logical conclusion that resources are large and probably measurable in billions of tons.

Sand and gravel produced within the basin are marketed from Meridian southward to the Gulf coast, including the towns of Pascagoula and Biloxi. Some sand and gravel are shipped as far as New Orleans. Except for sand and gravel used locally, shipment is by rail.

CONSTRUCTION

The expansion of population, the development of manufacturing facilities and the need for vast public improvements are expected to give considerable thrust to construction employment. Rising from 2,900 in 1930 to 10,900 in 1960, construction employment is projected to increase to 36,900 in 2015. Construction employment generated $25.4 million in wage and salary income in 1960, up from $3.6 million in 1930. By 2015, it is expected that wage and salary income from the construction industry will reach $196 million, indicating a large expansion in capital formation.

MANUFACTURING

Consistent decade-to-decade growth in manufacturing industries was achieved from 1930 to 1960. Manufacturing employment in the basin more than doubled during the 30-year period, as shown in Table 10. Employment in major water-using manufacturing industries increased from 3,800 workers in 1930 to 12,300 workers in 1960 and is projected to reach 45,000 by 2015. The most noticeable increases in the past occurred in the paper, food and chemical industries. In coming periods, the basin will experience significantly higher levels of employment in all major water-using industries. Other manufacturing employment increased from 10,600 in 1930 to 24,400 in 1960 and is forecast to rise to 63,300 by 2015.

Table 10

Employment in manufacturing industries - Pascagoula River Basin study area
1930-1960 and projected to 2015

Industry	Historical				Projected		
	1930	1940	1950	1960	1965	1980	2015
Major water-using:							
Food	1,672	3,827	3,314	4,728	5,830	6,920	11,600
Pulp and paper	738	1,272	4,026	5,322	6,140	8,360	17,110
Chemicals	816	1,470	1,700	1,671	2,000	2,770	10,090
Petroleum	---	3	143	391	1,180	2,630	5,140
Primary metals	525	106	34	236	300	490	1,060
Subtotal	3,751	6,678	9,217	12,348	15,450	21,170	45,000
Other manufacturing	10,618	16,252	19,981	24,357	25,660	32,420	63,280
Total manufacturing	14,369	22,930	29,198	36,705	41,110	53,590	108,280

With the abundance of water, it is only natural that manufacturing development should be shifting to major water-using industries. In 1930, only 26 percent of manufacturing employment was engaged in major water-using industries. By 1960, this had shifted to 34 percent and is projected to comprise 42 percent in 2015.

The proportion of wage and salary income from manufacturing increased from 28.4 percent in 1930 to 31.3 percent in 1960. This trend is expected to continue to 2015 when manufacturing wage and salary income will constitute 33.7 percent of total wage and salary income.

Value added by manufacturing, generally, is the best measure available for comparing the relative economic importance of manufacturing among industries and geographic areas. Total value added by manufacturing for the basin has increased at a steady rate from $172 million in 1947 to $292 million in 1963. The trend is expected to continue throughout the projection period, reaching approximately $2.066 billion by 2015.

WHOLESALE AND RETAIL TRADE

As indicated by employment trends, wholesale and retail trade is in a strong growth phase. In 1960, employment in wholesale and retail trade was the most significant sector of nonagricultural-nonmanufacturing employment. This pattern of development is expected to continue throughout the forecast period when employment will reach about 88,300 by 2015.

With the growth in employment, a corresponding growth in wage and salary income is expected. In 1960, this sector provided $81.6 million in wage and salary income, or 18.5 percent of total wage and salary income. By 2015, it will account for $824.1 million or 23.3 percent of the total.

TRANSPORTATION FACILITIES

The basin is served by an expanding network of highways and roads. Access is provided by seven highways on the U. S. numbered system and numerous State numbered highways and local roads. In addition, three interstate highways are under construction on the National System of Interstate and Defense Highways. Considerable effort also has been put forth on the part of local interests in recent years to improve the quality of their farm-to-market roads. Four interstate railroads serve the basin with regularly scheduled freight trains to all major cities and towns. Numerous interstate motor freight carriers operating on the well-developed highway system provide service throughout the basin. Air passenger and freight service is provided from the major cities to all parts of the country.

CHAPTER 4

PRESENT WATER AND RELATED LAND RESOURCE DEVELOPMENT

INTRODUCTION

The water and related land resources of the Pascagoula River Basin are largely undeveloped. The few principal water resource developments, either constructed or under construction by the Federal Government, include channel improvements for navigation and for flood control, and a multiple-purpose reservoir for flood control, water quality control, water supply, recreation, and fish and wildlife enhancement. Other Federal and non-Federal developments include one small reservoir for flood control, water supply and recreation, another reservoir for water supply for Mobile, Alabama, and several lakes, parks and related recreational areas. At the present time, municipal and industrial use of fresh water in the basin is approximately 115 million gallons per day. Of this total, groundwater supplies an estimated 60 million gallons per day. In addition, rural areas use 11 million gallons per day, cooling use is 75 million gallons per day, and saline water use is 250 million gallons per day.

EXISTING AND AUTHORIZED WATER RESOURCE DEVELOPMENTS

Corps of Engineers. Existing or authorized projects of the Corps of Engineers in the basin include navigation facilities in the lower portion, a flood control project along Sowashee Creek at Meridian, and a multiple-purpose reservoir on Okatibbee Creek near Meridian.

The existing navigation facilities in the basin include a deep-water channel from the Gulf of Mexico to the port of Pascagoula, with several turning basins and side channels; a seven-foot-deep channel in the Pascagoula River from Dog River (Escatawpa River) to Dead Lake, and then three feet to the head of the river; and high-water channels in the Leaf River to Hattiesburg and in the Chickasawhay River to Buckatunna. Of these, the harbor project is the only one being actively maintained and further developed. The Pascagoula River portion is being maintained only in the lower reaches as needed. The Leaf and Chickasawhay Rivers are commercially inactive and abandonment of the Federal projects therein has been recommended.

The only completed Corps of Engineers flood control project in the basin is a channel improvement project located on Sowashee Creek

at Meridian. The project was authorized by the Chief of Engineers under Section 205 of the Flood Control Act of June 30, 1948, as amended. It was completed in 1955.

The multiple-purpose Okatibbee Reservoir, in the upper portion of the basin, will partially regulate low flows for water quality in Okatibbee Creek and Chickasawhay River; modify flood peaks during floods; furnish a dependable water supply for the growing Meridian area; and provide a large lake for recreational purposes. Construction was initiated in June 1965 and is scheduled for completion in 1968.

Department of Agriculture. All of the counties in the basin are within organized Soil Conservation Districts and are actively engaged in carrying out soil and water conservation practices. Detailed soil surveys have been completed on 70 percent of the agricultural land. Farm plans have been prepared on 36 percent of the farms covering 34 percent of the agricultural land. Practices carried out to date through Soil Conservation Districts, agricultural conservation programs, the Clarke-McNary and Cooperative Forest Management Acts and other programs include conservation cropping systems, pasture planting and improvements, farm ponds, drainage, terracing, contour farming, critical area land treatment, tree planting and forest management practices.

Local water management districts have been formed and are in the process of organizing for the purpose of obtaining assistance under the Watershed Protection and Flood Prevention Act of the 83rd Congress. Dry Creek Watershed, covering 13,954 acres in Covington County, was approved for operation in August 1966. A work plan on Big Creek Watershed, covering 80,012 acres in Jasper, Jones and Smith Counties, was completed in January 1967. A work plan on Chunky River Watershed, covering 240,650 acres in Newton and Neshoba Counties, was completed in June 1967. Authority to plan Upper Leaf Watershed in Scott and Smith Counties was approved in September 1966 and authority to plan Sowashee Creek Watershed near Meridian was granted in April 1967. Souinlovey Creek, Okatoma Creek and Tallahoma Creek Watersheds are in the process of organizing and are expected to submit application for planning authorization in the near future. Structural measures expected to be constructed in these eight watershed projects consist of 96 floodwater retarding structures, 11 multiple-purpose structures and 558 miles of channel improvement. Land treatment measures for watershed protection and flood prevention on cropland, pastureland and forest lands are also to be installed in these projects.

Pat Harrison Waterway District. The Pat Harrison Waterway District was created by an act of the Mississippi Legislature in

1962 as a management tool to facilitate the coordinated and comprehensive development of Southeast Mississippi through improved use of the water and land resources of the Pascagoula River Basin. This State agency completed construction of a dam on Flint Creek near Wiggins in Stone County in 1966. The 600-acre reservoir formed by the dam provides storage for water supply for the City of Wiggins, recreation, flood control in the immediate area, and fish and wildlife enhancement. Complete development of the reservoir is expected to provide an economic stimulant to the local economy.

Mobile Water Works Board. The Mobile Water Works Board constructed a dam on Big Creek, a tributary of the Escatawpa River, as a source of water supply for the City of Mobile, Alabama. The dam was completed in December 1951. The 3,600-acre reservoir formed by the dam has a maximum dependable yield of about 100 million gallons of water a day. In addition, the reservoir also provides incidental fishing for the surrounding area.

Public parks and outdoor recreation areas. Recreational facilities are provided throughout the Pascagoula River Basin for various types of activities other than those associated with such water sports as boating, skiing and fishing. The larger part of the Federal lands in the basin are included in the Bienville and DeSoto National Forests and are under management for multiple-use including recreation. The Mississippi Game and Fish Commission manages the Red Creek, Chickasawhay, Bucatunna Creek, Leaf River, and Tallahala Creek Wildlife Management Areas, and many small parks and lakes in cooperation with the U. S. Forest Service and private landowners. In addition, there are three State parks within the basin and numerous private developments such as cabins and hunting areas. The public recreation areas in the basin are listed by county in Table 11.

Table 11

Public recreation areas in the Pascagoula River Basin

Facility name	Administrative agency [1]	County	Land acres	Water acres	Marsh acres	Total	Acres developed for recreation use
Bienville National Forest	USFS	Newton	3,128	---	---	3,128	---
Meridian National Fish Hatchery	BSF&W	Lauderdale	61	24	21	106	---
U. S. Naval Auxiliary Air Station	U.S.Navy	Lauderdale	4,000	---	2,000	6,000	76
Tom Bailey Lake	MG&F	Lauderdale	100	234	---	334	12
Clarkco State Park	MPS	Clarke	754	64	---	818	100
Bucatunna Creek Wildlife Management Area	MG&F	Clarke	64,900[2]	100	---	65,000[2]	---
Shongelo Recreation Area	USFS	Smith	37	3	---	40	15
Tishkill Lake Recreation Area	USFS	Smith	420	---	---	420	---
Marathon Recreation Area	USFS	Smith	400	70	---	470	29
USFS Lands - Smith County	USFS	Smith	67,371	---	---	67,371	---
Ross R. Barnett Lake	MG&F	Smith	48	87	---	135	7
USFS Lands - Jasper County	USFS	Jasper	17,140	---	---	17,140	---
Claude Bennett Lake	MG&F	Jasper	119	71	---	190	6
Tallahala Creek Management Area	MG&F	Jasper	28,850[2]	50	300	29,200[2]	---
Mike Conner Lake	MG&F	Covington	31	88	---	119	13
Bogue Homo Lake	MG&F	Jones	580	1,200	---	1,780	30
Chickasawhay Wildlife Management Area	MG&F	Jones	92,720[2]	---	---	92,720[2]	---
Point Laurel Recreation Area	USFS	Jones	43	---	---	43	2
Widow Landrum Recreation Area	USFS	Jones	70	---	---	70	---
Game Pond Recreation Area	USFS	Jones	110	---	---	110	---
Gavin Road Recreation Area	USFS	Jones	36	---	---	36	---
USFS Lands - Jones County	USFS	Jones	32,071	---	---	32,071	---
Thompson Creek Recreation Area	USFS	Wayne	80	---	---	80	6
Piney Woods Recreation Area	USFS	Wayne	80	---	---	80	3
USFS Lands, Wayne County	USFS	Wayne	89,682	---	---	89,682	---
Lakeland Park	MG&F	Wayne	12	---	12	24	---
Ashe Lake Recreation Area	USFS	Forrest	29	11	---	40	19
Red Creek Recreation Area	USFS	Forrest	11	---	---	11	4
Tiak BSA Org. Camp	USFS	Forrest	49	---	---	49	49
Black & Beaver Dam Creek Float Trip	USFS	Forrest	600	---	---	600	1
USFS lands - Forrest County	USFS	Forrest	49,959	---	---	49,959	---
Paul B. Johnson State Park	MPS	Forrest	810	320	---	1,130	195
Kamper Park	Hattiesburg	Forrest	36	4	---	40	24
Pineview Park	Hattiesburg	Forrest	40	---	---	40	30

Table 11 (Cont'd)

Public recreation areas in the Pascagoula River Basin

Facility name	Administrative agency [1]	County	Land acres	Water acres	Marsh acres	Total	Acres developed for recreation use
Miles Branch Recreation Area	USFS	Perry	15	---	---	15	1
New Augusta Recreation Area	USFS	Perry	15	---	---	15	1
Moody's Landing Recreation	USFS	Perry	20	---	---	20	2
Beaumont Recreation Area	USFS	Perry	80	---	---	80	---
Janice Recreation Area	USFS	Perry	20	---	---	20	4
Sweatwater Lake Recreation Area	USFS	Perry	500	---	---	500	---
Camp Attawah Recreation Area	USFS	Perry	47	---	---	47	47
Leaf River USFS Lands	USFS	Perry	107,613	---	---	107,613	---
Black Creek USFS Lands	USFS	Perry	51,865	---	---	51,865	---
Leaf River Wildlife Management Area	MG&F	Perry	3,520[2]	---	---	3,520[2]	---
Perry Lake	MG&F	Perry	50	125	---	175	6
USFS Lands - Greene County	USFS	Greene	33,443	---	---	33,443	---
Kurtz State Forest	MFC	Greene	1,740	20	---	1,760	---
Airey Lake Recreation Area	USFS	Stone	44	6	---	50	7
USFS Lands - Stone County	USFS	Stone	39,675	---	---	39,675	1
Red Creek Wildlife Management Areas	MG&F	Stone	306,895[2]	2,000	5,000	313,895[2]	---
USFS Lands - George County	USFS	George	8,819	---	---	8,819	---
McHenry Recreation Area	USFS	Harrison	89	---	---	89	---
Mill Creek Recreation Area	USFS	Harrison	251	---	---	251	---
Big Biloxi Recreation Area	USFS	Harrison	40	---	---	40	22
Tuxachanie Recreation Area	USFS	Harrison	2	---	---	2	2
Tuxachanie Trail	USFS	Harrison	456	---	---	456	1
USFS Lands - Harrison County	USFS	Harrison	60,704	---	---	60,704	---
Magnolia State Park	MPS	Jackson	200	---	---	200	39
USFS Lands - Jackson County	USFS	Jackson	19,205	---	---	19,205	---

[1] USFS = United States Forest Service; BSF&W = Bureau of Sport Fisheries and Wildlife; MG&F = Mississippi Game and Fish Commission; MPS = Mississippi Park Service; MFC = Mississippi Forestry Commission.

[2] Acreage figures for MG&F wildlife management areas embracing USFS lands have been adjusted by the amount of USFS land in order to avoid duplication of acreages. Actual acreages of these wildlife management areas are:

Red Creek Wildlife Management Area -------- 350,000
Chickasawhay Wildlife Management Area ----- 120,000
Bucatunna Creek Wildlife Management Area -- 65,000
Leaf River Wildlife Management Area ------- 42,000
Tallahala Creek Wildlife Management Area --- 42,000

CHAPTER 5

WATER AND RELATED LAND RESOURCE DEVELOPMENT NEEDS

INTRODUCTION

The ultimate goal of comprehensive river basin planning and the resultant programs is to satisfy human needs and to improve the social and economic well-being of all the people. It is basic that water and related land resources have value only to the extent that they are needed. Investigations have shown that economic development is occurring in varying degrees throughout the basin, with the lower portion developing rapidly into a major urban-industrial area. This basin-wide development is creating new and added demands for the use of water and related land resources. Evaluation of these demands involves consideration of past and present water and related land resource uses as related to economic activities in the study area and the broad projections of future economic growth. The increasing water and related land resource development needs in the basin are discussed in this chapter, without regard to priority.

FLOOD CONTROL NEEDS

The control of high flows is vitally important to the security of the people residing in those areas of the basin which are threatened by floods. Tremendous amounts of property damage and business losses have resulted from past floods. Potential damage from floods which could occur is even greater. Careful estimates of the potential damages from floods of several different magnitudes were used as a measure of the severity and extent of the flood problem. However, the anguish and suffering of those affected cannot be measured. For the purpose of this study, evaluation of these flood damages was divided geographically between upstream watershed areas and the Pascagoula River and its principal tributaries.

For the investigations and analyses of the upstream watersheds, the basin was divided into 63 sub-watersheds with drainage areas ranging from 22 to 377 square miles. These watersheds are generally rural in nature and their economy is related to agriculture. Due to the characteristics of the streams and lack of structural development, bottomlands are subject to flash floods from cloud-burst downpours. On-site field investigations were made to determine the frequency, amount, and extent of flood water damages to agricultural lands and fixed improvements in the rural and urban areas. Studies made by

the Department of Agriculture, as reported in Appendix F, show the average annual flood damages to 765,500 acres in these upstream areas to be approximately $1,901,340, based on long-term projected prices. Approximately $1,123,800 of this total is classed as agricultural damage, consisting principally of crop and pasture losses. The balance is related primarily to roads, bridges, and major improvements.

Field investigations were made by the Corps of Engineers to determine the extent of flood damages along the main streams and principal tributaries for an analysis of the flood control needs. Data on the use of rural land and farming practices in the flood plains were obtained from farmers, county agents and Soil Conservation Service representatives living in the affected areas. Operating officials and governmental agencies furnished information on damage to roads, highways and railroads. The urban areas affected by floods were inspected and appraisals made of the losses. A detailed description of the methods used in evaluating the flood damages along the main streams and principal tributaries is given in Appendix D.

The studies described in the preceding paragraph showed that there is a total of 464,800 acres of land subject to flooding along the Pascagoula River and principal tributaries. Of this total, 4,100 acres are urban and 460,700 rural. The average annual flood damages to these areas, in terms of 1962 flood plain development and 1965 prices, amounts to $1,960,600. Of this total, $680,700, or about 35 percent, is to urban development. The 17 principal urban centers affected by floods are shown on Figure 6. A detailed description of the flood damage in these centers is given in Appendix D.

The above estimates are a measure of the current need for flood control in the basin. The potential economic growth of the area and the capability of the flood plain in certain areas to sustain further economic development indicates that the level of average annual damages will increase in the future.

Figures 7 and 8 show typical flood scenes in the Pascagoula River Basin.

WATER QUALITY CONTROL NEEDS

One of the more serious water resource problems which exists to some extent in all parts of the Nation today is stream pollution. The use of water for municipal and industrial purposes almost inevitably results in the production of some liquid wastes which, even after a high degree of treatment, can degrade the quality of

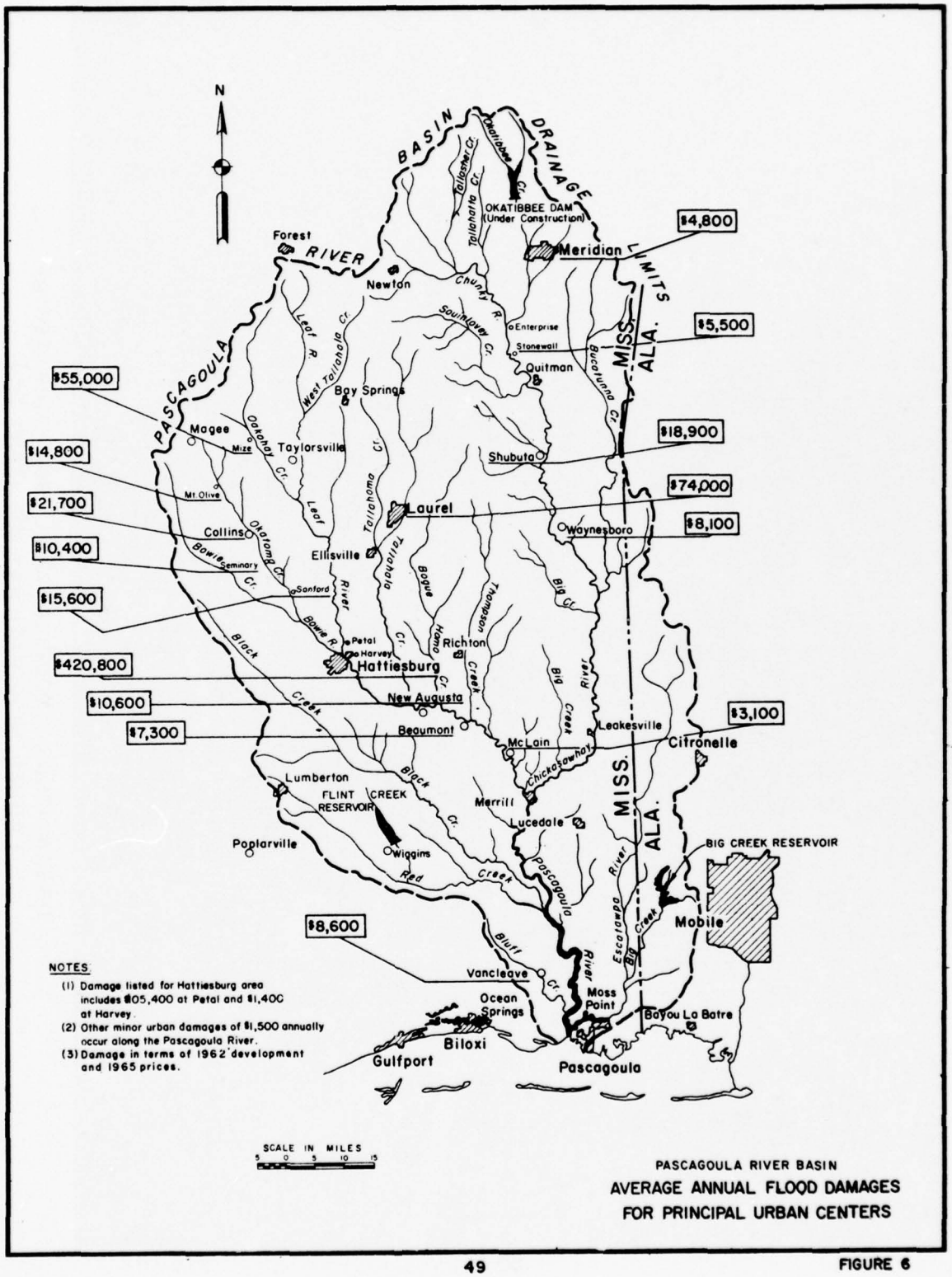

N
PASCAGOULA RIVER BASIN DRAINAGE
MISS. ALA. LIMITS
OKATIBBEE DAM (Under Construction)
Okatibbee Cr.
Tallahalla Cr.
Meridian
$4,800
Forest
Newton
Chunky R
Enterprise
Stonewall
Quitman
$5,500
Bucatunna Cr.
$55,000
Bay Springs
West Tallahala Cr.
Leaf R.
Magee
Mize
Oakohay Cr.
Taylorsville
$14,800
Shubuta
$18,900
Mt. Olive
$21,700
Laurel
$74,000
Tallahoma Cr.
Collins
Oloroma Cr.
Waynesboro
$8,100
$10,400
Bowie
Seminary
Ellisville
Bogue Homo Cr.
Sanford
$15,600
Bowie R.
Petal
Harvey
Richton
Hattiesburg
$420,800
Black Creek
New Augusta
$10,600
Thompson Creek
Big Cr.
Big Creek
$3,100
$7,300
Beaumont
Leakesville
McLain
Citronelle
Chickasawhay R.
Lumberton
FLINT CREEK RESERVOIR
Black Cr.
Merrill
Lucedale
Poplarville
Wiggins
Red Creek
Pascagoula River
BIG CREEK RESERVOIR
Escatawpa River
Big Creek
Mobile
$8,600
Bluff Cr.
Vancleave
Ocean Springs
Moss Point
Bayou La Batre
Biloxi
Gulfport
Pascagoula
NOTES
(1) Damage listed for Hattiesburg area includes $105,400 at Petal and $1,400 at Harvey.
(2) Other minor urban damages of $1,500 annually occur along the Pascagoula River.
(3) Damage in terms of 1962 development and 1965 prices.
SCALE IN MILES
5 0 5 10 15
PASCAGOULA RIVER BASIN
AVERAGE ANNUAL FLOOD DAMAGES
FOR PRINCIPAL URBAN CENTERS

FIGURE 6

FIGURE 7

URBAN AREAS FLOODED BY APRIL 1964 HIGHWATER AT
LAUREL, MISS. HIGHWAY NOS. 15 AND I-59

FIGURE 8

A FLOODED FARM NEAR LAUREL, MISS.
APRIL 1964 HIGHWATER

the receiving stream and limit downstream water uses. The maintenance of the water quality of the streams at levels satisfactory for multiple-use is required for the full economic development of the Pascagoula River Basin.

