

YAZOO BACKWATER AREA REFORMULATION

MAIN REPORT

SEPTEMBER 2000

YAZOO BACKWATER AREA REFORMULATION

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YAZOO BACKWATER AREA REFORMULATION

MAIN REPORT

STUDY AUTHORITY

1. The Yazoo Basin, Yazoo Backwater, Mississippi, Project was authorized by the Flood Control Act (FCA) of 18 August 1941 (House Document (HD) 359/77/1, as amended by the Acts of 22 December 1944 and 27 October 1965 (HD 308/88/2) and the Water Resources Development Act of 1986. Authorized flood control measures include levees, associated drainage channels, pumping plants, and floodgates. The backwater area is divided into five subbasins: (a) the Satartia Area, (b) the Satartia Extension Area, (c) the Rocky Bayou area, (d) the Carter Area, and (e) the Yazoo Area. The location of the various areas and the authorized flood control features are shown on Plate 4-1.

2. Flood protection for the entire Yazoo Backwater Area was authorized by Section 3 of the FCA of 18 August 1941, which states in part:

"(b) The project for flood control of the Yazoo River shall be as authorized by the Flood Control Act approved June 15, 1936, as amended, by Section 2 of the Act approved June 28, 1938, except that the Chief of Engineers may, in his discretion, from time to time, substitute therefore combinations of reservoirs, levees, and channel improvements; and except that the extension of the authorized project and improvements contemplated in Plan C of the report of March 7, 1941, of the Mississippi River Commission is authorized."

STUDY GUIDANCE

3. The Yazoo Basin, Yazoo Backwater Project, Mississippi, Reformulation Study is being conducted by the U.S. Army Corps of Engineers, Vicksburg District, in partial response to a directive from the Office of Management and Budget (OMB) contained in the Fiscal Year 1991 Budget Passback. The guidance reads as follows:

"Yazoo Basin Study (MS): The mark includes the requested funding for a restudy of the Yazoo Basin Project. However, in response to the request for review and redesign of the project by the Governor of Mississippi, a reformulation report shall be prepared to identify, display, and evaluate alternative plans for 1) greater levels of flood protection for urban areas; 2) reduced levels of agricultural intensification; and 3) reduced adverse impacts of the environment. The scope of the reformulation should encompass alternative reservoir operations, and flood damage reduction alternatives for the Yazoo Backwater Area in addition to the Yazoo Backwater Pumping Plant. Methodology of the report shall be in accordance with the Principles and Guidelines, including full consideration of predominantly nonstructural and nontraditional measures. Compliance with the Fish and Wildlife Coordination Act and the National Environmental Policy Act shall be integrated with the preparation of the reformulation report. The reformulation report should be transmitted to OMB by the fourth quarter of FY 1991.

Consistent with existing Army guidance, no new contracts should be awarded until the reformulation report is approved by OMB."

4. At the time of this guidance, reformulation was limited to 2 years and one report. However, as time progressed, it became apparent that detailed studies would take more time and resources. It would require four phases and could not be completed by the fourth quarter of Fiscal Year 1991, and that in lieu of one report, four reports would be required. Even the first two phases--Upper Steele Bayou and Upper Yazoo Projects--were not completed by the fourth quarter of Fiscal Year 1991. When these two phases were completed, then the next two phases--Yazoo Backwater and Yazoo Tributaries--were undertaken. This phase has taken considerably more time and resources due to the amount of coordination undertaken and the number of plans evaluated.

STUDY PURPOSE AND SCOPE

5. This report is in partial response to the OMB directive. Four areas were identified for reformulation under the directive: Upper Steele Bayou Project, Upper Yazoo Projects, Yazoo Backwater Project, and Yazoo Tributaries Project. Reformulation reports for the Upper Steele

Bayou Project and the Upper Yazoo Projects were completed in December 1992 and December 1993, respectively. Reformulated projects were developed that are economically justified and environmentally sustainable. The reformulation report for Upper Steele Bayou Project was approved by Headquarters, U.S. Army Corps of Engineers (HQUSACE) in June 1993. The Upper Yazoo Projects report was approved by HQUSACE in June 1994. Construction on the reformulated projects is currently underway. Reformulation studies for the Yazoo Tributaries Project are continuing.