In order to estimate the water quality control requirements, water quality objectives had to be established. These objectives had to include a satisfactory standard of stream water quality for all purposes, including municipal and industrial water supply and recreational use, as well as for propagation of fish and aquatic life. The objectives also had to be reasonably obtained. For the Pascagoula River Basin, quality objectives are based principally on dissolved oxygen concentration and confirmed coliform bacteria count. Storage provided for stream flow regulation should maintain a minimum dissolved oxygen concentration of 4.0 milligrams per liter at a point in the receiving waters where the maximum pollution is felt when base flow is at or in excess of the 7-day low-flow with a 10-year recurrence interval. Proposed recommendations for bacteriological water quality standards regarding waters used for contact recreation are: Fecal coliform density not to exceed 200 per 100 ml (geometrical mean); and fecal coliform density not to exceed 400 per 100 ml in more than ten percent of samples analyzed per month.

The Federal Water Quality Act, as amended, states that storage for regulation of streamflow for the purpose of water quality control shall not be provided as a substitute for adequate treatment or other methods of controlling wastes at their source. The recently established Mississippi State Air and Water Pollution Control Commission has been designated as the pollution control agency for Mississippi for purposes of the Federal Water Pollution Control Act, as amended. For Alabama, the Alabama Water Improvement Commission has been designated as the control agency for all purposes of the Federal Water Pollution Control Act, as amended.

There are manifestations of water quality problems in the four heaviest populated areas in the basin. Figure 9 illustrates the condition in one of these areas. These problems will be intensified and other problem areas will develop with the expected economic growth unless measures are undertaken to control the waste loads discharged into the streams. The magnitude of the problems is summarized in Table 12 which shows present and projected waste loads in 5-day biochemical oxygen demand ($B.O.D._5$). The projected residual waste loads assume the prerequisite levels of waste treatment prior to discharge into the receiving stream. These loads were determined by the Federal Water Pollution Control Administration as part of its study on water needs. The report of that agency is presented in Appendix G.

Figure 9

Typical scenes of pollution near the mouth
of the Escatawpa River

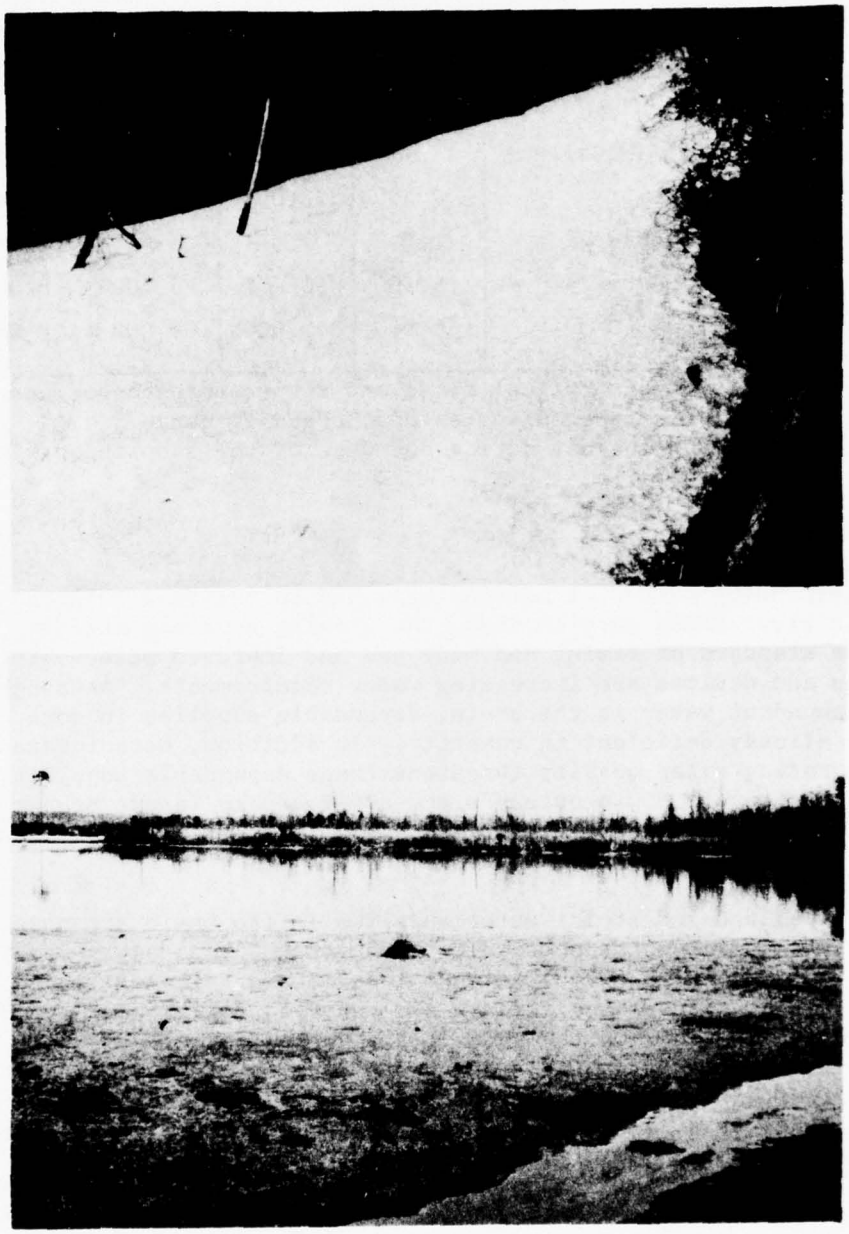


Table 12

Present and projected waste loads for critical areas in the Pascagoula River Basin

Area	Raw load (lbs/day $B.O.D._5$)		Residual load (lbs/day $B.O.D._5$)	
	1965	2015	1965	2015
Hattiesburg area	28,000	81,000	27,000	10,000
Possible paper mill (McCallum)	---	78,000	---	4,350[1]
Laurel-Ellisville area	7,500	22,000	3,800	3,300
Particle board industry	[a]	---	[a]	6,700[1]
Meridian area	15,500	60,000	8,100	8,000
Pascagoula area	140,000	870,000	109,000	128,000

[1]Allowable load based on critical flows and temperature conditions.
[a]The 1965 stream survey showed wastes discharged to range from 25,000 to 2,000,000 lbs/day during one week of the sampling period.

WATER SUPPLY NEEDS

The expanding number of persons expected to reside within the Pascagoula River Basin service area, the growing economic activity, the rising standard of living and many new and improved water-using appliances and devices are increasing water requirements. Although there is abundant water in the basin, dependable supplies in some areas are already deficient in quantity. In addition, deteriorated or deteriorating water quality threatens these dependable supplies and will continue to do so unless steps are taken to insure proper quality control. Rural water uses are a small but still significant part of these increasing water needs.

Municipal and industrial water supplies in the basin are obtained from springs, wells and streams. The 1965 fresh water supply requirements for municipal and industrial use totaled about 115 million gallons per day. These requirements are expected to increase to 686 million gallons per day by the year 2015. The estimates of future municipal and industrial water supply were made by the Federal Water Pollution Control Administration (Appendix G). The Administration estimated that, as a result of additional population and greater per capita water use, the municipal demand will increase from the 1965 level of 28.8 million gallons per day to 90.8 million gallons per day in 2015. Industrial water demand will increase in proportion to increased production and employment.

There are four major water-using centers in the basin. These correspond to the basin's population centers and are Meridian, Laurel, Hattiesburg and the Pascagoula-Moss Point complex. The combined municipal and industrial use of fresh water in these four centers in 1965 was about 105 million gallons per day, exclusive of 75 million gallons per day used as cooling water by a power plant near Hattiesburg. This use is expected to increase to approximately 523 million gallons per day in 2015, exclusive of the previously mentioned cooling water. The estimated future municipal and industrial fresh water requirements for these areas and other selected locations in the basin are shown on Figure 10.

Rural and agricultural water requirements were investigated by the Department of Agriculture (Appendix F). It was determined that water for agricultural and rural domestic needs is not a problem insofar as supply is concerned. Adequate groundwater is available from wells, springs and streams in all parts of the basin. In addition, farm ponds, mainly for livestock water, either have been or can be constructed on most farms in the basin. Water for household use is mostly from wells located near the farm or rural residences. In some cases, community water systems have been developed that use deep wells as a source of water supply.

OUTDOOR RECREATION NEEDS

The outdoor recreation needs of the Pascagoula River Basin were divided into the two categories of general recreation and fish and wildlife enhancement. General recreation includes such water-dependent and water-enhanced activities as swimming, boating, water skiing, sailing, camping, picnicking, sightseeing, hiking, nature study, and incidental fishing in combination with other activities. Fish and wildlife enhancement includes hunting and sport fishing.

The majority of people seeking outdoor recreation wish to be near water areas and to engage in water-associated activities such as swimming, boating, camping, picnicking and fishing. Our expanding population, with more leisure time, more purchasing power, and more mobility, continues to seek more opportunities to enjoy the outdoors. The demand for outdoor recreation, consequently, has been growing steadily. The increase for the period 1951-1959 is illustrated by Figure 11. In most densely populated areas of the country, the demand has led to overcrowding and extreme pressures on existing outdoor recreation facilities.

The growing demand for outdoor recreation in the Nation is detailed in "Outdoor Recreation for America," a report to the President and to the Congress by the Outdoor Recreation Resources Review Commission (ORRRC). This report, which was submitted in January 1962,

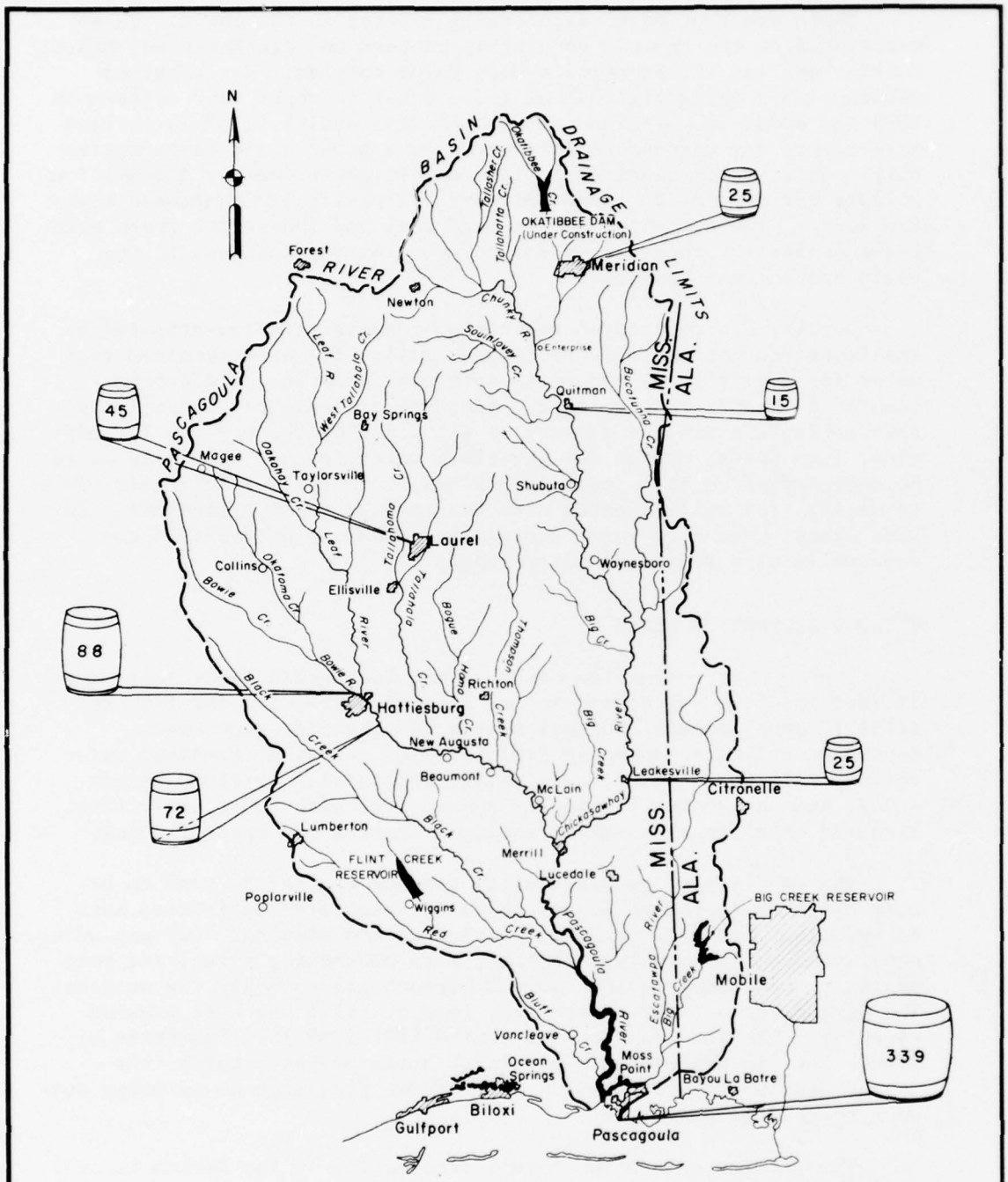
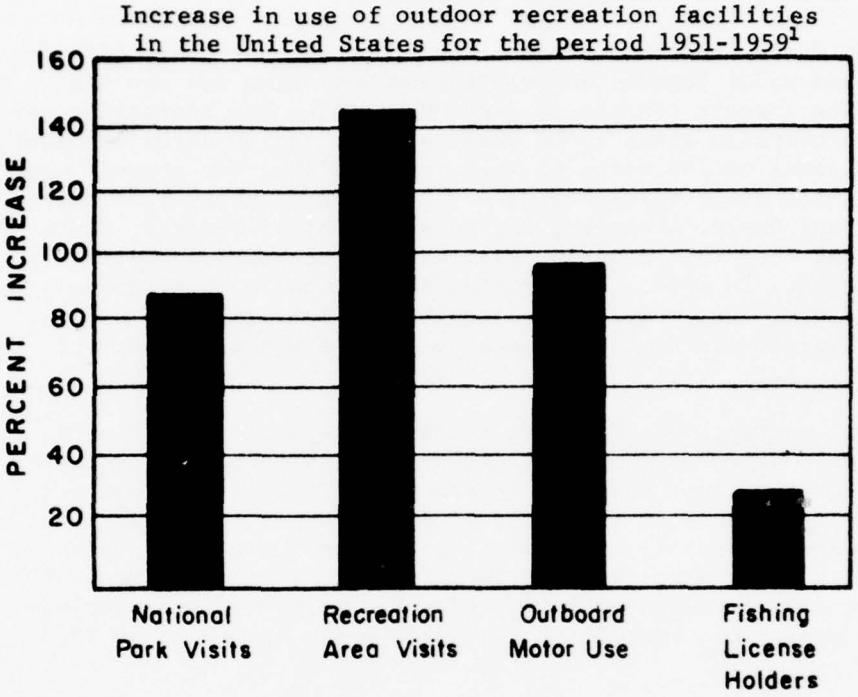

N
BASIN
DRAINAGE
PASCAGOULA RIVER
MISS. ALA. LIMITS
OKATIBBEE DAM
(Under Construction)
Okatibbee Cr.
Tallasha Cr.
Tallaharta Cr.
Meridian
Forest
Newton
Chunky R.
Enterprise
Quitman
Bucatunna Cr.
Bay Springs
Leaf R.
West Tallahala Cr.
Squinlovey Cr.
Magee
Taylorsville
Oakohay Cr.
Shubuta
Laurel
Tallahoma Cr.
Leaf
Collins
Oakohoma Cr.
Bowie Cr.
Ellisville
Tallahala
Bogue Homo Cr.
Thompson Creek
Big Cr.
Waynesboro
Bowie River
Richton
Hattiesburg
Black Creek
New Augusta
Beaumont
McLain
Big Creek
Leakesville
Citronelle
Chickasawhay River
Lumberton
Merrill
Lucedale
FLINT CREEK RESERVOIR
Poplarville
Wiggins
Red Creek
Pascagoula River
Escatawpa River
Big Creek
BIG CREEK RESERVOIR
Mobile
Bluff Cr.
Vancleave
Ocean Springs
Moss Point
Bayou La Batre
Biloxi
Gulfport
Pascagoula
45
25
15
88
72
25
339
SCALE IN MILES
PASCAGOULA RIVER BASIN
SURFACE WATER REQUIREMENTS
FOR THE YEAR 2015
(MILLION GALLONS PER DAY)

FIGURE 10.

Figure 11



[1]Data obtained from "Outdoor Recreation for America," January 1962.

shows that the number of occasions of outdoor activities in which persons over 12 years of age will participate is expected to increase 184 percent between 1960 and the year 2000, assuming that the quality and quantity of facilities per capita remain constant. With a greater opportunity factor provided by additional per capita facilities, the number of occasions of participation is expected to increase 228 percent by the year 2000. Outdoor activities, concerned directly with water – swimming, boating, and water skiing – should increase 251 percent by the year 2000, while additional per capita facilities should result in a participation increase of 311 percent. Proximity to water tends to enhance the pleasure associated with many other recreational activities. This is pointed out in the ORRRC report which states "Water is a prime factor in most outdoor recreation activities."

Participation in activities at public recreation areas in the United States represented almost 10 percent of the estimated outdoor recreational demand in 1960. The size of the public recreation

portion of the market is influenced by the quantity, quality and distribution of public recreation facilities.

In the Pascagoula River Basin, there are approximately 588,000 acres of land under Federal administration including two national forests. The forests contain 23 areas designated for recreation use. These areas comprise about 2,440 acres of land and 90 acres of water, of which a total of 164 acres of land are developed for present use. There are three State parks having a total area of about 2,150 acres and many local parks. However, the total amount of Federal, State and municipal land in the basin developed for recreation use is only 754 acres. In 1963, the reported day visits to these areas totaled 813,000. Water-associated activities in most parts of the basin are limited due to the absence of large fresh water surface areas.

General recreation. Existing needs for general recreation in the Pascagoula River Basin may be defined as the demand for recreation opportunities less the present capacity of existing resources and facilities. Table 13 shows the present and projected imbalance between demand and supply in terms of needs for the basin. Data shown in this table were obtained from the report of the Bureau of Outdoor Recreation presented in Appendix H. Supply figures include only those programmed facilities that will be in operation by 1970.

Table 13

Existing and projected total annual unsatisfied demand for swimming, boating, camping and picnicking in the Pascagoula River Basin
(1,000 activity occasions)

Year	Swimming	Boating	Camping	Picnicking
1965 Total annual demand	6,360.6	2,838.0	914.6	3,214.9
1965 Total annual supply*	1,070.0	104.2	272.2	327.8
1965 Total annual unsatisfied demand	5,289.7	2,733.8	642.4	2,887.1
1980 Total annual demand	11,320.3	5,050.0	1,627.1	5,723.4
1970 Total annual supply*	1,558.4	104.2	362.5	530.4
1980 Total annual unsatisfied demand	9,761.9	4,945.8	1,264.6	5,193.0
2015 Total annual demand	38,900.3	17,354.0	5,587.5	19,668.1
1970 Total annual supply*	1,558.4	104.2	362.5	530.4
2015 Total annual unsatisfied demand	37,341.9	17,249.8	5,225.0	19,137.7

*Annual use that can be expected from supply.

As shown in Table 13, there is a critical shortage of facilities in every class of water-dependent and water-enhanced outdoor recreation activities in the Pascagoula River Basin. Swimming area, picnicking and camping facilities, and water for boating do not satisfy the present demand, nor will the programmed facilities that are to be completed by 1970. The preference of the public to recreate on or near water, coupled with the expected large increases in the total market, indicates that any water areas developed in the Pascagoula River Basin would be utilized for public recreation to the maximum extent of the facilities provided.

Fish and wildlife enhancement. The fish and wildlife resources of the Pascagoula River Basin constitute a major recreation potential for residents of the area. The streams in the basin provide excellent opportunity for sport fishing. It is estimated that the present 52,669 acres of water surface in the basin have an annual fishing capacity of approximately 1,184,300 man-days.

Areas in the basin open to public hunting include about 1,039,570 acres under public ownership or under lease to the Mississippi State Game and Fish Commission. These lands supply hunter opportunity for about 74 percent of the existing demand at the 1965 level, and with intensive management can supply about the same percent for projected 2015 demand. Hunter demand, however, cannot be entirely satisfied with public-owned or State-managed lands. Private land holdings contribute, and will continue to contribute, to hunter opportunity, provided their use is of mutual benefit to both the landowner and sportsman.

The recreational value of fish and wildlife is of profound significance to the well-being of people in the basin, possibly even more so than the food value of this resource. The opportunity to hunt and fish will not automatically remain. Therefore, fish and wildlife resources must be considered in the comprehensive plan of improvement for the Pascagoula River Basin. The need or market for providing additional fish and wildlife opportunities for the basin was measured by the Bureau of Sport Fisheries and Wildlife in terms of man-days of fishing and hunting. The present and projected levels of man-days for sport fishing and hunting by that segment of the population 12 years and older in the basin are given in Table 14. These projections, developed by the Bureau of Sport Fisheries and Wildlife (Appendix I), were based upon projections of service area population contained in Appendix E and per capita demand factors from unpublished Census South data compiled by the Bureau of the Census during the 1960 Survey of Fishing and Hunting. The projections show an overall increase of about 135 percent in the number of residents, 12 years old and over, who will engage in these activities. These resident fishermen and hunters will account for a 120 percent increase in the total number of man-days of participation in hunting and fresh- and saltwater fishing between the years 1965 and 2015.

Table 14

Present and projected annual sport fishing and hunting demand
in the Pascagoula River Basin

Area	Population - 12 yrs.& older			Fishing demand[1]			Hunting demand[2]		
	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total
				(man-days)			(man-days)		
LEAF SUBAREA									
1960	52,008	78,568	130,576	210,112	285,769	595,881	59,289	206,634	265,923
1965	56,018	76,382	132,400	226,313	375,036	601,349	63,861	200,885	264,746
1980	72,827	73,973	146,800	294,221	363,207	657,428	83,023	194,549	277,572
2015	166,532	82,768	249,300	672,789	406,391	1,079,180	189,846	217,680	407,526
CHICKASAWHAY SUBAREA									
1960	41,112	51,944	93,056	166,092	255,045	421,137	46,868	136,613	183,481
1965	44,698	50,002	94,700	180,580	245,510	426,090	50,956	131,505	182,461
1980	52,053	47,247	99,300	210,294	231,983	442,277	59,340	124,260	183,600
2015	87,470	62,230	149,700	353,379	305,549	658,928	99,716	163,665	263,381
COASTAL SUBAREA									
1960	89,874	47,318	137,192	363,091	232,331	595,422	102,456	124,446	226,902
1965	109,440	50,560	160,000	442,138	248,250	690,388	124,762	132,973	257,735
1980	170,053	57,747	227,800	658,014	283,538	970,552	193,860	151,875	345,735
2015	403,603	105,997	509,600	1,630,556	520,445	2,151,001	460,107	278,772	738,879
PASCAGOULA BASIN									
1960	182,994	177,830	360,824	739,295	873,145	1,612,440	208,613	467,693	676,306
1965	210,156	176,944	387,100	849,031	868,796	1,717,827	239,579	465,363	704,942
1980	294,933	178,967	473,900	1,162,529	878,728	2,041,257	336,223	470,684	806,907
2015	657,605	250,995	908,600	2,656,724	1,232,385	3,889,109	749,669	660,117	1,409,786

[1]Man-days fishing demand per capita 12 years and older.

Urban - 4.04 days annually
Rural - 4.91 days annually

[2]Man-days hunting demand per capita 12 years and older.

Urban - 1.14 days annually
Rural - 2.63 days annually

COMMERCIAL FISHING NEEDS

A valuable commercial fishery resource exists in the Pascagoula River Basin, especially in the estuarine zone. Means of maintaining and enhancing this resource are considered an important part of the overall fish and wildlife requirements.

NAVIGATION NEEDS

The economic development of an area is greatly stimulated by a complete transportation complex that consists of all forms of transportation, including navigation. The need for a navigable waterway is dependent upon a sufficient volume of those commodities that can be moved at a savings by this form of transportation. The prime requisite for efficiency in barge transportation is consolidation of large volumes of freight at central points. Waterway service is generally restricted to a fairly limited range of commodities which are mostly bulky and, in many instances, unprocessed items. Typical commodities particularly adaptable to low-cost waterway transportation include bulk grains, chemicals and related products, and unprocessed non-metallic minerals. Some of the more important natural resources in the Pascagoula River Basin are petroleum, natural gas, water, timber, clays, sand and gravel. The availability of barge transportation would encourage the construction of plants in the middle and upper portions of the basin, utilizing one or more of these natural resources as raw material in the manufacturing process.

In view of the superiority of water transportation for some elements of the mass transportation market and the desires of local interests, investigations were made to determine the justification of providing suitable channels for modern barge transportation from Pascagoula to Hattiesburg on the Leaf River, to Laurel on Tallahala Creek, a tributary of Leaf River, and to Meridian on Okatibbee Creek, a tributary of Chickasawhay River. Studies included a review of previous navigation reports on the streams, a canvass of shippers and receivers of freight in the tributary area to determine the present traffic flow pattern, a freight rate analysis to develop information on commerce that could reasonably be expected to move on the waterways at a savings in transportation charges, and preliminary cost estimates for barge navigation.

The total potential waterborne commerce developed by canvass and study amounted to 2,908,000 tons, of which 1,617,000 tons were inbound and 1,291,000 tons outbound. The commodities comprising the potential commerce were analyzed and all items were eliminated which obviously could not move over the waterway because of the nature of the particular commodity, the circuity of routing or for other

reasons. The remaining traffic amounted to 2,470,000 tons, of which 1,332,000 tons were inbound and 1,138,000 tons outbound. This traffic, shown in Table 15 by commodity groups, was analyzed with respect to present and prospective transportation charges. Details of the analysis are given in Appendix D.

Table 15

Traffic subjected to rate analysis in the Pascagoula River Basin

Commodity and commodity group	Tonnage		
	Inbound	Outbound	Total
Animals and animal products, inedible	1,500	1,000	2,500
Vegetable food products	150,800	0	150,800
Vegetable products, inedible	13,700	61,700	75,400
Wood and paper	315,600	513,900	829,500
Non-metallic minerals	769,800	551,000	1,320,800
Metals and manufactures	11,800	4,600	16,400
Chemicals and related products	69,000	5,900	74,900
Total (rounded)	1,332,000	1,138,000	2,470,000

HYDROELECTRIC POWER NEEDS

The needs for power in the area are such that hydroelectric developments in the Pascagoula River Basin could be readily utilized. However, there are no facilities of this type in the basin and the potential for providing them is limited. Studies by the Corps of Engineers in 1937, 1944 and 1959 showed that development of hydroelectric power projects in the basin was not then economically feasible. The head and runoff at prospective damsites in the basin are sufficient only for the installation of small capacity plants and the wide valleys and poor foundation conditions result in high costs for the dam and powerplant facilities. Additional studies made by the Corps of Engineers for this report confirm the previous conclusions that development of hydroelectric power is not economical at this time. However, the sites afford opportunities for future development to meet the growing power needs of the area. The studies are given in Appendix D.

AGRICULTURAL LAND AND WATER MANAGEMENT NEEDS

Gully and sheet erosion is a problem in the Pascagoula River Basin. Studies by the Department of Agriculture indicate there are 3,106,500 acres that have an erosion problem or are susceptible to erosion. Approximately 857,800 acres are presently eroded in varying degrees. Of this amount, sheet erosion is moderately to severely active on 530,300 acres of cropland and slightly to moderately active on 327,500 acres of pasture and idle land. There are 28,420 acres of forest land and 61,150 acres of open land that are considered critical and in need of treatment. Gully erosion is active on 8,000 acres of gullies, pits and abandoned logging trails on open land, and 32,865 acres of logging trails in forest lands.

Damages from soil deposition are relatively minor. However, soil deposition contributes to the flooding problem by filling stream channels. Sediment in the streams also causes water quality problems. Some scour damage occurs on the floodplain, but this damage is limited and does not appreciably affect the productivity of the land.

Surface drainage is a problem on 463,000 acres of land near the coast in the southern portion of the basin. The hydrologic cover conditions of the land also cause excessive runoff from uplands in much of the basin.

An effective conservation program, based upon the use of each acre of land within its capability along with needed treatment, is necessary for a sound agricultural land and water management program. Basic to reaching this objective is the establishment and maintenance of applicable land treatment measures.

Land treatment measures are needed to reduce erosion, improve the hydrologic condition of the land, improve drainage, and stabilize critical areas. Major land treatment measures needed are: conservation cropping system, 590,000 acres; pasture planting and renovation, 600,000 acres; terracing, 4,000 miles; grassed waterways, 5,200 acres; drainage ditches, 2,200 miles; farm ponds, 10,200; tree planting, 680,500 acres; and hydrologic stand improvement, 1,836,000 acres. Critical area measures needed are: grasses and legumes, 15,000 acres; roadside erosion control, 8,500 miles; tree planting, 74,600 acres; logging trail stabilization, 32,900 acres; and fencing, 1,300 miles.

ENVIRONMENTAL QUALITY NEEDS

Water and related land resource needs of this nature derive from the amenities and aesthetics that determine the quality of environment. They include measures for creation, restoration, enhancement, and preservation. In the Pascagoula River Basin, a number of environmental quality needs would be satisfied with provision for needs of other types previously cited. Creation of reservoirs for multiple needs, including general recreation and fish and wildlife enhancement, would provide scenic and other aesthetic values associated with the impoundments and adjoining project lands, particularly desirable in a basin with no natural lakes of significant size. Similar values would accrue from restoration of polluted water areas, such as Tallahala Creek below Laurel and the Escatawpa River estuary at Moss Point and Pascagoula, and from restoration of watershed areas scarred by gully and sheet erosion. In addition, consideration should be given to the preservation of streams or selected reaches of streams in their natural state as scenic or "wild" river areas or as free-flowing float-fishing streams.

OTHER WATER ASSOCIATED NEEDS

The tidal section of the Pascagoula River is subject to occasional flooding by wind tides, particularly those caused by hurricanes. In compliance with authorization contained in Public Law 71, 84th Congress, 1st Session, approved June 15, 1955, studies were made in this region by the Corps of Engineers as part of the Hurricane Survey. An unfavorable report entitled, "Report on Hurricane Survey of Mississippi Coast," was issued in January 1965. It was recommended, however, that local interests consider the development of emergency preparedness and evacuation plans, building codes, and flood plain zoning regulations to reduce future tidal flood damages and hazards to life.

One of the more important needs to be met before proper development of the basin can be realized is the establishment of an effective water hygiene program by the state health agencies. Determination of raw water quality in light of all chemical characteristics included in the Public Health Service 1962 Drinking Water Standards has not been made a part of this report. Health significance of high total and fecal coliform densities has not been determined on streams where proposed reservoirs include recreation as a purpose. Continual surveillance of finished drinking water supplies, as well as waters used for contact recreation, is necessary for proper planning, development and safe utilization of the projects.

CHAPTER 6

SOLUTIONS CONSIDERED

INTRODUCTION

A comprehensive plan of development first must take into account the existing and currently planned improvements that affect the total needs in the basin. Then, it must provide for additional improvements or modifications of existing facilities as required to bring the overall program into balance; i.e., to satisfy the present and future needs in the most economical manner, consistent with the broad planning objectives and with due consideration of alternative measures for meeting the needs.

The water and related land resource needs of the Pascagoula River Basin, discussed in the previous chapter, may be met by a variety of methods, including single-purpose and multiple-purpose solutions. Consideration of the various solutions provided an insight into resource capability and alternative measures, structural and non-structural. In turn, this provided a basis for formulating a comprehensive plan for developing the water and related land resources of the basin, including a specific early-action program and a framework for future planning.

The solutions considered are discussed in the following paragraphs.

SINGLE-PURPOSE SOLUTIONS

Flood control. The single-purpose solutions considered for the flood problem in the basin included channel improvements, levees, flood control reservoirs, upstream floodwater retarding structures, stream diversion, flood plain evacuation, and flood plain management.

The possibility of providing local protection projects such as channel deepening and widening, the construction of levees and walls, and the provision of drainage systems and pumping stations in rural and urban areas was investigated. However, due to the distribution of the agricultural losses over long reaches and the high cost of protection, improvements of this type in the rural areas could not be economically justified. For the urban areas, eighteen projects were evaluated. Twelve of these projects were eliminated during early screening studies due to the small amounts of concentrated damages in the areas to be protected and the excessive cost of protection. Of the remaining projects, five were considered as alternatives to upstream reservoirs and one for protection against hurricane tides in the coastal area. All were found to be economically unfeasible.

The local flood protection projects considered are listed in Table 16.

Flood control storage as a single-purpose solution was investigated for both headwater and downstream areas. Analyses of 63 upstream watersheds covering the basin showed such storage in retarding structures effective and economically feasible for the control of floods in 17 of the watersheds in the upper portion of the basin. Thirty other watersheds have potential for the future. Floodwater retarding structures would reduce flood damages in the 17 watersheds by about $749,000 annually. On the major streams and other tributaries in the basin, it was determined, after screening 41 potential reservoir sites, that flood control storage totaling 795 thousand acre-feet in five reservoirs could reduce downstream damages to present development by about $830,000 annually. As single-purpose flood control projects, four of the reservoirs have benefits in excess of costs. When considered as an increment in a multiple-purpose reservoir, flood control storage at the fifth site would also be economically feasible.

Flood damages in the basin could not be relieved through the diversion of water from one stream to another. The relative locations of the streams are such that at no point could the necessary transfer of water be effected economically.

Serious consideration was not given to flood plain evacuation due to the degree of urban development in the flood plain at Hattiesburg and other centers. Further, even if evacuation were practicable and economically feasible, residents of the area would prefer remaining with existing risks rather than evacuating the area.

Flood plain management has the broad purposes of preventing public or private investment in areas where unusual hazards and potential flood losses exist, and protecting existing public and private investment in the flood plains by precluding activities which would adversely alter the flow conditions and increase the existing flood hazards. Specific regulations such as zoning, building codes, subdivision regulations and city ordinances can be used to regulate the use of the flood plain, adapt structures in the flood plain to be resistant to flood hazards, develop emergency evacuation plans and make the public aware of the flood hazard in these areas. However, the execution of any effective flood plain management program is encumbered by individual property rights, economic pressures, enforcement problems, and lack of public awareness.

In the Pascagoula River Basin to date, there has been little experience in this type of program. Much more consideration should be given to it by State and local interests as a practical solution

Table 16

Local flood protection projects considered
in the Pascagoula River Basin

Location[1]	Principal stream	Remarks[2]
Quitman	Chickasawhay River	Eliminated during early screening studies
Shubuta	Chickasawhay River	Eliminated during early screening studies
Collins	Okatoma Creek	Eliminated during early screening studies
Hattiesburg	Leaf River	Alternative to upstream flood control reservoir
Petal	Leaf River	Alternative to upstream flood control reservoir
Harvey	Leaf River	Alternative to upstream flood control reservoir
Merrill	Pascagoula River	Eliminated during early screening studies
Leakesville	Chickasawhay River	Eliminated during early screening studies
McLain	Leaf River	Alternative to upstream flood control reservoir
Moss Point	Pascagoula River & tides	Evaluated in "Report on Hurricane Survey of Mississippi Coast", January 1965
Vancleave	Bluff Creek	Eliminated during early screening studies
Ellisville	Tallahala Creek	Alternative to upstream flood control reservoir
Laurel	Tallahala Creek	Alternative to upstream flood control reservoir
New Augusta	Leaf River	Alternative to upstream flood control reservoir
Beaumont	Leaf River	Alternative to upstream flood control reservoir
Richton	Thompson Creek	Eliminated during early screening studies
Chicora	Chickasawhay River	Eliminated during early screening studies
Waynesboro	Chickasawhay River	Eliminated during early screening studies

[1]All towns are located in the State of Mississippi.
[2]All projects were found to be economically unfeasible.

to flood problems. The adoption of such measures, in many instances, would materially reduce flood damage potential. Wise utilization of the flood plains is an economic need and is being strongly encouraged through a broad program initiated late in 1966 by the President and Congress. Objectives of the program are outlined in "A Unified National Program for Managing Flood Losses," House Document No. 465, 89th Congress, 2nd Session. Under the provision of Section 206, Public Law 86-645, State and local governments and their planning agencies may request flood plain information and certain technical services from the Corps of Engineers to assist them in meeting the objectives of the program and in planning for use and regulation of flood plain areas.

Water quality control. Studies which are shown in Appendix G, indicated that four areas in the basin have water quality problems. These areas are Okatibbee Creek below Meridian, Tallahala Creek below Laurel, Leaf River below Hattiesburg, and Escatawpa estuary at Pascagoula and Moss Point.

Solutions to the water quality problems in the basin include secondary waste treatment, tertiary treatment, advanced waste treatment, special treatment and waste control methods, dilution and diversion of wastes.

Primary and some secondary waste treatment are the presently used methods of water quality control in the basin. The full practicable and economical development of secondary treatment facilities is considered a basic step in solving the water quality problems. However, since this treatment would satisfy only a part of the needs, other types of solutions must be considered.

Tertiary treatment and advanced waste treatment methods with efficiencies greater than those expected for primary and secondary processes are not presently being used. Research to date indicates the physical feasibility of advanced waste treatment for removal of nutrients, but the cost is extremely high.

Special treatment and waste control methods could be employed in some cases. Various industries in the basin are conducting studies to determine possible methods which may be used. To date, the studies indicate the cost of such measures to be extremely high when compared with secondary treatment methods.

Natural assimilation of residual wastes by increasing streamflow and by diverting waste effluents beyond the local area to points of greater streamflow were investigated during the course of the study. In the Escatawpa estuary area, it was determined that large volumes

of treated wastes might be transported to the Gulf of Mexico as an alternative to lowflow augmentation. Such a system would consist of an interceptor for all wastes now entering the Escatawpa River, a plant providing primary treatment of these wastes, and an ocean outfall. However, dilution flow, provided by reservoir storage, was found to be the most practical solution in the critical areas of the Pascagoula River Basin for water quality control beyond the level expected to be achieved by improved waste treatment.

Water supply. There are several possible solutions to the municipal and industrial water supply problems in the Pascagoula River Basin. These include curtailed use of water, pricing, groundwater developments, surface water developments, diversion from adjacent basins, and conversion of saline or brackish water into fresh water. Various combinations of these solutions may be needed to solve the water supply problem in a particular area.

Curtailed use of water, other than prudent utilization without undue waste, does not fit into the expected development pattern in the Pascagoula River Basin and is not a realistic solution. If such a measure were adopted, the lack of an adequate water supply would inhibit the economic growth of the area and could depress living standards.

A pricing policy to restrict use would not be consistent with the expected economic growth in the basin.

Groundwater developments were considered for satisfying water supply requirements of those areas of the basin where these resources existed in sufficient quantity. Data on the distribution of groundwater in the basin are given in Appendix K, and details on existing groundwater developments are presented in Appendix G. Small local requirements and scattered agricultural requirements can be satisfied by small-scale groundwater developments or individual wells.

Surface water developments were also considered for satisfying water supply requirements for those areas of the basin where preliminary studies indicated the possibility of reservoir storage. Water can be drawn directly from the reservoir and piped to the desired location or it can be released from the reservoir and withdrawn from the downstream channel, provided the proper stream quality is maintained. Single-purpose reservoir development costs for a given water supply vary from location to location, depending on the scale of development. For example, the average annual cost for the development of such a reservoir on Bowie Creek near Hattiesburg to provide 108 million gallons of water per day is estimated to be $590,000, while the average annual cost for development of a 100 million gallon per day single-purpose water supply reservoir on the Escatawpa River near the George-Jackson County line is estimated to be $1,060,000.

Diversion from other basins adjacent to the Pascagoula would serve as a means of augmenting surface water supplies, but this solution is generally precluded by the fact that the neighboring basins have preemptive requirements for present and future water and related land resource developments. Even if the water resources of a neighboring basin could be considered as surplus to its needs, the costs of developing such diversion probably would be prohibitive.

Conversion of saline or brackish water into fresh water could provide a means of water supply for some areas of the basin. However, under present conditions, this is not an economical solution. The facilities required would have a high construction cost and a high average annual operating cost. In addition, operation of the facilities would likely place a severe burden on available energy resources.

General recreation. Provisions for general recreation are not dependent on water resource development alone. The increasing demand for water-enhanced recreation activities, principally camping and picnicking, can be met in part at sites surrounding the future water impoundments in the basin and through expanded facilities of the U. S. Forest Service, Mississippi Game and Fish Commission, Mississippi Park System, Mississippi Forestry Commission, and local county and city parks. In addition, part of the demand can be met through providing greater access to the Pascagoula River and its tributaries and providing picnicking and camping sites where such access has been made available. Canoe-trip camping could be provided for at such sites, as well as at additional sites kept in a more primitive condition along the river as scenic or wild areas. Some stream improvement and provision of access every 15 or 20 miles along some of the basin streams would result in considerably more boating. Much of the needs for water-dependent recreation — swimming, boating and related water sports — could be met by water impoundments at potential reservoir sites on the main streams and tributaries and in upstream watersheds and National Forests. However, the projected demand for boating would not be satisfied even with full development of the streams and potential reservoirs by the year 2015. All of these items were given consideration in the recreation study, which is presented in Appendix H.

Fish and wildlife enhancement. Provisions for hunting and sport fishing also are not dependent on water resource development alone. As described in Appendix I, the Pascagoula River Basin presently contains excellent upland game and sport fisheries habitat and populations. Basin inhabitants have unusual opportunities for resource utilization on private and public lands and in fresh and salt water. Included in the diversified fishery habitat are several excellent float-fishing streams only partially developed for access and boat

launching. The basin contains many nature areas associated with coastal marshes, upland pine forests, and mixed bottomland hardwoods.

The increasing demand for fish and wildlife activities, like that for general recreation, can be met in part through expansion and existing programs and facilities of Federal, State and local agencies. A high-value fish and wildlife resource and associated use opportunity, in conjunction with potential water resource developments, would establish a diversified fish and wildlife program to help satisfy the present and anticipated future needs of the basin. This could be obtained through the provision of access to and use of impounded water areas, utilization of project lands for wildlife management purposes, provision of reservoir releases of suitable quality and quantity for maintenance of downstream sport and commercial fishery resources, protection and preservation of valuable estuarine habitat areas, establishment of a refuge for preservation and possible increase of a remnant flock of the Florida sandhill crane, preservation of Black Creek as a free-flowing float-fishing stream, and preservation of Red Creek and Chunky River as free-flowing streams.

Navigation. A channel, with a minimum depth of 9 feet and sufficient width to permit two-way navigation would be required in the Pascagoula River system to attract modern barge service and effect a reduction in transportation charges sufficient to divert traffic from other methods or routes. Studies of streamflow records and other characteristics of the rivers indicated that it would be physically impracticable to provide a dependable 9-foot channel by open river methods above about mile 47 on the Pascagoula River, even with flow augmentation by means of storage dams. Therefore, canalization above mile 47 would be the only practicable means to provide a dependable navigation channel throughout the system.

Three plans of improvement, referred to as plans A, B and C, were considered. Plan A would provide for improvement of the Pascagoula and Leaf Rivers from Pascagoula to Hattiesburg. Plan B would provide for improvement of the Pascagoula and Leaf Rivers to Hattiesburg and Tallahala Creek to Laurel. Plan C. would provide for improvement of the Pascagoula and Leaf Rivers to Hattiesburg, Tallahala Creek to Laurel, and Chickasawhay River and Okatibbee Creek to Meridian. None of these plans had benefits in excess of the cost. Since the cities of Hattiesburg, Laurel, and Meridian are presently the only terminals which would reasonably be expected to generate significant volumes of traffic, development of a lesser scope, such as channel improvements as far as Merrill, offered an even less feasible possibility. However, recent discovery of large deposits of sulphur in the vicinity of Merrill may possibly provide sufficient additional volumes of traffic in the future to warrant development of navigation to Merrill.

Details of the navigation study, including the first cost, annual charges, benefits, and benefit-to-cost ratios for the three plans considered, are described in Appendix D.

Hydroelectric power. The possibility of providing single-purpose reservoirs for hydroelectric power was investigated at five prospective damsites in the basin. At all of these sites, the head and runoff were sufficient only for the installation of small capacity plants. In addition, the wide valleys and poor foundation conditions resulted in high costs for the dams and powerplant structures. Therefore, as single-purpose projects, none of the five reservoirs has benefits in excess of costs. The benefit-to-cost ratio of specific power facilities alone would be less than unity. Details on the projects considered, including the first costs, annual charges, benefits, and benefit-to-cost ratios, are given in Appendix D.

Agricultural land and water management. The most practical solution to the agricultural land and water management problems of the basin was determined to be a continuation and acceleration of current land management and conservation programs. Floodwater retarding and multiple-use structures within the 17 upstream watersheds would reduce flooding on these tributaries and downstream reaches. In addition, water would be provided for recreation and fish and wildlife enhancement. Land treatment and structural programs would benefit the entire basin by reducing erosion and sediment accumulation in stream channels and by reducing damages resulting from annual rains and floods. Details of the forest management and land treatment programs are contained in Appendix F.

Environmental quality. As stated previously, creation of reservoirs for multiple needs would provide scenic and other aesthetic values associated with the impoundments and adjoining project lands. Investigations conducted for this report revealed that no significant archeological or historical sties were within the potential reservoir areas. However, all reservoir areas should be thoroughly investigated for archeological and historical information prior to construction and inundation. Restoration of polluted water areas and watershed areas scarred by gully and sheet erosion would also increase the environmental quality of the basin. In addition, consideration should be given to the preservation of streams or selected reaches of streams in their natural state as scenic or "wild" river areas or as free-flowing float-fishing streams.

MULTIPLE-PURPOSE SOLUTIONS

Reservoirs are capable of satisfying different requirements at the same time, either by multiple use of the same storage or by inclusion of storage increments to serve additional purposes. Storage

reservoirs used for water supply and water quality control not only serve these purposes but also create a recreational resource by providing bodies of water. These, just by their existence, will serve to satisfy some of the recreation demand. The addition of recreation facilities and developed recreation areas around these reservoirs will meet an even greater portion of the recreation demand. The joint-use of the large scale facilities for flood control, water quality control, water supply, and outdoor recreation, including fishing and hunting, results in a substantial reduction in the costs for each purpose when compared to the single-purpose use of storage to provide identical amounts of goods and services.

Studies revealed that multiple-purpose projects could be economically developed at 5 sites considered previously for single-purpose flood control reservoirs and at 7 other sites in the basin. In addition, 11 other sites were determined to be potentially feasible for development at some future date.

Investigation of the possibility of developing multiple-purpose projects at those sites considered previously for single-purpose power projects revealed that the specific cost to power alone at each site exceeded the power benefits and, therefore, power could not be considered as a purpose. The investigations also revealed that multiple-purpose projects, excluding power, could be economically developed at only one of these locations which also was a flood control reservoir site.

The possibility of developing multiple-purpose structures in upstream watersheds was also investigated. The investigation revealed that multiple-purpose structures could be economically developed at 20 sites in the watersheds and that 10 other sites had potential for development in the future.

CHAPTER 7

PLAN FORMULATION

GENERAL CONSIDERATION

As previously stated, the basic objective in the formulation of a comprehensive plan of development for the water and related land resources of the Pascagoula River Basin is to provide the best use, or combination of uses, of these resources to meet the foreseeable short- and long-term needs within the study area. Plan formulation studies must consider all water and related land problems and the interrelation of project purposes and projects in order to fully develop the potentials of the basin, to foster economic development, and to enhance the conditions of health and welfare of the people and the quality of their environment.