6. According to the OMB guidance, "the scope of the reformulation should encompass alternative reservoir operations and flood damage reduction alternatives for the Yazoo Backwater Area in addition to the Yazoo Backwater Pumping Plant." This OMB guidance encompasses four projects as previously stated; however, the Upper Yazoo Projects and the Yazoo Tributaries Project are influenced by reservoir operations. Reservoir operations were considered as part of the completed Upper Yazoo Projects and it was determined that the optimum operation had already been established but could not be maintained due to lack of channel capacity. Since reservoir operations have been addressed under the Upper Yazoo Projects, they will not be readdressed under the Yazoo Tributaries Reformulation Project. The Yazoo Backwater Reformulation Study is not affected by reservoir releases. The guidance to consider flood damage reduction measures was followed in completing the Upper Yazoo Projects and Upper Steele Bayou reformulation as well as in the current Yazoo Backwater Reformulation Study.

7. The purpose of this study is to review the uncompleted features of the authorized Yazoo Backwater Project to determine if features are economically feasible, environmentally sustainable, and are the best plan for meeting the area's current and future water resource needs.

8. The Yazoo Backwater Area is located in west-central Mississippi immediately north of Vicksburg, Mississippi. The Backwater Area is bounded on the west by the left descending bank Mississippi River levee, the Yazoo Basin escarpment on the east, and the Yazoo River on the

south. The Backwater Area contains about 1,074,000 acres and is the area that has historically been subject to flooding from backwater by the Mississippi River. The area is also subject to headwater flooding from the Yazoo River, Sunflower River, and Steele Bayou. The Backwater Area is divided into five subareas: (a) the Satartia Area, (b) the Satartia Extension Area, (c) the Rocky Bayou Area, (d) the Carter Area, and (e) the Yazoo Area (see Plate 4-1).

9. The report is comprised of a main report (which includes the Environmental Impact Statement (EIS) supplement) and supporting documentation. The main report discusses existing conditions, problems and opportunities, plan formulation, evaluation of alternative plans, public involvement, and presents the results of the study and the recommendation. The EIS supplement addresses potential environmental impacts, minimization and avoidance measures, and compensatory requirements. The supporting documentation addresses mitigation, Fish and Wildlife Coordination Act Report, Section 404(b)(1) evaluation, coordination, engineering investigations, economics, real estate, environmental analyses, cultural resources, and water quality. The supporting documentation is presented in 16 technical appendixes. The report has been prepared in accordance with Engineer Regulation 1105-2-100, "Guidance for Conducting Civil Works Planning Studies," (28 December 1990), including the Economic and Environmental Principles for Water and Related Land Resource Implementation Studies (3 February 1983), and the Economic and Environmental Guidelines for Water and Related Land Resources Implementation Studies (10 March 1983), commonly referred to as the Principles and Guidelines.

THE REPORTING PROCESS

10. This report, which includes the draft Supplemental Environmental Impact Statement (SEIS) and appendixes, is in response to the referenced authorities and guidance. The report develops a project plan that addresses the flooding problems and includes environmental features which help to restore some of the area to a forested condition.

11. The draft report and draft SEIS are being furnished to Federal, state, and local agencies and other interested entities for review. It will also be available through the internet at www.mvk.usace.army.mil. Following the distribution of this document, a public meeting will be held to discuss the recommended plan. After the receipt of comments from the review of the draft report and draft SEIS and from the public meeting, the recommended plan will be revised as necessary and a final report and final SEIS prepared. The final report will include responses to comments received from the review of the draft report and draft SEIS. This report will be forwarded again to Federal, state, and local agencies and other interested entities for final review and comment.