An analysis and comparison of the solutions available to meet the needs, as discussed in the previous chapter, indicated in general terms the elements required in any comprehensive water resource development plan for the Pascagoula River Basin. The choice of flood control solutions was made on the basis of economics and the type of protection most suitable for each individual damage area. Local protection projects would not be economically feasible at the major damage centers in the basin nor would levees be feasible in the agricultural areas. It would be economical, however, to protect many of the areas with single-purpose flood control reservoirs on principal streams and with flood-water retarding structures in upstream watersheds. Provision of flood control storage in reservoirs and in upstream watershed structures needed for other purposes would be even more economical due to cost sharing between purposes. Land treatment measures and channel improvement in upstream watersheds would also alleviate flooding in the basin. In presently developed areas where protection is not economically feasible, a flood plain management program by State and local governments, in cooperation with the Federal Government, would limit the growth of uneconomic development in areas subject to flooding.

The water quality problem in the Leaf River at Hattiesburg would be alleviated by adequate secondary treatment of wastes in the area. For the other critical areas, lowflow augmentation by reservoir storage is the only practical method presently available to maintain water quality after adequate secondary treatment of wastes at their source has been accomplished. Advanced waste treatment is not, with present knowledge, a practical or economical solution.

For the major water supply needs, storage of surface water in a multiple-purpose reservoir is the principal economic solution although

abundant groundwater resources underlie most of the basin. The shallow groundwater resources have been developed intensively in the Hattiesburg, Laurel, Meridian and Pascagoula areas. However, much of the deep portion of the fresh-water section has not been developed due to the availability at shallow depths of supplies adequate for present needs. In most cases, small future needs could be met at lesser cost with groundwater than with surface water stored in single-purpose water supply reservoirs. Therefore, groundwater would be used for the relatively small local communities and individual home or farm supplies. However, for large needs, the advantages of multiple-purpose cost sharing would effect a reduction in cost and it would normally be more economical to develop the water supply quantities in multiple-purpose reservoir projects. The coastal area must depend on utilization of both ground and surface sources to meet its needs.

Outdoor recreation is not primarily dependent on major water resource developments since parks, natural areas, land, streams, and shores provide much opportunity for general recreation and fishing and hunting. On the other hand, water is an important focal point for outdoor recreation and is in great demand. Therefore, recreation and fish and wildlife enhancement were considered equal to other purposes during formulation of the comprehensive plan of development.

In the field of navigation, providing barge navigation to Hattiesburg, Laurel, and Meridian, as strongly desired by local interests, is not economically feasible at this time. However, it should be included in the comprehensive plan as a potential for future development. The regulated flow from reservoirs provided for other purposes would aid navigation should it be found feasible at some later date.

The development of hydroelectric power in the Pascagoula River Basin is uneconomical at this time. Preliminary estimates showed that the low head and small flow would produce a benefit-to-cost ratio for the specific power facilities alone of less than unity. However, hydroelectric power may still be considered as a long-range potential for development in the comprehensive plan.

Land management, conservation measures, maintenance of an adequate water hygiene program, and other nonstructural measures are vital adjuncts to any basin-wide or local water and related land resource development plan.

Environmental quality would be enhanced by measures to satisfy other needs. Scenic and other aesthetic values would accrue to the area from the creation of reservoir lakes and the restoration of

polluted and eroded areas. Similar values would be associated with the preservation of selected free-flowing streams in their natural state.

PROJECT SELECTION

General. The most important and complex problem encountered in the development of the comprehensive plan was weaving together into one overall scheme the best means of satisfying the water and related land needs of the basin and, in particular, formulating the most economical early-action portion of the plan. Selecting and fitting plan segments together and considering alternatives in the search for the proper programs, the proper number of projects, and the best size for each element of the plan required extensive analysis and coordinated effort by the study participants. During the evaluation of possible alternative solutions to the basin problems, all agencies worked cooperatively and adequately resolved questions in areas of overlapping interest in agency missions and programs so as to provide the most efficient plan to meet the needs. It was determined during the evaluation that the majority of the basin needs could be met more economically through the provision of multiple-purpose reservoirs and upstream watershed projects than by any other method. Such projects, supplemented by nonstructural measures, form the foundation for the proposed comprehensive plan.

Projects included in the comprehensive plan developed for the basin were separated into the following two categories:

- The "Early-Action Program" includes projects found necessary to meet immediate and future needs and to be economically feasible for construction within the next 10 to 15 years.

- The "Framework for Future Planning" includes projects that are not economically feasible for construction in the next 10 to 15 years but which could help meet future needs of the basin and are potentially feasible for development or are strongly supported by local interests.

Reservoirs. A preliminary selection of potential reservoir project sites, required in order to provide basic data for establishment and evaluation of plans, was made from map studies. This selection of sites having an apparent storage potential and an acceptable damsite was based primarily on topography and included all sites studied previously. Subsequently, reconnaissance-type field investigations were made of each site to obtain information on possible engineering and geological problems, economic development in reservoir areas, and general attributes of the damsites. Storage

capabilities were developed in engineering studies, along with relationships between storage capacity and preliminary cost information. Those sites having obvious defects, such as unsuitable geologic conditions and extremely poor cost-to-storage relationships were eliminated from further consideration in developing the comprehensive plan. In this manner, 41 sites were analyzed and compared. The sites are listed in Table 17 and their locations within the basin are shown on Figure 12.

During the first preliminary review, as Table 17 shows, 17 of the reservoir sites analyzed were eliminated from further consideration in developing the comprehensive plan and construction on one was initiated by the Pat Harrison Waterway District. Data on the 23 sites remaining were then developed in greater detail. Preliminary designs and cost estimates were made for each reservoir. During this phase, a preliminary evaluation of potential uses of the water resources was made. Using these data, those projects that might possibly be economically feasible and needed in the action program for development in the next 10 to 15 years were selected for an even more refined analysis. Table 18 lists the sites considered in this second review and identifies those sites which were selected for final evaluation and inclusion in the early-action program of construction.

Those sites not economically justified for the early-action program during the second review but needed to help satisfy the projected needs of the basin were adopted for inclusion in the framework for future planning.

During the evaluation of possible early-action solutions to the basin needs, it was determined that the multiple-purpose reservoir on the Leaf River near Taylorsville and an upstream watershed project in the same area had overlapping interests. Further evaluations revealed that the needs of the area could not be met by either measure alone, and that both were needed to adequately solve the problems. The most economical solution was found to be modification of the multiple-purpose reservoir to allow for development of the upstream watershed improvement. This modification consisted of requiring flowage easement rights, in lieu of fee title, on approximately 3,000 acres of land lying in the upper end of two arms of the reservoir. This land lies upstream from the end of the 100-year-frequency-flood pool and would not be needed for project purposes.

Data on the reservoirs selected for the comprehensive plan are contained in Appendixes D and N.

Table 17

Summary of preliminary analysis of reservoirs - First review
Pascagoula River Basin

Location		Drainage area		
Stream	Site No.	(sq. mi.)	Disposition[1]	Remarks
Escatawpa River	1	583	Retained	
Escatawpa River	2	425	Retained	
Escatawpa River	3	380	Eliminated	Alternate to #2. Larger controlled drainage area desirable.
Bluff Creek, Jackson County	4	49	Retained	
Moungers Creek	5	28	Eliminated	Poor cost-to-storage relationship
Red Creek	6	220	Retained	
Bluff Creek, Stone County	7	35	Eliminated	Poor cost-to-storage relationship
Flint Creek	8	10	Retained	Construction initiated by Pat Harrison Waterway District
Black Creek	9	530	Retained	
Black Creek	10	330	Eliminated	Alternate to #9. Larger controlled drainage area desirable.
Pierces Creek	11	18	Eliminated	Poor cost-to-storage relationship
Big Creek	12	46	Retained	
Whiskey Creek	13	31	Eliminated	Poor cost-to-storage relationship
Black Creek	14	45	Eliminated	Poor cost-to-storage relationship
Flint Creek	15	25	Eliminated	Construction initiated on site upstream by Pat Harrison Waterway District
Leaf River	16	1,011	Eliminated	Extensive relocations
Leaf River	17	422	Retained	
Thompson Creek	18	176	Retained	
Bogue Homo Creek	19	127	Eliminated	Extensive relocations. Better adapted to upstream watershed development.
Tallahala Creek	20	152	Retained	
Bowie Creek	21	293	Retained	
Oakohay Creek	22	150	Retained	
Big Creek, Greene County	23	130	Retained	
Bucatunna Creek	24	495	Retained	
Bucatunna Creek	25	263	Retained	
Long Creek	26	69	Eliminated	Alternate to #25. Larger controlled drainage area desirable.
Chickasawhay River	27	1,640	Retained	
Eucutta Creek	28	67	Eliminated	Large operating oil field in reservoir site.
Shubuta Creek	29	92	Eliminated	Topographic limitations and extensive relocations
Souinlovey Creek	30	103	Eliminated	Better adapted to upstream watershed development. Extensive interstate highway relocations.
Chunky River	31	509	Eliminated	Extensive highway and railroad relocations
Tallahatta Creek	32	70	Retained	
Tallahatta Creek	33	47	Eliminated	Site 32 provides larger storage.
Bogue Flower Creek	34	11	Eliminated	Better adapted to upstream watershed development
Tallahoma Creek	35	111	Retained	
Tallasher Creek	36	95	Retained	
Little Black Creek	37	16	Retained	
Archusa Creek	38	16	Retained	
Kittrell Creek	39	10	Retained	
West Tiger Creek	40	6	Retained	
Whetstone Creek	41	7	Retained	

[1] Those sites eliminated were not given further consideration in developing the comprehensive plan.

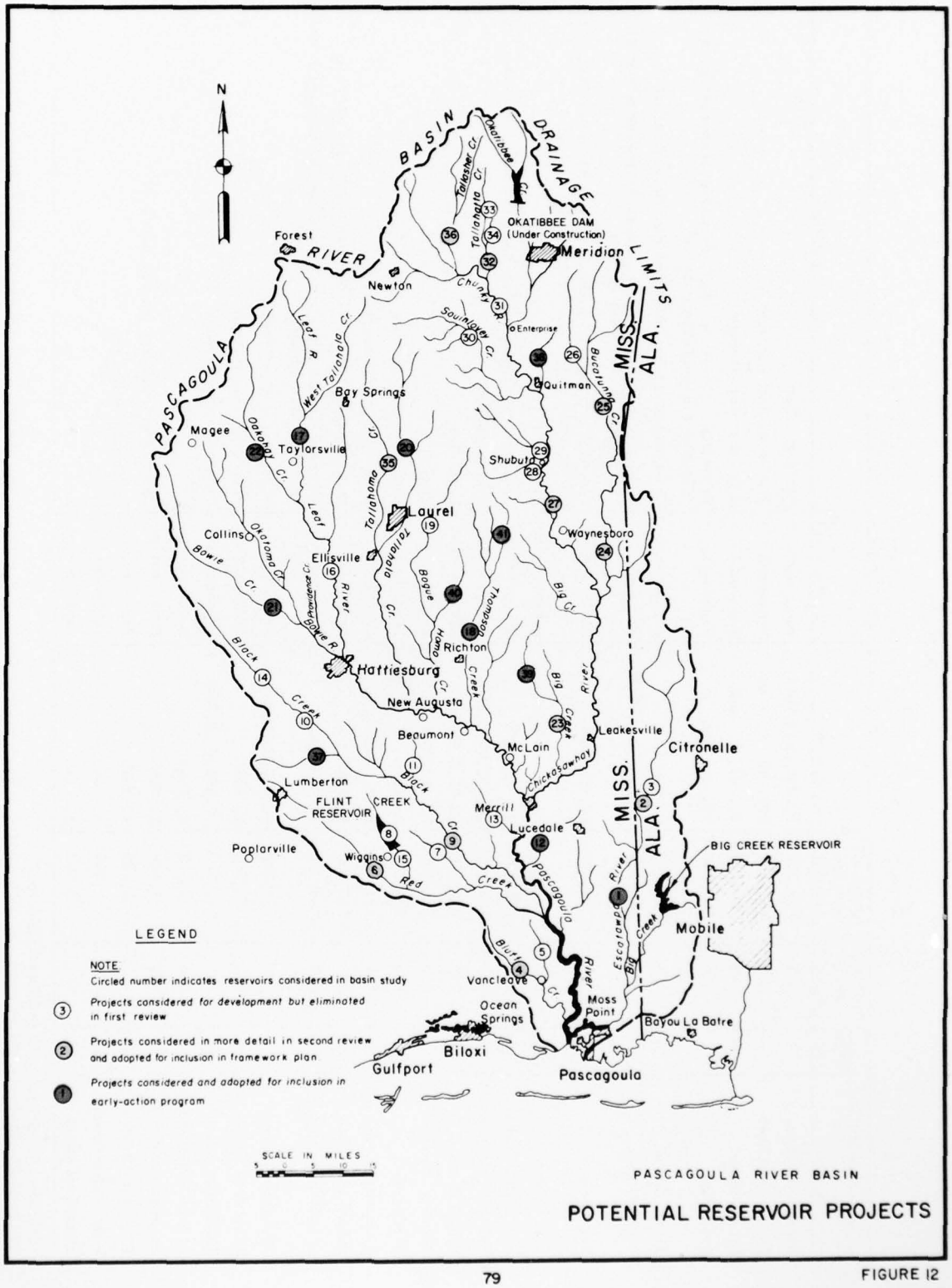

N
PASCAGOULA RIVER BASIN DRAINAGE
OKATIBBEE DAM (Under Construction)
Meridian
Forest
Newton
Enterprise
Quitman
Bay Springs
Magee
Taylorsville
Shubuta
Laurel
Collins
Ellisville
Waynesboro
Hattiesburg
Richton
New Augusta
Beaumont
McLain
Leakesville
Citronelle
Lumberton
FLINT CREEK RESERVOIR
Merrill
Lucedale
Poplarville
Wiggins
BIG CREEK RESERVOIR
Mobile
Vancleave
Ocean Springs
Moss Point
Bayou La Batre
Biloxi
Gulfport
Pascagoula
MISS.
ALA.
LIMITS
LEGEND
NOTE
Circled number indicates reservoirs considered in basin study
(3) Projects considered for development but eliminated in first review
(2) Projects considered in more detail in second review and adopted for inclusion in framework plan
(1) Projects considered and adopted for inclusion in early-action program
SCALE IN MILES
PASCAGOULA RIVER BASIN
POTENTIAL RESERVOIR PROJECTS

FIGURE 12

Table 18

Summary of preliminary analysis of reservoirs - Second review
Pascagoula River Basin

Location		Drainage area	Potential[1] storage			
Stream	Site No.	(sq.mi.)	(ac-ft)	Purpose[2]	Disposition	Remarks
Escatawpa River	1	583	948,300	FC,WQC,WS,R,F&WL	Early action	Harleston Dam
Escatawpa River	2	425	442,000	WQC, WS, R, F&WL	Framework	High cost for storage
Bluff Creek	4	49	49,000	FC, WS, R, F&WL	Framework	High cost for storage
Red Creek	6	220	187,000	WS, R, F&WL	Framework	Extensive relocation cost. Possible preservation as free-flowing float-fishing stream
Flint Creek	8	10	12,800	R, F&WL, WS	Constructed	Constructed by Pat Harrison Waterway District
Black Creek	9	530	586,000	P,FC,WS,R,F&WL,C	Framework	Extensive relocation cost. Possible preservation as free-flowing float-fishing stream
Big Creek	12	46	54,000	WS, R, F&WL	Early action	Planning initiated by Pat Harrison Waterway District. Site moved slightly upstream.
Leaf River	17	422	572,900	FC, R, F&WL, C	Early action	Taylorsville Dam
Thompson Creek	18	176	76,800	WS, R, F&WL	Early action	Planning initiated by Pat Harrison Waterway District.
Tallahala Creek[3]	20	152	302,900	FC,WQC,WS,R,F&WL	Early action	Tallahala Dam
Bowie Creek	21	293	422,400	FC,WS,R,F&WL	Early action	Bowie Dam
Oakohay Creek	22	150	211,000	FC, R, F&WL, C	Early action	Mize Dam
Big Creek	23	130	146,000	R, F&WL	Framework	High cost for storage
Bucatunna Creek	24	495	423,000	P, R, F&WL	Framework	High cost for storage
Bucatunna Creek	25	263	228,000	R, F&WL	Framework	More expensive than 24 and provides less storage
Chickasawhay River	27	1,640	209,000	P, R, F&WL	Framework	Storage limitations by R.R. and towns. High cost and extensive relocations
Tallahatta Creek	70	70	61,000	FC,WQC,WS,R,F&WL	Framework	High cost for storage
Tallahoma Creek	35	111	85,000	R, F&WL	Framework	High cost for storage
Tallasher Creek	36	95	105,000	FC,WQC,WS,R,F&WL	Framework	High cost for storage
Little Black Creek	37	16	2,500	R, F&WL	Early action	Planning initiated by Pat Harrison Waterway District
Archusa Creek	38	16	2,700	R, F&WL	Early action	
Kittrell Creek	39	10	3,000	R, F&WL	Early action	
West Tiger Creek	40	6	2,000	R, F&WL	Early action	
Whetstone Creek	41	7	2,500	R, F&WL	Early action	

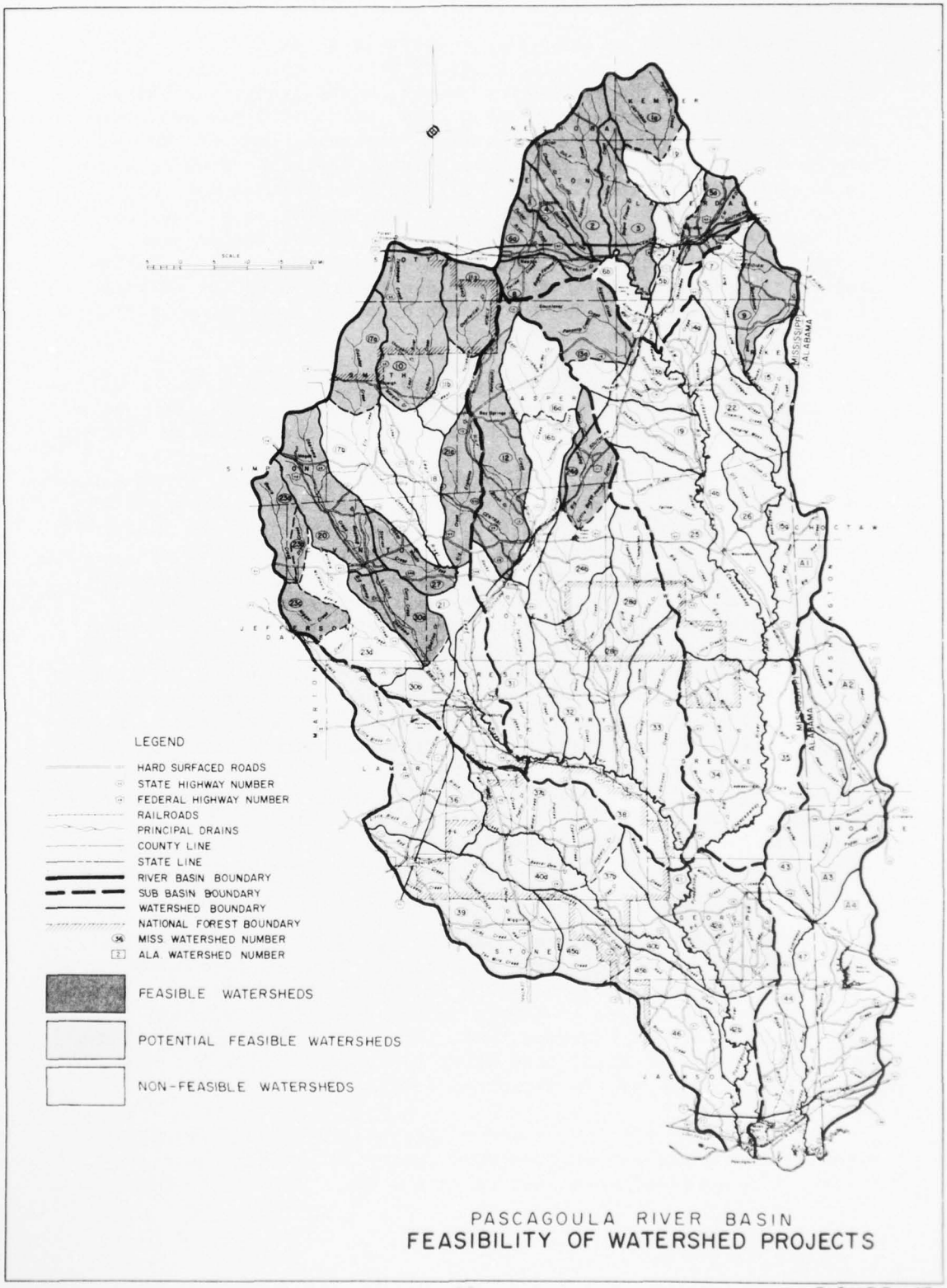
[1] Storage above required sedimentation pool.
[2] FC = Flood Control; WQC = Water Quality Control; WS = Water Supply; R = General Recreation; F&WL = Fish and Wildlife; C = Conservation for future water use needs; P = Hydroelectric Power.
[3] Included in Interim Report submitted by the Corps of Engineers in April 1966.

In addition to selecting new reservoir sites for plan formulation, it was determined that, in order to meet the required scale of development of the recreation resources throughout the basin, recreational facilities other than those originally planned would have to be provided at the authorized Okatibbee Reservoir and at the Tallahala Reservoir, now pending authorization. Studies shown in Appendix H revealed that the additional facilities would be economically justified. Provision of the facilities at the Okatibbee Reservoir is being given consideration in the master plan presently being prepared by the Corps of Engineers under existing authority. Consideration will be given to providing the additional facilities at Tallahala Reservoir during advance planning studies, if the project is authorized.

Upstream watershed projects. Land management and conservation measures are essential to any basin-wide resource development plan and were considered as the first increment in evaluation of upstream watershed projects. Policies of the Secretary of Agriculture in carrying out provisions of the Public Law 566 Watershed Protection and Flood Prevention Act served as guides in formulating projects and plans in upstream watersheds. For these studies, the Pascagoula River Basin was divided into 63 upstream watersheds. Evaluation procedures consisted of detailed studies in sample watersheds and expansion of these data to other similar watersheds for which reconnaissance studies had been made. Also, data obtained from watersheds for which Public Law 566 work plans had been prepared or preliminary evaluation made, were used to expand similar watersheds not studied in detail. Using this procedure, development of all or parts of 17 watersheds were determined as being needed and economically feasible for initiation of installation within the next 10 to 15 years. All or parts of 30 watersheds were determined to be potentially feasible and needed to help meet future requirements of the basin. The remaining 16 watersheds were eliminated from further consideration in the comprehensive plan due to the character of the soils in the flood plain or other undesirable features. The watersheds are shown on Figure 13.

Structural measures needed in the 17 feasible watersheds include 133 floodwater retarding structures, 20 multiple-purpose structures with recreational facilities and 852 miles of channel improvement. Accelerated land treatment measures and critical land area stabilization are also needed in the 17 watersheds, as well as the stabilization of critical land areas for the entire basin. Data on all of these measures are presented in Appendix F.

As indicated previously under "Reservoirs", feasible upstream watershed projects and early-action reservoir projects were found to be fully complementary, except in the case of Taylorsville



PASCAGOULA RIVER BASIN
FEASIBILITY OF WATERSHED PROJECTS

FIGURE 13

AD-A036 705 CORPS OF ENGINEERS MOBILE ALA MOBILE DISTRICT F/G 8/6
PASCAGOULA RIVER COMPREHENSIVE BASIN STUDY. VOLUME I. SUMMARY R--ETC(U)
FEB 68

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2 OF 2
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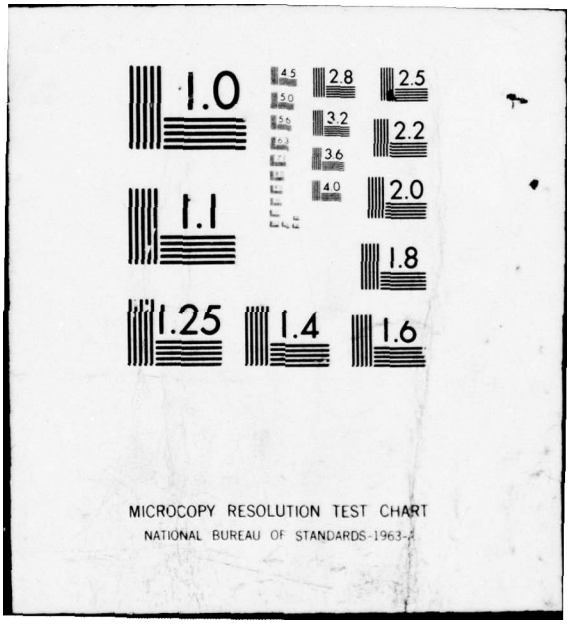

1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.2
3.6
4.0
4.5
5.0
MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

Reservoir where a slight modification of the reservoir land requirements was found to be the most economical solution. Potentially feasible reservoir and upstream watershed projects included in the framework for future planning were not analyzed in sufficient detail to evaluate any similar areas of conflict that might require choices between alternatives or compromise of the individual projects. This would be done in future planning studies.

Navigation. Investigations were made to determine justification of providing suitable channels for modern barge transportation from Pascagoula to Hattiesburg on the Leaf River; Laurel on Tallahala Creek, a tributary of the Leaf River; and Meridian on Okatibbee Creek, a tributary of the Chickasawhay River. Preliminary traffic and cost studies showed that navigation could not be economically justified to any of these cities at this time. However, recent discovery of large deposits of sulphur in the vicinity of Merrill may possibly provide sufficient additional volumes of traffic in the future to warrant development of navigation to Merrill. Other portions could be added as the need arises and the expenditure can be justified. Such a project has the strong support of local interests and therefore has been included in the framework for future planning. The considered waterway systems are shown on Figure 14. Details on the navigation study are given in Appendix D.

SUMMARY OF PLAN FORMULATION

In formulating a comprehensive plan of development for the water and related land resources of the Pascagoula River Basin, projects were screened to determine:

a. Those that are not qualified for inclusion in the plan.

b. Those that are economically feasible for construction within the next 10 to 15 years and are necessary to meet immediate and future needs (early-action program).

c. Those that are not economically feasible for construction in the next 10 to 15 years but that could help meet future needs of the basin and are potentially feasible for development or are strongly supported by local interests (framework for future planning).

An analysis of the needs of the basin and the resources available to meet them indicated that any comprehensive plan would include multiple-purpose developments consisting of reservoirs, upstream watershed projects and improvements for navigation. Included in the early-action program are 11 reservoirs and 17 upstream watershed projects. One additional reservoir is pending authorization. Within the 17 upstream watershed projects, there are 133 floodwater retarding

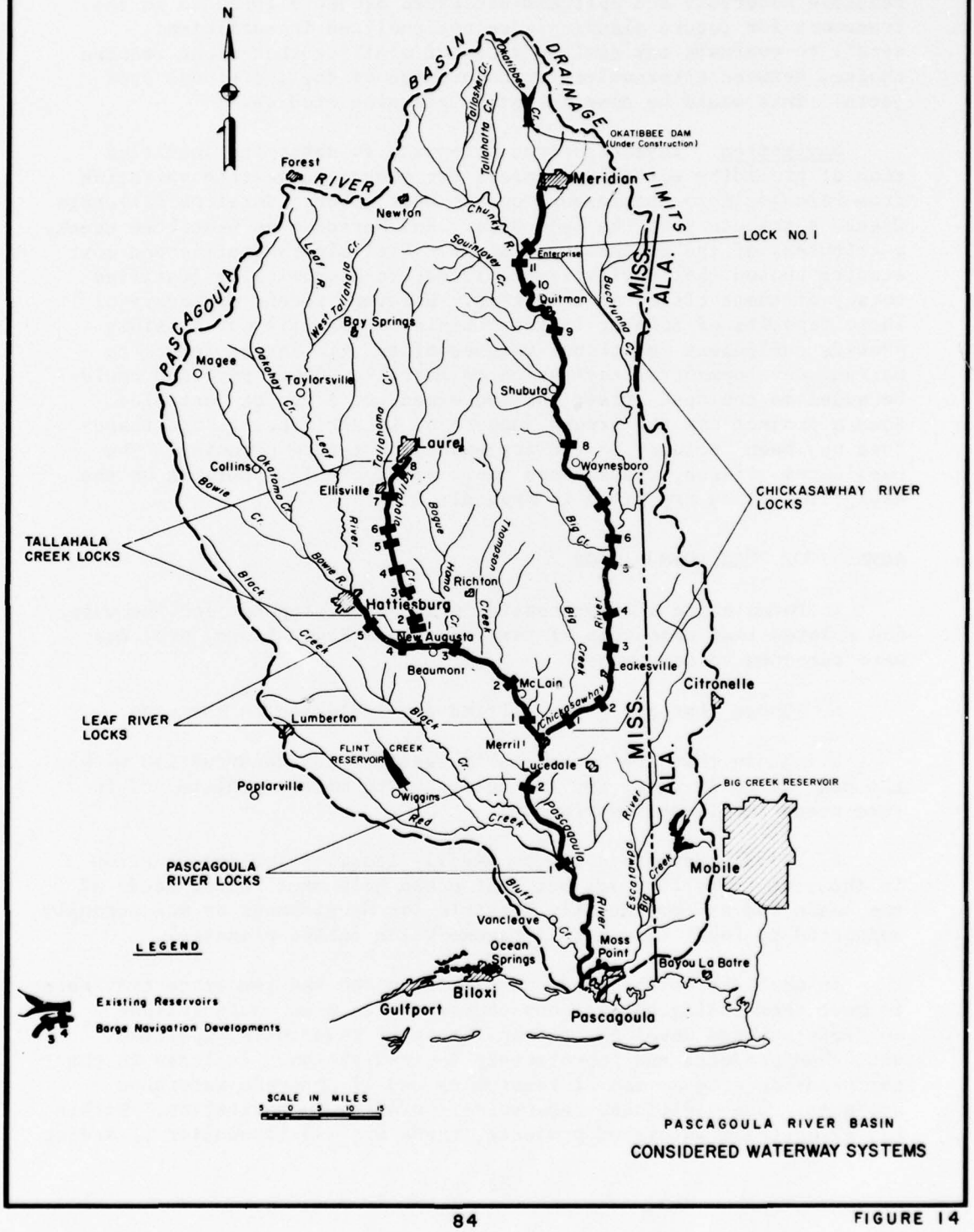

N
PASCAGOULA RIVER BASIN DRAINAGE
MISS.-ALA. LIMITS
OKATIBBEE DAM (Under Construction)
LOCK NO. 1
CHICKASAWHAY RIVER LOCKS
TALLAHALA CREEK LOCKS
LEAF RIVER LOCKS
PASCAGOULA RIVER LOCKS
Forest
Newton
Meridian
Enterprise
Quitman
Bay Springs
Magee
Taylorsville
Shubuta
Laurel
Waynesboro
Collins
Ellisville
Richton
Hattiesburg
New Augusta
Beaumont
McLain
Leakesville
Citronelle
Lumberton
Merrill
Lucedale
Flint Creek Reservoir
Wiggins
Poplarville
Big Creek Reservoir
Mobile
Vancleave
Ocean Springs
Moss Point
Bayou La Batre
Biloxi
Gulfport
Pascagoula
Okatibbee Cr.
Tallahaga Cr.
Tallahoma Cr.
Chunky R.
Squinlorey Cr.
Leaf R.
West Tallahala Cr.
Bucatunna Cr.
Dorahoy Cr.
Tallahoma Cr.
Leaf River
Okatoma Cr.
Bowie Cr.
Tallahala Creek
Bowie R.
Black Creek
Boque Homo Creek
Thompson Creek
Big Cr.
Big Creek
Chickasawhay River
Black Cr.
Red Creek
Pascagoula River
Escatawpa River
Big Creek
Bluff Cr.
LEGEND
Existing Reservoirs
Barge Navigation Developments
SCALE IN MILES
5 0 5 10 15
PASCAGOULA RIVER BASIN
CONSIDERED WATERWAY SYSTEMS

FIGURE 14

structures, 20 multiple-purpose structures, 852 miles of channel improvement, and land treatment measures for watershed protection. Stabilization of critical land areas throughout the basin is also a part of the early-action program. Included in the framework for future planning are 11 reservoirs, 30 upstream watershed projects including 10 multiple-purpose structures, and a barge navigation project. In addition, supplementary nonstructural measures complete the total plan for the Pascagoula River Basin.

The comprehensive plan is discussed in the following chapter.

CHAPTER 8

THE COMPREHENSIVE PLAN

GENERAL FEATURES OF THE PLAN

The comprehensive plan developed for the Pascagoula River Basin includes the existing, under-construction and pending-authorization water improvement facilities in the basin, and additional improvements required to meet present and long-range water and related land resource needs to the maximum practicable extent. The additional improvements are separated into the categories of:

(1) Those recommended for inclusion in an early-action program of construction; and

(2) Those recommended for inclusion in a framework for future planning.

Data on projects that constitute the comprehensive plan are given in Table 19. The locations of the structural measures are shown on Plate 1 in the back of this volume.

In addition to the structural measures listed in Table 19, nonstructural measures are also a vital part of the plan. Land treatment, critical land area stabilization and flood plain management are important examples of such measures. Other measures are: designation of streams or reaches of streams as free-flowing float-fishing streams, preservation of natural areas, establishment of a refuge for the preservation and possible increase of a remnant flock of the Florida sandhill crane, and acquisition or lease of acres of wildlife habitat for addition to the present basin wildlife management program. These measures would help satisfy recreation, fish and wildlife and environmental quality needs of the basin.

STRUCTURAL MEASURES — EARLY-ACTION PROGRAM

Structural measures included in the early-action portion of the comprehensive plan consist of: 11 multiple-purpose reservoirs; and 133 floodwater retarding structures, 20 multiple-purpose structures, and 852 miles of channel improvement in 17 upstream watersheds. An additional reservoir, located on Tallahala Creek above Laurel, was also selected for the early-action program. However, due to the urgency of the problems in the area, a plan for development of the Tallahala Reservoir was presented in an interim report submitted by the Corps of Engineers in April 1966. The project, which would provide flood control, water quality control, water supply, recreation

Table 19

Comprehensive plan of development
for the Pascagoula River Basin

RESERVOIRS

Name	Location: Stream	Location: Mile	Location: County *	Drainage area (sq.mi.)	Purpose 1/	Total storage capacity 2/ (acre-feet)	Area at normal pool (acres)
			EXISTING OR UNDER CONSTRUCTION Federal Reservoirs				
Okatibbee	Okatibbee Creek	37.7	Lauderdale	154	FC,WS,WQC,R,F&WL	142,400	3,200
			Non-Federal Reservoirs				
Flint Creek	Flint Creek	10.0	Stone	15.6	FC, WS, R, F&WL	12,800	600
Big Creek	Big Creek	10.4	Mobile, Ala.	103.0	WS, F&WL	59,500	3,600
Bogue Homo	Bogue Homo Creek	57.0	Jones	125.0	R, F&WL	---	1,200
			PENDING AUTHORIZATION Federal Reservoirs				
Tallahala	Tallahala Creek	82.1	Jasper	152	FC,WQC,WS,R,F&WL	113,000	4,000
			RECOMMENDED FOR INCLUSION IN EARLY-ACTION PROGRAM				
Harleston	Escatawpa River	42.0	George-Jackson	583	FC,WQC,WS,R,F&WL	965,000	15,900
Big Creek	Big Creek	18.0	George	16	WS, R, F&WL	3,000	400
Taylorsville	Leaf River	131.5	Smith	422	FC, R, F&WL, C	582,000	3,500
Thompson Creek	Thompson Creek	21.0	Perry	176	WS, R, F&WL	76,800	4,100
Bowie	Bowie Creek	11.0	Covington	293	FC, WS, R, F&WL	428,000	5,500
Mize	Oakohay Creek	28.0	Smith	150	FC, R, F&WL, C	211,000	3,600
Little Black Cr.	Little Black Creek	16.0	Lamar	16	R, F&WL	2,500	400
Archusa Creek	Archusa Creek	5.0	Clarke	16	R, F&WL	2,700	400
Kittrell Creek	Kittrell Creek	4.0	Greene	10	R, F&WL	3,000	329
West Tiger Creek	West Tiger Creek	8.0	Jones	6	R, F&WL	2,000	217
Whetstone Creek	Whetstone Creek	6.0	Wayne	7	R, F&WL	2,500	256
			RECOMMENDED FOR INCLUSION IN FRAMEWORK FOR FUTURE PLANNING				
Upper Escatawpa	Escatawpa River	52.0	Mobile, Ala.	425	P,WQC,WS,R,F&WL	442,000	2,900
Vancleave	Bluff Creek	15.0	Jackson	49	FC, WS, R, F&WL	49,000	360
Perkinston	Red Creek	40.0	Stone	220	WS, R, F&WL	187,000	1,900
Benndale	Black Creek	29.0	Stone	530	FC,P,WS,R,F&WL	586,000	2,600
Leakesville	Big Creek	11.0	Greene	130	R, F&WL	146,000	1,400
Bucatunna	Bucatunna Creek	12.0	Wayne	495	P, R, F&WL	423,000	3,800
Manasse	Bucatunna Creek	50.0	Clarke	263	R, F&WL	228,000	2,500
Waynesboro	Chickasawhay River	100.0	Wayne	1,640	P, R, F&WL	209,000	7,000
Graham	Tallahatta Creek	6.0	Lauderdale	70	FC,WQC,WS,R,F&WL	61,000	640
Moss	Tallahoma Creek	21.0	Jasper	111	R, F&WL	85,000	1,300
Tallasher	Tallasher Creek	3.0	Newton	95	FC,WQC,WS,R,F&WL	105,000	1,100

NAVIGATION AND FLOOD CONTROL IMPROVEMENTS

Project	Stream	Type of Improvement
	EXISTING Federal Projects	
Navigation-Pascagoula Harbor	Pascagoula and Escatawpa Rivers	Canalization
Navigation-Pascagoula River	Pascagoula River	Canalization; cleaning and snagging
Flood Control-Sowashee Cr.	Sowashee Creek	Channel Improvement
	RECOMMENDED FOR INCLUSION IN FRAMEWORK FOR FUTURE PLANNING	
Navigation channels	Pascagoula-Leaf and Chickasawhay Rivers; Tallahala and Okatibbee Creeks	Canalization

Table 19 (Continued)

Comprehensive plan of development
for the Pascagoula River Basin

UPSTREAM WATERSHED PROJECTS 3/

Watershed name 4/	Watershed number	Watershed area (acres)	Percent watershed area controlled by structural measures	Number of multiple-purpose structures 5/	Potential storage in retarding structures (acre-feet)
		RECOMMENDED FOR INCLUSION IN EARLY ACTION PROGRAM			
Upper Okatibbee Creek	1A	67,641	43.9	1	94,800
Chunky River	2, 4, 6A & 8	240,650	27.4	2	231,500
Tallahatta Creek	3	83,880	20.6	1	53,050
Sowashee Creek	5A	52,910	22.9	1	49,550
Upper Bucatunna Creek	9	77,960	33.3	1	89,800
Upper Leaf River	10	138,120	27.3	1	191,800
West Tallahala Creek	11A	64,905	10.6	1	29,600
Tallahoma Creek	12	137,264	28.6	1	144,750
Souinlovey Creek	13A	109,851	23.1	1	101,000
Oakohay Creek	17A	60,444	11.3	1	27,100
Okatoma Creek	20 & 30A	179,205	40.7	2	338,000
Big Creek	21A	80,012	31.0	2	97,300
Upper Bowie River	23A	46,603	30.6	1	52,700
Dry Creek	23B	13,954	20.5	1	9,550
West Bowie River	23C	29,601	30.7	1	35,400
Upper Bogue Homo Creek	24A	67,940	18.9	1	53,300
Station Creek	27	35,980	33.2	1	53,000
		RECOMMENDED FOR INCLUSION IN FRAMEWORK FOR FUTURE PLANNING			
Lower Okatibbee	5B	52,750	22.0	--	48,900
Lower Potterchitto	6B	25,270	16.7	--	16,300
Long Creek	7	82,660	30.9	1	69,700
Lower West Tallahala	11B	42,967	0.0	--	0
Lower Souinlovey	13B	61,053	25.0	--	56,800
Upper Chickasawhay	14A	41,205	44.1	1	47,300
Cedar Creek	15	55,220	30.0	--	62,400
Big Red	15A & A1	103,526	27.6	--	110,450
Upper East Tallahala	16A	73,550	9.8	--	28,300
Shubuta	19	87,940	32.5	1	107,600
Lower Leaf	21B	92,233	16.5	--	56,200
Five Mile Creek	22	50,560	32.5	1	107,600
Upper Bogue Homo	24B	96,900	14.8	--	61,300
Big and Yellow	25	219,980	35.1	1	261,200
Shiloh	26	74,400	20.9	--	56,500
Upper Thompson Creek	28A	75,745	19.6	--	58,100
Lower Bowie	30B	96,275	33.1	--	136,100
Lower Tallahala	31	141,780	12.0	1	71,500
Lower Bogue Homo	32	108,440	19.1	1	84,000
Gaines Creek	33	158,160	28.3	1	164,300
Big Creek	34	188,810	20.7	--	159,300
Upper Black	36	216,836	49.3	1	450,000
Cypress Creek	37A	135,434	44.1	--	249,500
Upper Red	39	197,980	45.2	--	365,800
Beaver Dam	40A	60,704	26.9	--	87,300
Whiskey Creek	41	50,740	42.4	--	96,000
Indian Creek	42A	194,174	30.8	--	216,600
Middle Escatawpa	43 & A3	183,446	31.0	--	220,850
Lower Red	45A	69,136	22.3	--	56,400
Upper Escatawpa	A2	140,293	30.6	1	187,000

* Counties are in Mississippi unless otherwise noted.

1/ FC = Flood control; WQC = Water quality control; WS = Water supply; R = General recreation; F&WL = Fish and wildlife enhancement; C = Conservation; P = Hydroelectric power.

2/ - Storage above required sedimentation pool.

3/ Accelerated land treatment for the recommended early-action projects and critical land area stabilization for the entire basin are also included in the comprehensive plan.

4/ See Plate 1 for location.

5/ Provides 3,960 acres of water surface for recreation in early-action program and 4,000 acres in framework for future planning.

and fish and wildlife enhancement to the Laurel area, is now awaiting authorization by the Congress.

The 11 multiple-purpose reservoirs and works of improvement in the upstream watersheds are described in the following paragraphs.

Reservoirs. The 11 reservoir projects would variously serve the purposes of flood control, water quality control, water supply, general recreation and fish and wildlife enhancement. These projects are listed in Table 20, with pertinent data, and their locations are shown on Plate 1.

The plan for each reservoir project consists of a compacted earthfill dam, a high-level, fixed-crest spillway for emergency use and an outlet works to regulate flow for project purposes. Recreation facilities would be provided for fishing, swimming, boating, camping, picnicking, hiking and other water-related or water-enhanced activities. An artist's conception of a completed project is shown in Figure 15.

Figure 15

Artist's conception of completed reservoir project

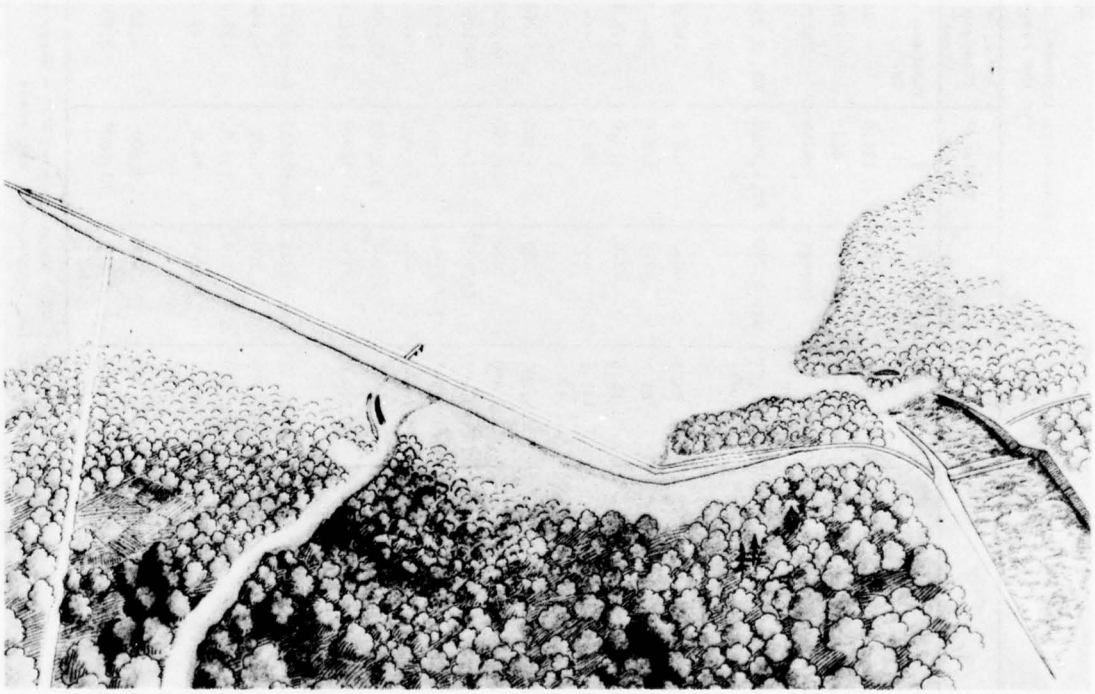


Table 20

Reservoirs included in the early-action program
for the Pascagoula River Basin

Item	Harleston	Big Creek[2]	Taylorsville	Thompson Creek[2]	Bowie	Mize	Little Black Creek[2]	Archusa Creek[2]	Kittrell Creek[2]	West Tiger Creek[2]	Whetstone Creek[2]
Stream	Escatawpa R.	Big Cr.	Leaf R.	Thompson Cr.	Bowie Cr.	Oakohay Cr.	Little Black Cr.	Archusa Cr.	Kittrell Cr.	West Tiger Cr.	Whetstone Cr.
Stream mile	42	18	131.5	21	11	28	16	5	4	8	6
Drainage area, sq. mi.	583	16	422	176	293	150	16	16	10	6	7
Dam location, county	George-Jackson	George	Smith	Perry	Covington	Smith	Lamar	Clarke	Greene	Jones	Wayne
Purpose[1]	FC,WQC,WS R,F&WL	WS, R,F&WL	FC,R,F&WL C	WS, R,F&WL	FC, WS, R F&WL	FC,R,F&WL C	R,F&WL	R,F&WL	R,F&WL	R,F&WL	R,F&WL
Pool elevations, m.s.l.											
Sedimentation	54.5	60.0	268.0	160.0	210.0	298.5	258.0	200.0	179.0	190.0	222.0
Conservation (normal)	85.5	85.0	278.0	181.5	236.0	316.0	275.0	218.0	192.0	205.0	232.0
Average summer	81.5	82.0	278.0	176.8	236.0	316.0	274.0	218.0	192.0	205.0	232.0
100-year flood	101.5	---	301.3	---	253.0	329.0	---	---	---	---	---
Storage volumes, acre-feet											
Sedimentation	16,700	500	9,100	5,700	5,600	3,000	500	500	300	200	200
Conservation	258,800	3,000	28,900	40,000	74,400	37,000	2,500	2,700	3,000	2,000	2,500
Water supply	(30,300)	(3,000)	(---)	(40,000)	(74,400)	(---)	(---)	(---)	(---)	(---)	(---)
Water quality	(228,500)	(---)	(---)	(---)	(---)	(---)	(---)	(---)	(---)	(---)	(---)
Flood (100-year pool)	323,300	---	195,000	---	135,700	70,000	---	---	---	---	---
Total, to spillway crest	965,000	3,500	582,000	45,700	428,000	211,000	3,000	3,200	3,300	2,200	2,700
Spillway crest elev., msl	114.0	85.0	319.0	181.5	267.5	340.0	275.0	218.0	192.0	205.0	232.0
Dam dimensions and data											
Type	earthfill	earthfill	earthfill	earthfill	earthfill	earthfill	earthfill	earthfill	earthfill	earthfill	earthfill
Length, feet	13,700	1,500	7,500	6,560	8,600	5,200	1,400	1,500	2,140	2,015	1,830
Top elevation, msl	125.0	95.0	331.0	197.0	279.5	350.5	283.0	228.0	202.0	213.0	240.0
Maximum height, feet	80.0	45.0	86.0	47.0	94.5	64.5	35.0	35.0	39.0	26.0	21
Areas, acres											
Average summer pool	14,000	400	3,500	4,100	5,500	3,600	400	400	329	217	256
Total to be acquired	38,100	1,000	31,000[3]	5,800[4]	22,450	13,600	700	800	730[4]	500[4]	500[4]

[1] FC = Flood control; WS = Water supply; WQC = Water quality control; R = Recreation; F&WL = Fish and wildlife; C = Conservation for future water use needs

[2] Generalized curves and assumed datum used to determine spillway crest and top of dam elevations and storage requirements.