12. The final report, along with any comments received from the final review, will be submitted to the President, Mississippi River Commission, in Vicksburg, Mississippi. Following review, the Commander will file the final SEIS with the Environmental Protection Agency. The 30-day review period for the Final SEIS begins the day the filing is placed in the Federal Register. At the conclusion of the review period, the Commander will sign the Record of Decision and issue a notice of availability of the report.

AUTHORIZED PROJECT

13. The 7 March 1941 report by the Mississippi River Commission (CEMRC), which is printed in HD 359, 77th Congress, was prepared in response to resolutions by the Committee on Flood Control, House of Representatives, and the Committee on Commerce of the Senate, dated 2 August 1939 and 12 March 1940, respectively.

14. The FCA of 1941 authorized the extension of the east bank Mississippi River levee, generally along the west bank of the Yazoo River for a distance of about 54 miles to a connection in the vicinity of Yazoo City, Mississippi, with the Yazoo River levee feature of the Yazoo Basin Headwater Project. A structure was included at Little Sunflower River, and a combination of structures and pumping plants at Big Sunflower River, Deer Creek, and Steele

Bayou with a total pumping capacity of 14,000 cubic feet per second (cfs) were planned. The capacities of the three pumping stations were to be 11,000, 700, and 2,300 cfs for the Big Sunflower River, Deer Creek, and Steele Bayou, respectively. By closing the structures and operating the pumps when the Yazoo River reaches elevation 80 feet, National Geodetic Vertical Datum (NGVD), the pumping capacity of 14,000 cfs would prevent the elevation of water ponding behind the structures from rising above 90 feet, NGVD, more often than once in 5 years. The Act also provided for the enlargement of 7 miles of levee in the Rocky Bayou Area, and the adjustment in the discretion of the Chief of Engineers of grades of existing levees on the east bank of the Yazoo River, all as contemplated in Plan C of the report of CEMRC, dated 7 March 1941. The Act provided that the Chief of Engineers should fix the grade of the extension levees so that their construction would give the maximum practicable protection to the Yazoo Backwater Area without jeopardizing the safety of the mainline Mississippi River levees.

15. The FCA of 1944 extended the project, at the discretion of the Chief of Engineers, to include 38 miles of levees on the east bank of the Yazoo River (the Satartia and Satartia Extension Areas).

16. The Committee on Public Works of the U.S. Senate on June 12, 1954, adopted a resolution calling on the Chief of Engineers to "examine and review the project for flood control of the Mississippi River in its alluvial valley . . . as authorized by the Flood Control Act approved May 15, 1928, as amended by subsequent Acts of Congress, as one comprehensive whole and in its entirety, and to submit at the earliest practicable date recommendations for any modifications that are advisable with respect to the project or any feature of the project." In response, and in accordance with instructions from the Chief of Engineers, the Vicksburg District created a document that became Annex L to the Comprehensive Review. That Annex addressed the Yazoo Backwater Project, Mississippi, and put forward a plan to connect the Sunflower and Steele Bayou sumps by a channel.

17. As a result of the Comprehensive Review of the Mississippi River and Tributaries Project Report dated 6 April 1962 (HD 308/88/2), the Chief of Engineers modified the authorized plan

for the backwater area to include a connecting channel between the Sunflower River and Steele Bayou, with all interior drainage evacuated through the Little Sunflower and Steele Bayou structures. The Chief of Engineers Report reads in part as follows:

". . . I believe that, at some future time, protection of some areas in the Yazoo Backwater by pumping may be warranted. Since the new plan developed by the Mississippi River Commission is proposed for construction under existing project authorization, selection of this plan does not affect those authorizations, which I consider sufficiently broad to permit selection of location and capacities of pumping plants, or a combination of gravity and pumped drainage, as future developments dictate."