[3] Includes 3,000 acres on which flowage easement rights will be obtained.

[4] U. S. Forest Service lands not to be acquired, only utilized.

The Harleston Reservoir would alleviate flood control, water quality control, water supply, recreation, and fish and wildlife enhancement needs in the Escatawpa River sub-basin and estuary.

The Taylorsville, Bowie and Mize Reservoirs would function as a flood control system for the downstream urban and rural areas, particularly the Hattiesburg metropolitan area. Provisions for recreation and fish and wildlife enhancement would also be included in each reservoir. In addition, storage for municipal and industrial water supply would be provided in the Bowie Reservoir, and conservation storage would be provided in the Taylorsville and Mize Reservoirs for future water needs should they arise.

The reservoirs on Big Creek, Thompson Creek, Little Black Creek, Archusa Creek, Kittrell Creek, West Tiger Creek, and Whetstone Creek would be primarily for recreation and fish and wildlife enhancement. However, water supply storage would also be provided in Big Creek and Thompson Creek.

Costs and benefits. Costs and benefits for the 11 reservoirs included in the early-action program are summarized in the following paragraphs. Details on the Harleston, Taylorsville, Bowie and Mize projects are contained in Appendix D. Details on the Big Creek, Thompson Creek, Little Black Creek, Archusa Creek, Kittrell Creek, West Tiger Creek and Whetstone Creek projects are given in Appendix N.

The total initial first cost of the 11 reservoirs is estimated to be $115,608,000 and the total with delayed recreational facilities, $135,655,000. The financial investment for each project would include the initial cost plus interest for the construction period. The "economic" investment would be the financial investment plus the present worth of future additions. No interest during construction was computed for the delayed facilities as it was assumed the cost would be incurred uniformly during the period 1980-2014. No credit was taken for salvaging reservoir lands at the end of a project's life, thus making the net investment equal to the gross investment. The total gross investment of the 11 reservoir projects would be $143,310,000, of which $123,263,000 would be for the initial project works and $20,047,000 for the delayed project works. A summary of the investment costs for each project is given in Table 21.

Annual charges for each project consist of interest on the gross investment at 3.25 percent, amortization of the net investment over a 100-year useful economic life, operation and maintenance, and major replacements. The total annual charges for the 11 reservoirs would be $5,326,000, of which $4,828,000 would be for the initial project works and $498,000 for the delayed recreation facilities. A summary of the annual charges for each project is given in Table 22.

Table 21

Summary of investment costs for 11 reservoirs in early-action program
for the Pascagoula River Basin
(Costs in $1,000 - 1966 price level)

Item	Harleston	Big Creek	Taylors-ville	Thompson Creek	Bowie	Mize	Little Black Creek	Archusa Creek	Kittrell Creek	West Tiger Creek	Whetstone Creek	Total
FIRST COST AND INVESTMENT												
INITIAL PROJECT WORKS												
First cost	46,500	1,500	21,900	6,300	20,400	12,800	1,500	1,500	1,316	868	1,024	115,608
Interest during construction	3,778	---	1,424	295	1,326	832	---	---	---	---	---	7,655
Gross and net investment	50,278	1,500	23,324	6,595	21,726	13,632	1,500	1,500	1,316	868	1,024	123,263
DELAYED PROJECT WORKS												
First cost	10,459	---	2,692	---	4,174	2,722	---	---	---	---	---	20,047
Interest during construction	---	---	---	---	---	---	---	---	---	---	---	---
Gross and net investment	10,459	---	2,692	---	4,174	2,722	---	---	---	---	---	20,047
Present worth of gross and net investment	4,100	---	1,052	---	1,631	1,064	---	---	---	---	---	7,847
TOTAL PROJECT												
First cost	56,959	1,500	24,592	6,300	24,574	15,522	1,500	1,500	1,316	868	1,024	135,655
Gross and net investment	60,737	1,500	26,016	6,595	25,900	16,354	1,500	1,500	1,316	868	1,024	143,310
Present worth of gross and net investment	54,378	1,500	24,376	6,595	23,357	14,696	1,500	1,500	1,316	868	1,024	131,110

Table 22

Summary of annual charges for 11 reservoirs in early-action program
for the Pascagoula River Basin
(Charges in $1,000 - 100-year project life - 1966 price level)

Item	Harleston	Big Creek	Taylors-ville	Thompson Creek	Bowie	Mize	Little Black Creek	Archusa Creek	Kittrell Creek	West Tiger Creek	Whetstone Creek	Total
ANNUAL CHARGES												
INITIAL PROJECT WORKS												
Interest	1,634	49	758	214	706	443	49	49	43	28	33	4,006
Amortization	69	2	32	9	30	19	2	2	2	1	1	169
Operation and maintenance	210	6	139	62	120	85	6	6	5	3	4	646
Major replacements	4	---	1	---	1	1	---	---	---	---	---	7
Total initial project annual charges	1,917	57	930	285	857	548	57	57	50	32	38	4,828
DELAYED PROJECT WORKS												
Interest	133	---	34	---	53	35	---	---	---	---	---	255
Amortization	6	---	1	---	2	1	---	---	---	---	---	10
Operation and maintenance	150	---	22	---	35	26	---	---	---	---	---	233
Total delayed project annual charges	289	---	57	---	90	62	---	---	---	---	---	498
TOTAL PROJECT ANNUAL CHARGES	2,206	57	987	285	947	610	57	57	50	32	38	5,326

The projects would provide benefits from flood control, water quality control, water supply, general recreation and fish and wildlife enhancement. Some benefit would also be obtained from economic redevelopment, although these were not used in project justification. The total average annual benefits attributable to the 11 reservoirs would be $17,088,000, of which $12,206,000 would accrue to the initial project works and $4,882,000 to installation of the delayed recreation facilities. Of the initial benefits, $11,063,000 are attributable to flood control, water quality control, water supply, recreation and fish and wildlife enhancement as project purposes, and $1,143,000 are attributed to economic redevelopment of the areas around the projects. A summary of the benefits for each project is given in Table 23.

Economic justification. The economic justification of each project is summarized in Table 24. Economic redevelopment benefits, which would increase the benefit-to-cost ratio of nine of the projects, are not used in this justification.

Upstream watershed projects. The 17 watersheds in which land treatment measures and structural measures were determined to be economically feasible for initiation of construction within the next 10 to 15 years are listed in Table 25, with pertinent data.

Land treatment measures were considered the basic element for each watershed project and the initial increment for project justification. Floodwater detention structures were considered as the first choice in retarding the flow of floodwaters and in reducing damages to agricultural and urban areas. The second choice, in combination with detention structures, was channel improvement. Structural measures needed in the 17 watersheds include 133 floodwater retarding structures, 20 multiple-purpose structures with recreational facilities and 852 miles of channel improvement. The locations of the feasible watersheds are shown on Plate 1. Data on the watersheds are summarized in the following paragraphs. Details are given in Appendix F.

Land treatment and critical land area stabilization measures would be required on 547,800 acres of land and 8,125 miles of roads. The cost would be about $24,101,000. The floodwater retarding structures would be compacted homogeneous earthfill dams having a fixed drawdown tube and an emergency spillway. The estimated installation cost for these structures is approximately $14,924,000. Installation cost of the 20 multiple-purpose structures for flood prevention and recreation, including basic facilities, is estimated to be about $8,984,000. Channel improvement consists of snagging and shaping, clearing and snagging, and channel enlargement or excavation. The total installation costs of the approximately 852 miles of channel improvement

Table 23

Summary of annual benefits for 11 reservoirs in early-action program
for the Pascagoula River Basin
(Benefits in $1,000 - 100-year project life - 1966 price level)

Type of benefit	Harles-ton	Big Creek	Taylors-ville	Thomp-son Creek	Bowie	Mize	Little Black Creek	Archusa Creek	Kittrell Creek	West Tiger Creek	Whet-stone Creek	Total
INITIAL PROJECT												
Flood control	36	---	1,086	---	811	568	---	---	---	---	---	2,501
Water quality control	940	---	---	---	---	---	---	---	---	---	---	940
Water supply	460	---	---	---	109	---	---	---	---	---	---	569
Recreation	2,942	113	736	898	1,156	756	113	113	93	61	72	7,053
General recreation	(2,759)	(105)	(690)	(816)	(1,084)	(709)	(105)	(105)	(86)	(57)	(67)	(6,583)
Fish and wildlife	(183)	(8)	(46)	(82)	(72)	(47)	(8)	(8)	(7)	(4)	(5)	(470)
Total, excluding economic redevelopment	4,378	113	1,822	898	2,076	1,324	113	113	93	61	72	11,063
Economic redevelopment	498	10	217	41	216	137	---	10	8	---	6	1,143
Total, including economic redevelopment	4,876	123	2,039	939	2,292	1,461	113	123	101	61	78	12,206
DELAYED PROJECT												
General recreation	2,570	---	642	---	1,009	661	---	---	---	---	---	4,882
TOTAL PROJECT												
Total, excluding economic redevelopment	6,948	113	2,464	898	3,085	1,985	113	113	93	61	72	15,945
Total, including economic redevelopment	7,446	123	2,681	939	3,301	2,122	113	123	101	61	78	17,088

Table 24

Summary of annual charges, benefits, and benefit-to-cost ratios for 11 reservoirs in early-action program for the Pascagoula River Basin
(100-year project life - 1966 price level)

Project	Annual charges ($1,000)			Annual benefits ($1,000)			Benefit-to-cost ratio	
	Initial	Delayed	Total	Initial	Delayed	Total	Initial	Total
Harleston	1,917	289	2,206	4,378	2,570	6,948	2.3	3.1
Big Creek	57	---	57	113	---	113	2.0	2.0
Taylorsville	930	57	987	1,822	642	2,464	2.0	2.5
Thompson Creek	285	---	285	898	---	898	3.2	3.2
Bowie	857	90	947	2,076	1,009	3,085	2.4	3.3
Mize	548	62	610	1,324	661	1,985	2.4	3.3
Little Black Creek	57	---	57	113	---	113	2.0	2.0
Archusa Creek	57	---	57	113	---	113	2.0	2.0
Kittrell Creek	50	---	50	93	---	93	1.9	1.9
West Tiger Creek	32	---	32	61	---	61	1.9	1.9
Whetstone Creek	38	---	38	72	---	72	1.9	1.9
Total	4,828	498	5,326	11,063	4,882	15,945	2.3	3.0

Table 25

Pertinent data on 17 upstream watersheds in early-action program for the Pascagoula River Basin

Name	Watershed number	Area (acres)	Floodwater retarding structures (number)	Channel improvement (miles)	Multiple-purpose structures	
					Number	Normal pool (acres)
Upper Okatibbee Creek	1A	67,641	6	37.3	1	250
Chunky River	2,4,6A & 8	240,650	25	148.5	2	550
Tallahatta Creek	3	83,880	5	43.6	1	150
Sowashee Creek	5A	52,910	9	30.7	1	100
Upper Bucatunna Creek	9	77,960	6	45.3	1	250
Upper Leaf River	10	138,120	7	71.1	1	250
West Tallahala Creek	11A	64,905	2	22.5	1	150
Tallahoma Creek	12	137,264	13	85.7	1	300
Souinlovey Creek	13A	109,851	11	61.1	1	250
Oakohay Creek	17A	60,444	3	29.1	1	150
Okatoma Creek	20 & 30A	179,205	17	86.7	2	550
Big Creek	21A	80,012	11	59.7	2	360
Upper Bowie River	23A	46,603	5	30.2	1	100
Dry Creek[1]	23B	13,954	3	14.4	1	150
West Bowie River	23C	29,601	6	20.3	1	100
Upper Bogue Homo Creek	24A	67,940	3	42.8	1	200
Station Creek	27	35,980	1	22.8	1	150
Total		1,487,280	133	851.8	20	3,960

[1]Authorized for operation August 1966.

planned for the 17 watersheds is about $9,465,000. The total estimated installation cost of the land treatment and structural measures of the 17 feasible watersheds is $57,474,000. These costs are summarized in Table 26.

Table 26

Estimated installation cost of land treatment and structural measures of 17 upstream watersheds in early-action program for the Pascagoula River Basin

Item	Estimated cost[1]
LAND TREATMENT MEASURES[2]	$ 24,101,000
STRUCTURAL MEASURES	
Floodwater retarding structures	14,924,000
Multiple-purpose structures (including basic recreational facilities)	8,984,000
Stream channel improvement	9,465,000
Total structural measures	33,373,000
TOTAL	$ 57,474,000

[1] Based on data contained in Appendix F updated to 1966 prices and rounded.

[2] Includes land treatment measures for 17 watersheds and basin-wide critical land area stabilization.

The total annual cost of all structural measures in the 17 watersheds is estimated to be $1,701,200, of which $570,500 would be for operation and maintenance. These costs are summarized in Table 27.

Table 27

Summary of annual costs of 17 upstream watersheds in early-action program for the Pascagoula River Basin

Item	Amortization of installation cost[1]	Operation & maintenance cost	Total
Floodwater retarding structures	$ 505,600	$ 46,200	$ 551,800
Multiple-purpose structures (including basic recreation facilities)	304,400	323,200	627,600
Channel improvements	320,700	201,100	521,800
Total	$1,130,700	$ 570,500	$1,701,200

[1] Costs in Table 26 amortized at 3.25 percent interest rate and a 100-year project life.

The estimated total average annual benefits which would accrue to upstream watershed improvements are $2,460,300. These benefits would consist of the following:

Damage reduction benefits	$ 783,600
Changed and more intensive land use	264,000
Planned recreation	1,038,000
Incidental recreation	64,800
Secondary benefits	309,900
Total	$2,460,300

In addition, annual benefits in the amount of approximately $5,800 would accrue to three upstream watersheds above reservoir projects included in the early-action program. The benefits would be from increased storage of beneficial water due to less sediment entering the reservoirs from upstream watersheds. However, these benefits were not used in project justification. Excluding them, the benefit-to-cost ratio for all structural measures in the 17 watersheds is 1.4.

Summary. Structural measures in the early-action program for the basin consist of: 11 multiple-purpose reservoirs; and 133 floodwater retarding structures, 20 multiple-purpose structures, and 852 miles of channel improvement in 17 upstream watersheds. Accelerated land treatment measures in the 17 watersheds and stabilization of critical land areas for the entire basin are also a part of the

early-action program. The locations of the 11 multiple-purpose reservoirs and the 17 upstream watersheds are shown on Figure 16 and Plate 1.

The total first cost of the early-action program would be $193,129,000, of which $135,655,000 would be for reservoirs and $57,474,000 for the upstream watersheds, including $24,101,000 for land treatment and critical land area stabilization. Excluding land treatment and critical land area stabilization, the estimated total average annual charges are $7,027,000 and the total average annual benefits $18,406,000, giving an overall benefit-to-cost ratio of 2.6. A summary of the first costs, annual charges, benefits, and benefit-to-cost ratios of the various elements of the early-action program is given in Table 28. Economic redevelopment benefits are not included in the above figures or in the table. These benefits would increase the overall benefit-to-cost ratio to 2.8

STRUCTURAL MEASURES — FRAMEWORK FOR FUTURE PLANNING

Structural measures included in the framework for future planning consist of reservoirs, upstream watershed projects and improvements for barge navigation. Although these measures are not economically justified for inclusion in the early-action program, they are needed to help satisfy the remaining projected needs of the basin or are strongly supported by local interests. The measures are discussed in the following paragraphs.

Reservoirs. There are 11 reservoirs included in the framework for future planning. These reservoirs have potential storage for flood control, water quality control, water supply, power, recreation, and fish and wildlife enhancement. In addition to being able to help satisfy the projected needs of the basin not being met by the early-action projects, these reservoirs have the capability of meeting potential needs beyond 2015, the limits of the study. Needs which may possibly occur beyond 2015 include water quality control and water supply. As these needs occur, each potential project will have to be studied in more detail to determine its economic justification and to evaluate possible alternative solutions.

Pertinent data for the 11 reservoirs included in this category are given in Table 29. The location of each is shown on Plate 1.

Upstream watershed projects. Thirty upstream watersheds were determined to be potentially feasible projects and required to help satisfy future needs in the basin. In addition to land treatment measures, these watersheds would have single-purpose flood water retarding structures, multiple-purpose structures for flood control and recreation, and channel improvements.

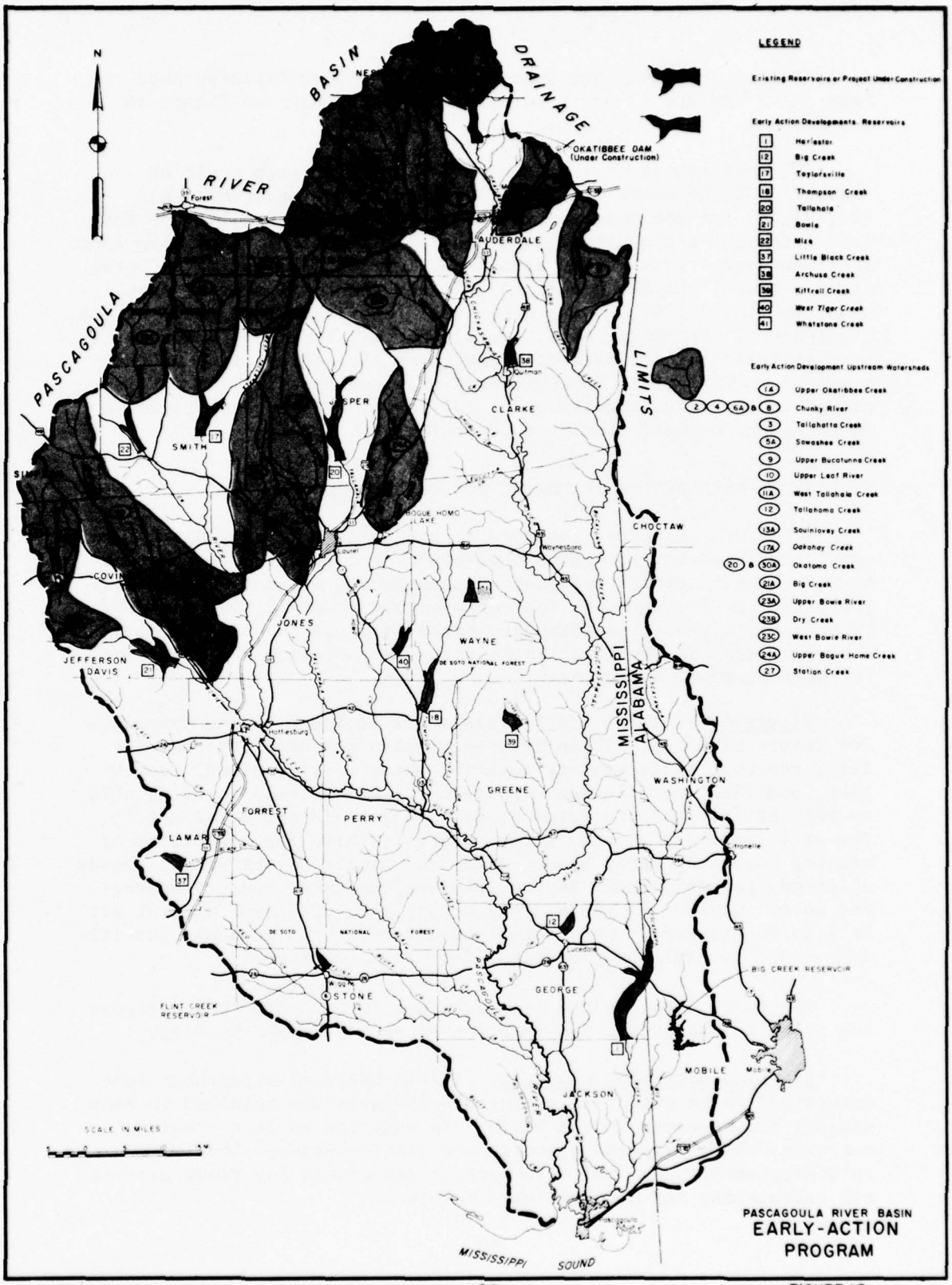

LEGEND
Existing Reservoirs or Project Under Construction
Early Action Developments, Reservoirs
1 Heriestor
12 Big Creek
17 Taylorsville
18 Thompson Creek
20 Tallahala
21 Bowie
22 Mize
37 Little Black Creek
38 Archusa Creek
39 Kittrell Creek
40 West Tiger Creek
41 Whatstone Creek
Early Action Development Upstream Watersheds
1A Upper Okatibbee Creek
2 4 6A & 8 Chunky River
3 Tallahatta Creek
5A Sowashee Creek
9 Upper Bucatunna Creek
10 Upper Leaf River
11A West Tallahala Creek
12 Tallahoma Creek
13A Souinlovey Creek
17A Oakohay Creek
20 & 30A Okatoma Creek
21A Big Creek
23A Upper Bowie River
23B Dry Creek
23C West Bowie River
24A Upper Bogue Home Creek
27 Station Creek
OKATIBBEE DAM (Under Construction)
BIG CREEK RESERVOIR
FLINT CREEK RESERVOIR
PASCAGOULA RIVER BASIN
EARLY-ACTION PROGRAM
SCALE IN MILES
MISSISSIPPI SOUND
MISSISSIPPI ALABAMA LIMITS
JEFFERSON DAVIS
SMITH
JASPER
CLARKE
JONES
WAYNE
GREENE
PERRY
FORREST
LAMAR
STONE
GEORGE
JACKSON
WASHINGTON
CHOCTAW
MOBILE
LAUDERDALE
DE SOTO NATIONAL FOREST

FIGURE 16

Table 28

Summary of first costs, annual charges, benefits, and benefit-to-cost ratios for portions of early-action program for the Pascagoula River Basin

Item	Reservoirs												Upstream watershed [1] projects	Totals
	Harlestón	Big Creek	Taylorsville	Thompson Creek	Bowie	Mize	Little Black Creek	Archusa Creek	Kittrell Creek	West Tiger Creek	Whetstone Creek	Subtotal		
PROJECT FIRST COSTS ($1,000)														
Initial	46,500	1,500	21,900	6,300	20,400	12,800	1,500	1,500	[illegible]16	868	1,024	115,608	57,474[2]	173,082
Delayed	10,459	---	2,692	---	4,174	2,722	---	---	---	---	---	20,047	---	20,047
Total	56,959	1,500	24,592	6,300	24,574	15,522	1,500	1,500	1,316	868	1,024	135,655	57,474	193,129
PROJECT ANNUAL CHARGES ($1,000)														
Initial	1,917	57	930	285	857	548	57	57	50	32	38	4,828	1,701[3]	6,529
Delayed	289	---	57	---	90	62	---	---	---	---	---	498	---	498
Total	2,206	57	987	285	947	610	57	57	50	32	38	5,326	1,701	7,027
PROJECT ANNUAL BENEFITS ($1,000)														
Initial:														
Flood control	36	---	1,086	---	811	568	---	---	---	---	---	2,501	1,048	3,549
Water quality control	940	---	---	---	---	---	---	---	---	---	---	940	---	940
Water supply	460	---	---	---	109	---	---	---	---	---	---	569	---	569
Recreation (including fish and wildlife enhancement)	2,942	113	736	898	1,156	756	113	113	93	61	72	7,058	1,103	8,156
Other	---	---	---	---	---	---	---	---	---	---	---	---	310[4]	310
Subtotal	4,378	113	1,822	898	2,076	1,329	113	113	93	61	72	11,068	2,461	13,[illegible]29
Delayed:														
Recreation	2,570	---	642	---	1,009	661	---	---	---	---	---	4,882	---	4,[illegible]82
Total	6,948	113	2,464	898	3,085	1,985	113	113	93	61	72	15,950	2,461	18,406
BENEFIT-TO-COST RATIO (total)	3.1	2.0	2.5	3.2	3.3	3.3	2.0	2.0	1.9	1.9	1.9	3.0	1.4	2.6

[1] From data in Appendix F, updated to 1966 prices

[2] Includes land treatment, basin-wide critical land area stabilization and structural measures

[3] Structural measures only

[4] Secondary benefits as determined by Department of Agriculture

Table 29

Pertinent data on 11 reservoirs included in the framework for future planning for the Pascagoula River Basin

Name	Site No.	Location			Drainage area (sq.mi.)	Potential storage[2] (ac. ft.)	Potential purpose[3]	Normal pool size (acres)
		Stream	Stream mile	County[1]				
Upper Escatawpa	2	Escatawpa R.	52	Mobile, Ala.	425	442,000	P,WQC,WS,R,F&WL	2,900
Vancleave	4	Bluff Creek	15	Jackson	49	49,000	FC, WS, R, F&WL	360
Perkinston	6	Red Creek	40	Stone	220	187,000	WS, R, F&WL	1,900
Benndale	9	Black Creek	29	Stone-Perry	530	586,000	FC, P,WS,R,F&WL	2,600
Leakesville	23	Big Creek	11	Greene	130	146,000	R, F&WL	1,400
Bucatunna	24	Bucatunna Cr.	12	Wayne	495	423,000	P, R, F&WL	3,800
Manasse	25	Bucatunna Cr.	50	Clarke	263	228,000	R, F&WL	2,500
Waynesboro	27	Chickasawhay R.	100	Wayne	1,640	209,000	P, R, F&WL	7,000
Graham	32	Tallahatta Cr.	6	Lauderdale	70	61,000	FC,WQC,WS,R,F&WL	640
Moss	35	Tallahoma Cr.	21	Jasper	111	85,000	R, F&WL	1,300
Tallasher	36	Tallasher Cr.	3	Newton	95	105,000	FC,WQC,WS,R,F&WL	1,100

[1] County is in Mississippi unless noted.
[2] Storage above required sedimentation pool.
[3] FC = Flood Control; WQC = Water Quality Control; WS = Water Supply; R = General Recreation; F&WL = Fish and Wildlife; P = Hydroelectric Power.

Pertinent data for the 30 upstream watersheds included in this category are given in Table 30. The location of each is shown on Plate 1.

Navigation. The navigation project considered in this report would provide barge transportation from the existing deep-draft harbor at Pascagoula to the inland cities of Hattiesburg, Laurel and Meridian. This project, designated as the "Pat Harrison Waterway" by local interests, was determined to be uneconomical for inclusion in the early-action program. As stated previously, recent discovery of large deposits of sulphur in the vicinity of Merrill may possibly provide sufficient additional volumes of traffic in the future to warrant development of navigation to Merrill. Other portions could be added as the need arises and the expenditure can be justified. This project has the strong support of local interest and therefore has been included in the framework for future planning. The project is shown on Plate 1.

Summary. Structural measures included in the framework for future planning include 11 reservoirs, works of improvement in 30 upstream watersheds and improvements for barge navigation. The locations of the reservoirs, upstream watersheds and navigation improvements, are shown on Figure 17.

As stated previously, these measures would help meet future needs in the basin. However, further detailed study is needed to adequately define those projects that should be undertaken, evaluate possible alternatives and determine the most economical means of satisfying the basin needs. Such study should be undertaken when periodic review of the comprehensive plan indicates the need.

Table 30

Pertinent data on 30 upstream watersheds included in the framework for future planning for the Pascagoula River Basin

Watershed name	Watershed No.	Watershed area	Area subject to flooding	Average frequency of flooding/Year	Area controlled by structural measures	Erosion problem	Floodplain capability for production of			Potential storage	Potential for outdoor recreation*	Potential for	
							Crops	Pasture	Woods			Fish	Wildlife
		Acres	Acres		Percent	[1]	[2]	[2]	[2]	Ac. Ft.	[2]	[2]	[2]
Lower Okatibbee	5B	52,750	6,064	4.2	22.0	M	G	G	G	48,900	G	P	F
Lower Potterchitto	6B	25,270	3,664	4.2	16.7	M	G	G	G	16,300	G	G	G
Long Creek	7	82,660	13,226	4.5	30.9	M	G	G	G	69,700	E	G	G
Lower West Tallahala	11B	42,967	6,875	3.5	0	S	G	G	G	0	F	F	G
Lower Souinlovey	13B	61,053	6,530	5.7	25.0	S	F	G	G	56,800	G	G	G
Upper Chickasawhay	14A	41,205	2,884	4.8	44.4	S	G	G	G	47,300	E	G	G
Cedar Creek	15	55,220	8,283	4.5	30.0	M	G	G	G	62,400	G	F	G
Big Red	15A &A1	103,526	9,317	5.1	27.6	S	G	G	G	110,450	F	F	G
Upper East Tallahala	16A	73,550	9,806	5.5	9.8	M	G	G	G	28,300	G	P	G
Shubuta	19	87,940	12,312	5.7	32.5	S	F	G	G	107,600	F	F	G
Lower Leaf	21B	92,233	6,456	5.2	16.5	M	F	G	G	56,200	G	G	G
Five Mile Creek	22	50,560	13,312	5.7	32.5	S	G	G	G	107,600	G	P	G
Upper Bogue Homo	24B	96,900	13,566	5.5	14.8	M	G	G	G	61,300	G	G	F
Big and Yellow	25	219,980	24,304	5.1	35.1	S	F	G	G	261,200	G	G	G
Shiloh	26	74,400	6,696	5.1	20.9	S	G	G	G	56,500	G	F	G
Upper Thompson Creek	28A	75,745	10,396	2.8	19.6	M	F	G	G	58,100	F	G	G
Lower Bowie	30B	96,275	10,546	5.6	33.1	S	G	G	G	136,100	E	G	G
Lower Tallahala	31	141,780	14,178	5.5	12.0	S	F	G	G	71,500	G	P	G
Lower Bogue Homo	32	108,440	20,604	2.8	19.1	S	F	G	G	84,000	G	F	G
Gaines Creek	33	158,160	18,292	2.8	28.3	S	F	G	G	164,300	G	G	G
Big Creek	34	188,810	18,881	5.1	20.7	S	F	G	G	159,300	E	E	G
Upper Black	36	216,836	23,852	4.9	49.3	S	F	G	G	450,000	G	E	G
Cypress Creek	37A	135,434	14,150	4.9	44.1	S	F	G	G	249,500	G	E	G
Upper Red	39	197,980	20,061	5.0	45.2	S	F	G	G	365,800	G	E	G
Beaver Dam	40A	60,704	14,742	4.9	26.9	S	F	G	G	87,300	G	E	G
Whiskey Creek	41	50,740	5,074	4.9	42.4	S	F	G	G	96,000	F	P	E
Indian Creek	42A	194,174	11,993	5.2	30.8	S	F	G	G	216,600	G	E	E
Middle Escatawpa	43 & A3	183,446	16,900	5.9	31.0	S	P	F	G	220,850	G	E	G
Lower Red	45A	69,136	11,982	4.9	22.3	S	F	G	G	56,400	G	E	E
Upper Escatawpa	A2	140,293	18,238	5.9	30.6	S	F	G	G	187,000	F	P	F
Total		3,178,167	373,184							3,693,300			

* Recreation activities include swimming, boating, camping, picnicking, hiking and nature trails.

[1] M = Moderate; S = Slight.

[2] E = Excellent; F = Fair; G = Good; P = Poor.

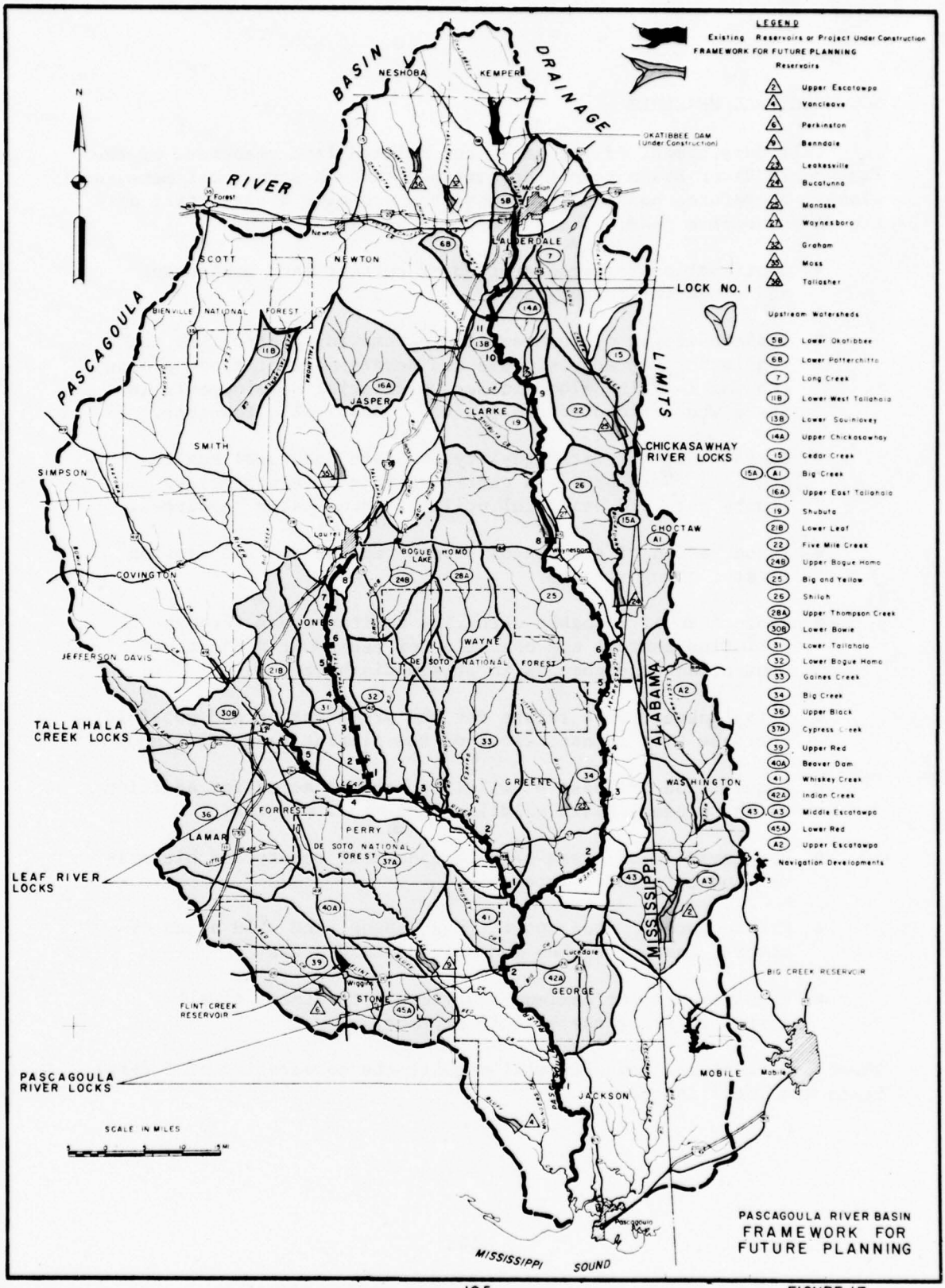

LEGEND
Existing Reservoirs or Project Under Construction
FRAMEWORK FOR FUTURE PLANNING
Reservoirs
2 Upper Escatawpa
4 Vancleave
6 Perkinston
9 Benndale
23 Leakesville
24 Bucatunna
25 Manasse
27 Waynesboro
32 Graham
33 Moss
34 Tallasher
Upstream Watersheds
5B Lower Okatibbee
6B Lower Potterchitto
7 Long Creek
11B Lower West Tallahala
13B Lower Souinlovey
14A Upper Chickasawhay
15 Cedar Creek
15A A1 Big Creek
16A Upper East Tallahala
19 Shubuta
21B Lower Leaf
22 Five Mile Creek
24B Upper Bogue Homo
25 Big and Yellow
26 Shiloh
28A Upper Thompson Creek
30B Lower Bowie
31 Lower Tallahala
32 Lower Bogue Homo
33 Gaines Creek
34 Big Creek
36 Upper Black
37A Cypress Creek
39 Upper Red
40A Beaver Dam
41 Whiskey Creek
42A Indian Creek
43 A3 Middle Escatawpa
45A Lower Red
A2 Upper Escatawpa
Navigation Developments
N
BASIN
DRAINAGE
PASCAGOULA
RIVER
NESHOBA
KEMPER
OKATIBBEE DAM
(Under Construction)
LAUDERDALE
NEWTON
SCOTT
LOCK NO. 1
BIENVILLE NATIONAL FOREST
JASPER
CLARKE
SMITH
SIMPSON
LIMITS
CHICKASAWHAY
RIVER LOCKS
CHOCTAW
COVINGTON
BOGUE
LAKE
HOMO
JONES
WAYNE
DE SOTO NATIONAL FOREST
JEFFERSON DAVIS
ALABAMA
TALLAHALA
CREEK LOCKS
GREENE
WASHINGTON
LAMAR
FOREST
PERRY
DE SOTO NATIONAL
FOREST
LEAF RIVER
LOCKS
MISSISSIPPI
BIG CREEK RESERVOIR
FLINT CREEK
RESERVOIR
STONE
GEORGE
MOBILE
PASCAGOULA
RIVER LOCKS
JACKSON
SCALE IN MILES
MISSISSIPPI SOUND
PASCAGOULA RIVER BASIN
FRAMEWORK FOR
FUTURE PLANNING

FIGURE 17

NONSTRUCTURAL MEASURES

Full development of the water and related land resources of the Pascagoula River Basin cannot be attained through structural measures alone. Therefore, nonstructural measures are also a vital part of the comprehensive plan. These measures include:

- Continuation and acceleration of current land management and conservation programs.
- Implementation of management programs for controlling and regulating the economic use and development of flood plains and for reducing flood losses to existing developments in areas where flood control is not economically feasible.
- Surveillance of water quality by State and local health agencies (both pre- and post-reservoir development) to assure safe and healthful utilization of water resources.
- Preservation of streams or stream reaches as free-flowing float-fishing streams.
- Protection of valuable estuarine habitat areas through pollution control and operation of reservoir projects to prevent adverse changes in stream discharge.
- Establishment of a refuge for the preservation and possible increase of a remnant flock of the Florida sandhill crane.
- Acquisition or lease of wildlife habitat acres for addition to the present basin wildlife management program.
- Preservation of areas of unique natural beauty and historical and scientific interest.
- Maintenance of open space, green space, and wild areas of rivers, lakes, beaches and related land areas.
- Requirements for maximum practicable treatment of all wastes entering the basin's streams.

These nonstructural measures will require the cooperation of Federal, State and local interests.

CHAPTER 9

EFFECTS OF THE COMPREHENSIVE PLAN

GENERAL

The plan for the development of the water and related land resources in the Pascagoula River Basin presented in Chapter 8 contains an early-action program to meet immediate and near future needs of the basin and a long-range program to serve as a guide for future development. The following paragraphs present an evaluation of the plan by areas of identified needs.

FLOOD CONTROL

Floods in the basin affect both urban and rural areas. The urban areas having the heaviest concentration of damages are Meridian, Laurel and Hattiesburg. Okatibbee Reservoir, presently under construction, will improve flood conditions in rural areas below the dam and at Meridian. Development of the Tallahala Reservoir, in accordance with the plan presented in an interim report submitted in April 1966 by the Corps of Engineers and now pending authorization, would alleviate flood conditions at Laurel and downstream rural areas. The Taylorsville, Bowie, and Mize Reservoirs, part of the early-action program, would provide a high degree of protection for the Hattiesburg metropolitan area and varying degrees of protection for the agricultural lands and lesser urban areas downstream to McLain. The Harleston Reservoir, also a part of the early-action program, would provide varying degrees of protection for the rural lands from the damsite downstream to the mouth of the Escatawpa River. The floodwater retarding structures included in the early-action program would provide flood control for the rural areas in 17 upstream watersheds in the northern and northwestern parts of the basin. Overall, the structural measures of the early-action program and the proposed Tallahala Reservoir would reduce total damages in the basin by about 46 percent, as shown in Table 31. The major urban areas in the basin, particularly Hattiesburg and Laurel, would be provided an even higher degree of flood protection.

Development of those multiple-purpose reservoirs with flood control storage and the potentially feasible upstream watershed projects contained in the framework for future planning would provide varying degrees of protection for agricultural lands.

Table 31

Damage reduction - Early-action program

Program	Average annual damage		Percent reduction
	Without program	With program	
RESERVOIRS			
Basinwide[1]	$1,739,100	$ 909,400	48
Downstream of proposed reservoir projects[2]	931,200	101,500	89
UPSTREAM WATERSHEDS			
Basinwide[1]	1,901,400	1,056,100	44
Seventeen feasible upstream watersheds[3]	1,236,500	391,200	68
TOTAL			
Basinwide[1]	3,640,500	1,965,500	46
Downstream of proposed reservoirs and in 17 feasible watersheds	2,167,700	492,700	77

[1] Damages as shown in Appendixes D and F adjusted for overlap of the flood damage studies.
[2] Tallahala, Taylorsville, Bowie, Mize and Harleston.
[3] From Appendix F.

In addition, implementation of management and preventive programs for controlling and regulating the economic use and development of flood plains would reduce flood damages to existing development and militate against the increase of flood-damage potential.

WATER QUALITY CONTROL

Generally, the quality of water in the streams in the basin is satisfactory at the present time with the exception of Okatibbee Creek at Meridian, Tallahala Creek at Laurel, Leaf River at Hattiesburg, and the Escatawpa estuary at Moss Point and Pascagoula. The study showed that adequate treatment and control of wastes discharged into the Leaf River at Hattiesburg would eliminate the problem in that area. However, even with adequate treatment of wastes discharged into Okatibbee Creek, Tallahala Creek and the Escatawpa estuary, augmentation of low flow would be required to maintain the desired water quality. The regulated flows from Okatibbee Reservoir, presently under construction, and Tallahala Reservoir, now pending authorization,

would help eliminate the existing pollution problems at Meridian and Laurel, respectively. The Harleston Reservoir would provide storage to increase the dependable flow of the Escatawpa River and thus help eliminate the major pollution problem in the estuary area. With the above projects in place, the programs now underway by local governments and private interests for pollution control and the establishment and enforcement of water quality standards by the States in compliance with the Federal Water Pollution Control Act, as amended, would insure the maintenance of good quality water throughout the basin.

WATER SUPPLY

Abundant groundwater resources underlie most of the Pascagoula River Basin and should be sufficient, in most parts, to meet present and foreseeable water supply needs. However, the shallower aquifers have been developed intensively at the metropolitan areas of Meridian, Laurel, Hattiesburg and Pascagoula. Therefore, since only the deeper, more expensively developed aquifers are available at these locations to meet future needs, local interests have requested that water supply storage be included in several of the planned reservoirs. The requirement of 25 million gallons a day for the Meridian area will be met by Okatibbee Reservoir, presently under construction. The requirement of 45 million gallons a day in the Laurel area would be met by Tallahala Reservoir, pending authorization. The Bowie Reservoir would provide the Hattiesburg metropolitan area with 108 million gallons a day of the projected surface water demand of 160 million gallons a day in 2015. The remainder of the demand is available from groundwater sources and the Leaf River, or it could be obtained from the Taylorsville and Mize Reservoirs upstream, when needed.

The Harleston Reservoir, with full upstream inflow, could provide the surrounding area with 100 million gallons a day. Local interests have indicated their desire to obtain that amount to help meet the projected demand of 339 million gallons a day in 2015 in the lower portion of the basin and the project has been evaluated on that basis in this report. However, the City of Mobile has recently announced that it is proceeding with plans to augment its industrial water supply by pumping water from the Escatawpa River in Alabama over the divide into the Big Creek watershed and its Big Creek Reservoir system. The proposed pumping plant would have a capacity of 50 million gallons a day. It is understood that the States of Mississippi and Alabama will initiate discussions to reach an agreement for a proportional sharing of the Escatawpa River water supply. The resolution of this question would not change the merits of the project but would affect the amount of water supply available to Mississippi interests and cost allocations in the final formulation of the project.

The remainder of the projected demand for the lower portion of the basin could be obtained by enlarging the existing supply from the Pascagoula River and developing additional surface water supplies on tributary streams above Cumbest Bluff. This includes possible development of the Bluff Creek, Red Creek and Black Creek reservoir sites contained in the framework for future planning. Although this conflicts with the presently proposed use of Red and Black Creeks as free-flowing float-fishing streams, a decision as to the best use of the resources can be made when the need occurs.

Water for agricultural and rural domestic needs is not a problem insofar as supply is concerned since adequate water is available from wells, springs and streams in all parts of the basin.

GENERAL RECREATION

The varied topography, the existing impoundments and many miles of free-flowing streams in the basin are favorable for nearly all types of recreational activities. However, only a relatively small part of the full recreational potential of the basin has been developed and a critical shortage of facilities exists in every class of water-dependent and water-enhanced outdoor recreation activity.

Studies revealed a need for privately and publicly developed facilities to provide opportunity for an annual visitation of about 56.7 million in 1980 and 195 million in 2015. This need should be satisfied through development of a basinwide recreation plan within the overall recreation plans that are presently being formulated by the States in cooperation with the Bureau of Outdoor Recreation. It is not practicable to meet the entire need through development of water and related land resources alone. However, as part of the total recreational effort, development of the water and related land resources of the basin should satisfy as much of the need as appropriate and practicable.

Development of the early-action program would provide a water-surface area of approximately 46,000 acres to meet some of the present and future recreational needs of the basin. Initial development of the early-action projects would support an annual visitation of approximately 9.9 million. Ultimate development of the projects would support an annual visitation of about 23.5 million. The early-action program would meet 71 percent of the unsatisfied swimming demand, 30 percent of the unsatisfied boating demand, 46 percent of the unsatisfied camping demand, and 60 percent of the unsatisfied picnicking demand estimated in the basin for the year 1980.

Development of all the projects in the framework for future planning and ultimate development of the recreation facilities at the early-action projects would meet the following portions of the unsatisfied demand in 2015: swimming, 87 percent; boating, 15 percent; camping, 55 percent; and picnicking, 62 percent. For ultimate development of the early-action projects alone, the portions satisfied would be: swimming, 51 percent; boating, 9 percent; camping, 32 percent; and picnicking, 36 percent.

The remaining recreational needs could be met through other developments. The Mississippi Sound is capable of meeting much of the demand for boating and swimming water. To meet this demand, public access must be made available to the waters at the mouth of the Pascagoula River and the Mississippi Sound. Providing public access to other streams in the basin would also meet a portion of the demand for boating and swimming water. Development of these access areas could be a role of the State, counties and municipalities and, in fact, some are presently being contemplated by the Pat Harrison Waterway District.

The increasing demand for camping and picnicking can be met in part by providing camping and picnicking sites in areas where access to streams and the Mississippi Sound is afforded, and through expanded facilities of the Mississippi State Park System, and local county and city parks.

In addition to the public supply of facilities that can be developed to meet the recreational demand in the basin, the private sector is also expected to increase its share of the recreation supply.

FISH AND WILDLIFE

Studies show that there are now, and will be in the target years, sufficient quantities of salt-water fish available to satisfy the demand for sport salt-water fishing. However, the anticipated deficit in fresh-water sport fishing opportunity is estimated to increase from 248,616 man-days per year in 1980 to 1,327,278 man-days per year in 2015. The reservoir projects included in the early-action plan would satisfy essentially all of the 1980 demand and approximately 67 percent of the 2015 demand. Reservoirs included in the framework for future planning would provide almost 40,000 surface acres of additional fishery habitat and would provide a capacity level in excess of the anticipated demand. However, single-purpose projects, such as State owned and managed fishing lakes and access to streams should be considered either as alternative solutions, or possibly in combination with several of the multiple-purpose reservoirs, to provide diversified sport fishing opportunities.

Studies of wildlife resources show that capacity basinwide is presently adequate to satisfy the demand for hunting for all periods of the study. However, there would be a loss of high-value upland-game habitat and associated hunting opportunity with construction of reservoirs and stream channelization. Utilization of reservoir project lands for wildlife management purposes by appropriate state game and fish agencies would help compensate for project induced losses and would provide diversified public hunting. Provisions for mitigating wildlife habitat losses in upstream watershed structures and channel improvement features would also be important in reducing such losses.

COMMERCIAL FISHING

Commercial fishery resources in the basin would increase significantly through construction of reservoir projects. Valuable estuarine habitat and associated finfish and shellfish resources would benefit from higher levels of treatment of mainland municipal and industrial pollution, and also from water quality storage proposed in the Harleston project.

NAVIGATION

During the course of this study, investigations were made to determine the justification of providing suitable channels for modern barge traffic from Pascagoula to Hattiesburg on the Leaf River, to Laurel on Tallahala Creek, a tributary of Leaf River, and to Meridian on Okatibbee Creek, a tributary of Chickasawhay River. It was determined that navigation at the present time or in the near future is not warranted. However, due to the strong support of local interests and the recent discovery of large sulphur deposits near Merrill at the confluence of the Leaf and Chickasawhay Rivers, the navigation project has been included in the framework for future planning.

HYDROELECTRIC POWER

Since it would not be economically feasible, there is no provision for hydroelectric power in the early-action program. However, the development of hydroelectric power should be considered in any reservoir projects in future planning.

AGRICULTURAL LAND AND WATER MANAGEMENT

The implementation of structural and land treatment measures as proposed in the plan will include using the land within its capabilities and treating it according to its needs for protection and

improvement. This would (1) reduce floodwater and sediment damages in the basin, (2) reduce soil erosion, (3) improve soil fertility and increase the productivity of crop and pasture lands, woodland and wildlife habitat, (4) increase agricultural income through more efficient land use and management, and (5) provide for the multiple use of waters as a result of these measures. The stability of family farms and the economic conditions of low income farm families would be improved by more efficient operations.

ENVIRONMENTAL QUALITY

Implementation of the comprehensive plan would improve many aspects of the environment of the basin. The provision of water impoundments and associated recreational facilities, restoration of polluted water areas and provision of access for public use, preservation of selected natural stream reaches, and land treatment measures for wildlife habitat improvement would provide aesthetic values and opportunities for enjoyment of and employment in outdoor recreational activities that are now generally lacking in the basin. The reduction of flooding would alleviate some of the health problems associated with flood flows.

SUMMARY

The proposed comprehensive plan is considered the most suitable to meet the present and future needs of flood control, water quality control, water supply, recreation and fish and wildlife enhancement in the Pascagoula River Basin. Development of the selected early-action program and the proposed Tallahala Reservoir would:

(1) Reduce damages in the basin by about 46 percent;

(2) Provide sufficient quantities of water to help eliminate existing major pollution problems in the basin streams;

(3) Furnish water for municipalities and industry;

(4) Make water and water-associated recreation possible and safe from a sanitary and aesthetic viewpoint;

(5) Protect and enhance fish and wildlife; and

(6) Improve the social and economic environment of the basin.

The selected early-action program accomplishes a balance in the project purposes in a manner that provides for full utilization of the sites for which structures are proposed, without waste of the

basin's resources through underdevelopment or overdevelopment in excess of anticipated needs. A reasonable and equitable distribution of the beneficial and adverse effects within the limitations imposed by physical conditions is attained.

The early-action program provides for the water and related land resource developments needed in the basin within the next 10 to 15 years and the framework for future planning provides a basis for additional development as the needs arise in the future.

CHAPTER 10

IMPLEMENTATION OF PLAN

GENERAL

The proposed comprehensive plan for the development of the water and related land resources of the Pascagoula River Basin includes structural and nonstructural measures. Those structural measures included in the early-action program should be implemented within the next 10 to 15 years. Additional studies will be required before implementation of any of the structural measures included in the framework portion of the plan. Therefore, the discussion of implementation of structural measures in this report is limited to those in the early-action program. Nonstructural measures should be implemented at the earliest practicable date in order to obtain their maximum benefit.

Structural measures included in the early-action program would be constructed under authorities of the Corps of Engineers, Department of Agriculture, and Pat Harrison Waterway District. Each of these agencies would also play a major role in implementation of the various nonstructural measures. The implementation of the nonstructural and early-action structural portions of the plan is discussed by major features in the following paragraphs.

RESERVOIRS

The reservoir portion of the early-action program has been divided, for implementation purposes, into two parts and assigned to Federal or non-Federal interests in accordance with existing statutes and policies. Hence, the primary responsibility for development of four reservoirs was assigned to the Corps of Engineers and seven reservoirs to the Pat Harrison Waterway District.

Corps of Engineers. Four major multiple-purpose reservoirs are proposed for construction within the next 10 to 15 years under authority of the Corps of Engineers. They are: Taylorsville Reservoir on Leaf River above Hattiesburg; Bowie Reservoir on Bowie Creek above Hattiesburg; Mize Reservoir on Oakohay Creek above Mize and Hattiesburg; and Harleston Reservoir on Escatawpa River above Moss Point and Pascagoula. In addition, the Okatibbee Reservoir on Okatibbee Creek above Meridian is presently under construction and a plan for development of the Tallahala Reservoir on Tallahala Creek above Laurel is now under consideration by the Congress.

The Corps of Engineers will submit a separate report or reports recommending authorization of the Taylorsville, Bowie, Mize and Harleston Reservoirs by the Congress. The reports will contain details on the projects and required local cost sharing and assurances. Local interests would be required to pay all costs allocated to water supply storage in the Bowie and Harleston projects, one-half of the separable first costs of all four projects allocated to recreation and fish and wildlife enhancement, bear all costs of operation and maintenance and replacement of all recreation and fish and wildlife enhancement facilities and all operation and maintenance costs allocated to water supply.

Local interests would be further required to furnish assurances that they would:

(a) Obtain water rights needed for storage and use of water, resolve any conflicts in water rights as necessary to assure effective operation of the projects, and use water in a manner consistent with Federal and State laws;

(b) Prevent encroachment and obstruction of downstream channels which would adversely affect operation of the projects;

(c) Provide assurances that water flowing into all the reservoirs will be of a quality needed for project purposes in each reservoir;

(d) Control pollution in the streams subject to lowflow augmentation by adequate treatment or other methods of controlling wastes at their source; and

(e) Exercise to the full extent of their legal capability, control against removal or detention of streamflow made available for water quality control.

The assurances of local cooperation are discussed further in Appendix B.

Pat Harrison Waterway District. Seven early-action reservoir projects to satisfy selected local needs would be implemented by the Pat Harrison Waterway District. They are: Little Black Creek Reservoir in Lamar County; Big Creek Reservoir in George County; Archusa Creek Reservoir in Clarke County; Kittrell Creek Reservoir in Greene County; Thompson Creek Reservoir in Perry and Wayne Counties; West Tiger Creek Reservoir in Wayne County; and Whetstone Creek Reservoir in Jones County. In addition, the Flint Creek Reservoir in Stone County was completed in 1966.

The Kittrell Creek, Thompson Creek, West Tiger Creek and Whetstone Creek Reservoirs are located partially or wholly within the boundaries of the DeSoto National Forest. The availability of National Forest land for these developments has been coordinated with the U. S. Forest Service. However, additional coordination will be needed to delineate responsibility and authority between the two agencies prior to construction.

In addition to constructing its own projects, the Pat Harrison Waterway District will assist in implementation of the plan by coordinating all facets with other State and local agencies, and by furnishing the necessary assurances of local cooperation for proposed Corps of Engineers and Department of Agriculture projects.

UPSTREAM WATERSHEDS

Eight of the 17 upstream watershed projects will be carried out by the Department of Agriculture in accordance with the Watershed Protection and Flood Prevention Act of the 83rd Congress (Public Law 566). The remaining nine watershed projects and critical land area stabilization for the remainder of the basin will be recommended for special basinwide authorization in a separate report by the Department of Agriculture.

Local interests would provide the necessary cooperation in implementing and constructing the works of improvement. Plans would be developed by the local sponsoring organizations, Soil Conservation Districts, water management districts, and the Pat Harrison Waterway District, with technical assistance being provided by the Department of Agriculture.

Watershed projects would be planned and works of improvement installed in a progressive manner. A legally constituted local sponsoring organization would provide assurances satisfactory to the Secretary of Agriculture that they would provide the necessary local interests' share of the installation costs, obtain necessary easements and rights-of-way, and guarantee the operation and maintenance of works of improvement.

NONSTRUCTURAL MEASURES

Implementation of nonstructural measures of the comprehensive plan will require the cooperation of many Federal, State and local agencies. Management programs for controlling and regulating the economic use and development of flood plains and for reducing flood losses to existing developments in areas where flood control is not economically feasible should be undertaken by State and local

governments in conjunction with Federal interests. While Federal agencies can prevent unwise Federal and Federally assisted construction in the flood plains and provide information and guidance on flood hazard areas, State and local leadership in flood plain management is essential for it to become effective. Regulation of flood plain usage by zoning, subdivision regulations, building codes, and other police power measures can be done only by State or local governments. Legislation should be passed by the States requiring local communities with existing or potential flood problems to establish flood plain regulations. In addition, programs should be undertaken to define floodways throughout the States. The Corps of Engineers, under the provisions of Section 206, Public Law 86-645, will assist State and local governments and their planning agencies in implementation of flood plain management programs.

Current land management and conservation programs should be continued and accelerated by local interests in cooperation with the Department of Agriculture. State agencies and local interests, in cooperation with the Bureau of Outdoor Recreation and the Bureau of Sport Fisheries and Wildlife should undertake programs to complete an adequate recreation plan and a diversified fish and wildlife program for the basin. An adequate water hygiene program should be maintained by the States in cooperation with the Public Health Service. Maximum practicable treatment of all wastes entering the basin's streams will require a cooperative effort of State agencies, the Public Health Service, and the Federal Water Pollution Control Administration.

SUMMARY

A plan including such a large number of structures and affecting so many people in different areas can only be implemented by the cooperative effort of all interests concerned. Although the majority of the structural portion of the plan would be provided by Federal agencies, a portion of the construction program would be the responsibility of the Pat Harrison Waterway District. In addition to having primary responsibility for a part of the structural measures, local interests would be required to pay for water supply storage and a portion of the separable recreation and fish and wildlife enhancement cost in Federal projects. Therefore, they should at least be able to:

- Collect revenue and pay the non-Federal share of project costs.
- Provide management and maintenance services for reservoirs and recreation areas.

- Provide coordination among other interested State agencies and local organizations.

- Preserve the reservoir sites in the comprehensive plan.

The Pat Harrison Waterway District, an agency of the State of Mississippi, was created by the Mississippi Legislature in 1962 to provide the means of coordinating and participating in planning and implementing recommendations for the beneficial use of the waters in the Pascagoula River Basin. This agency is capable of meeting the above requirements and has furnished assurances that it will meet the items of local cooperation required for construction of proposed Corps of Engineers and Department of Agriculture projects.

The Governors of Mississippi and Alabama also have given their assurances of interest and cooperation in implementing the plan. In addition, other State and local governmental agencies, business communities, and civic organizations have indicated considerable enthusiastic support for the plan. The only significant opposition has been by resident and non-resident property owners who would be affected by land acquisition for the projects.

CHAPTER 11

RECOMMENDATIONS

The Coordinating Committee makes the following recommendations:

RECOMMENDATION I

That the comprehensive plan of structural and nonstructural measures presented in this report be adopted as the basic plan for development and beneficial use of the water and related land resources of the Pascagoula River Basin.

The comprehensive plan consists of:

1. The early-action program, which includes the following projects that are needed now and are economically justified for construction within the next 10 to 15 years:

   a. Eleven multiple-purpose reservoirs.

   b. Land treatment measures, 133 floodwater retarding structures, 20 multiple-purpose structures, and 852 miles of channel improvement in 17 upstream watersheds and critical land area stabilization for the remainder of the basin.

2. The framework for future planning, which includes the following:

   a. Eleven multiple-purpose reservoirs.

   b. A barge navigation project from Pascagoula Harbor to the inland cities of Hattiesburg, Laurel and Meridian.

   c. Land treatment measures, upstream watershed structures, including 10 multiple-purpose structures, and channel improvement in 30 upstream watersheds.

3. Management programs for controlling and regulating the economic use and development of flood plains and for reducing flood losses to existing developments in areas where flood control is not economically feasible.

4. Continuation and acceleration of current land management and conservation programs.

5. Maintenance of an adequate water hygiene program by the States.

6. Development of an adequate recreation plan, including preservation of areas of unique natural beauty and historical and scientific interest, and maintenance of open space, green space, and wild areas of rivers, lakes, beaches, and related land areas.

7. Development of a diversified fish and wildlife program, including streams for float-fishing, estuarine habitat protection, a refuge for the Florida sandhill crane, and expansion of the present basin wildlife management program.

8. Maximum practicable treatment of all wastes entering the basin's streams.

RECOMMENDATION II

That the early-action program be implemented as follows:

1. That authorization by the Congress for reservoirs designated as Taylorsville, Bowie, Mize and Harleston be sought by the Corps of Engineers. Estimated total costs for construction are $121,647,000; annual charges, $4,750,000; and annual benefits, $14,482,000. The benefit-to-cost ratio is 3.0.

2. That reservoirs designated as Little Black Creek, Big Creek, Archusa Creek, Kittrell Creek, Thompson Creek, West Tiger Creek, and Whetstone Creek be implemented by the Pat Harrison Waterway District as State of Mississippi projects with Federal aid. Estimated total costs for construction are $14,008,000; annual charges, $576,000; and annual benefits, $1,463,000. The benefit-to-cost ratio is 2.5.

3. That land treatment measures, 133 floodwater retarding structures, 20 multiple-purpose structures, and 852 miles of channel improvement in 17 upstream watersheds and critical land area stabilization for the remainder of the basin be implemented by the Department of Agriculture. Works of improvement and land treatment measures in 8 watersheds will be implemented through going programs (Public Law 566). Special basinwide Congressional authorization would be sought for works of improvement and land treatment measures in the remaining 9 watersheds and critical land area stabilization in the remaining portion of the basin. The estimated total cost for these measures is $57,474,000, of which $24,101,000 is for land treatment and critical land area stabilization. Excluding land treatment and critical land area stabilization, annual charges are $1,701,000 and annual benefits are $2,461,000, giving an overall benefit-to-cost ratio of 1.4.

RECOMMENDATION III

That the States adopt such legislation as may be required and take appropriate action, utilizing available Federal assistance and programs, to permit implementation of the various nonstructural measures in the plan.

RECOMMENDATION IV

That the comprehensive plan be reviewed and updated periodically.

SWEP T. DAVIS
State of Mississippi

CLAUDE D. KELLEY
State of Alabama

ROBERT C. PRICE
Federal Power Commission

DOUGLAS E. SCHNEIBLE
Department of Commerce and
Department of Transportation

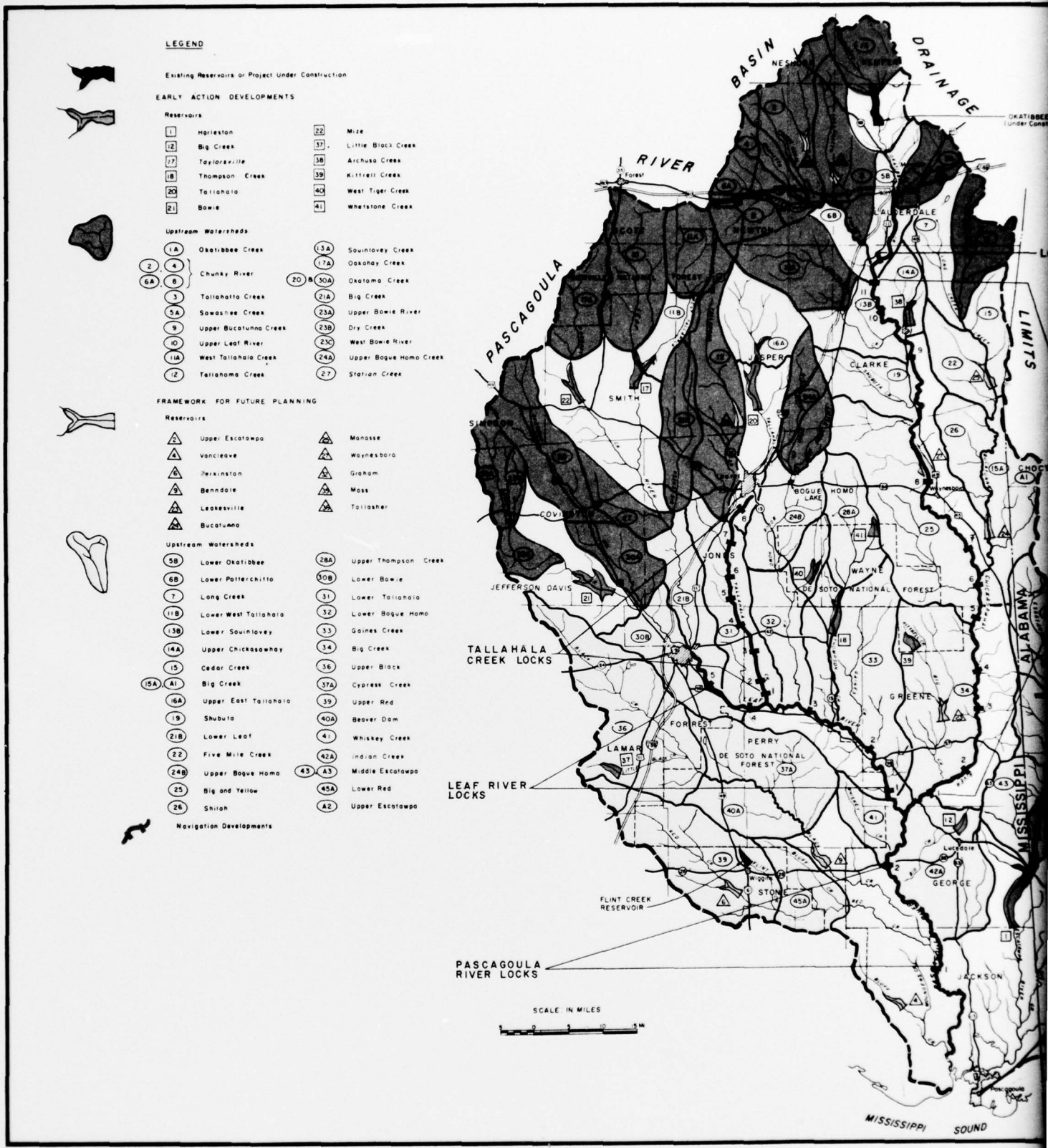
HOWARD W. CHAPMAN
Department of Health, Education
and Welfare

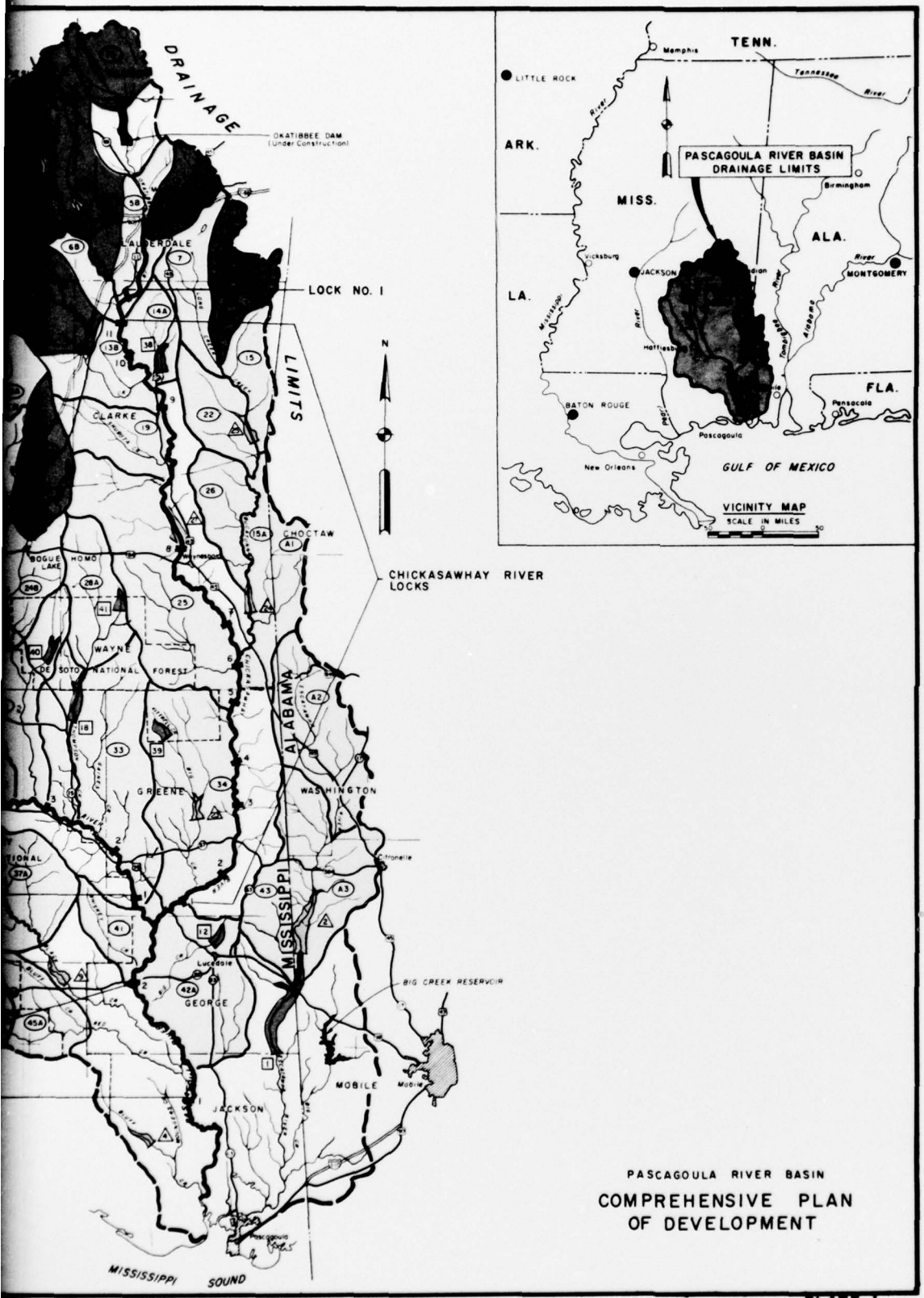
KENNETH D. McCALL
Department of the Interior

W. L. HEARD
Department of Agriculture

ROBERT E. SNETZER, CHAIRMAN
COL, Corps of Engineers
Department of the Army

February 29, 1968


LEGEND
Existing Reservoirs or Project Under Construction
EARLY ACTION DEVELOPMENTS
Reservoirs
1 Harleston
12 Big Creek
17 Taylorsville
18 Thompson Creek
20 Tallahala
21 Bowie
22 Mize
37 Little Black Creek
38 Archusa Creek
39 Kittrell Creek
40 West Tiger Creek
41 Whetstone Creek
Upstream Watersheds
1A Okatibbee Creek
2 4 6A 8 Chunky River
3 Tallahatta Creek
5A Sowashee Creek
9 Upper Bucatunna Creek
10 Upper Leaf River
11A West Tallahala Creek
12 Tallahoma Creek
13A Souinlovey Creek
17A Oakohay Creek
20 & 30A Okatoma Creek
21A Big Creek
23A Upper Bowie River
23B Dry Creek
23C West Bowie River
24A Upper Bogue Homo Creek
27 Station Creek
FRAMEWORK FOR FUTURE PLANNING
Reservoirs
2 Upper Escatawpa
4 Vancleave
6 Perkinston
9 Benndale
11 Leakesville
12 Bucatunna
28 Manasse
29 Waynesboro
32 Graham
35 Moss
36 Tallasher
Upstream Watersheds
5B Lower Okatibbee
6B Lower Potterchitto
7 Long Creek
11B Lower West Tallahala
13B Lower Souinlovey
14A Upper Chickasawhay
15 Cedar Creek
15A A1 Big Creek
16A Upper East Tallahala
19 Shubuta
21B Lower Leaf
22 Five Mile Creek
24B Upper Bogue Homo
25 Big and Yellow
26 Shitah
28A Upper Thompson Creek
30B Lower Bowie
31 Lower Tallahala
32 Lower Bogue Homo
33 Gaines Creek
34 Big Creek
36 Upper Black
37A Cypress Creek
39 Upper Red
40A Beaver Dam
41 Whiskey Creek
42A Indian Creek
43 A3 Middle Escatawpa
45A Lower Red
A2 Upper Escatawpa
Navigation Developments
BASIN
DRAINAGE
RIVER
PASCAGOULA
LIMITS
ALABAMA
MISSISSIPPI
JEFFERSON DAVIS
SMITH
JASPER
CLARKE
JONES
WAYNE
LAMAR
FORREST
PERRY
GREENE
STONE
GEORGE
JACKSON
DE SOTO NATIONAL FOREST
BOGUE HOMO
LAUDERDALE
TALLAHALA CREEK LOCKS
LEAF RIVER LOCKS
PASCAGOULA RIVER LOCKS
FLINT CREEK RESERVOIR
SCALE IN MILES
MISSISSIPPI SOUND



PASCAGOULA RIVER BASIN

COMPREHENSIVE PLAN OF DEVELOPMENT

PLATE 1