18. Included in the recommended plan was the purchase in fee title of 70,000 acres of land in the ponding areas and the operation of the ponding areas to produce optimum flood control and fish and wildlife benefits. These modifications were recognized by the FCA of 1965.

19. A report on Muddy Bayou (Eagle Lake) was prepared in December 1969 in response to requests by the Warren County Board of Supervisors, the Mississippi Game and Fish Commission, and other local interests. The report presented results of studies to determine the impacts of completed and authorized flood control works on Eagle Lake and to determine the feasibility and advisability of providing structural measures for fishery management practices and improvement of water quality in the lake. As a result of the report, the Yazoo Backwater Project was modified to include the Muddy Bayou Structure under the discretionary authority of the Chief of Engineers. The water control structure was approved in 1970. The structure allows manipulation of lake levels for improvement of water quality and fishery resources and also provides incidental flood protection for properties along Eagle Lake. This structure was completed in 1978.

20. The 23 July 1976, Yazoo Basin, Yazoo Backwater Area, Fish and Wildlife Mitigation Plan report proposed the implementation of an increment of structural measures to mitigate fish and wildlife losses resulting from the constructed flood control works in the backwater area. The

report was submitted for early action under the authority of the Yazoo Basin Comprehensive Study. The measures proposed in the report were limited to only those mitigation measures that might be implemented without acquiring additional lands because of then current Corps policy to use existing public lands. The plan recommended the construction of nine greentree reservoirs and nine slough impoundments on lands of the Delta National Forest under the discretionary authority of the Chief of Engineers. The recommended improvements were approved by the Chief of Engineers on 3 December 1976. During preparation of Design Memorandum No. 15 entitled Fish and Wildlife Facilities, Structural Measures, Delta National Forest dated 19 April 1979, approved by CEMRC, 11 June 1979, and with concurrence of the U.S. Forest Service, the nine greentree reservoirs were reduced to four and the nine slough control structures were reduced to five. Four of the slough control structures and one of the greentree reservoirs were eliminated due to unsuitable site conditions. One additional greentree reservoir was deleted because of problems with an existing easement. Three of the reservoirs were eliminated because the U.S. Forest Service informally indicated that they did not want any more greentree reservoirs built in the Delta National Forest. In summary, four greentree reservoirs and five slough control structures have been completed.

21. A reevaluation of the economic feasibility of the pumping stations features of the backwater project was completed by the Vicksburg District in 1982. The results of the reevaluation are presented in the Yazoo Basin, Yazoo Backwater Area, The Yazoo Pump Project report dated July 1982 and revised November 1982.

22. The alternatives considered during the reevaluation study were:

- a. Nonstructural measures.
- b. Levee system along both sides of the Sunflower River.
- c. Dual pumping plants at the mouth of the Little Sunflower River and Steele Bayou.

d. Alternative pump sizes at Steele Bayou:

(1) 10,000 cfs

(2) 15,000 cfs

(3) 17,500 cfs

(4) 20,000 cfs

(5) 25,000 cfs

(6) 30,000 cfs

e. Alternate pumping criteria:

(1) Initiate pumping at 80 feet, NGVD, year-round.

(2) Initiate pumping at 80 feet, NGVD, during cropping season; initiate pumping at 85 feet, NGVD, 1 December to 15 March and maintain an 85-foot elevation 1 January to 15 April by pumping and induced ponding.

(3) Initiate pumping at 80 feet, NGVD, during cropping season; initiate pumping at 85 feet, NGVD, 1 December to 15 March; and maintain the interior sump at 85 feet, NGVD, 1 January to 15 March and 80 feet, NGVD, 15 March to 15 April by pumping and induced ponding.

(4) Initiate pumping at 83 feet, NGVD, during the cropping season and initiate pumping at 85 feet, NGVD, during 1 December to 1 March.

(5) Initiate pumping at 85 feet, NGVD, year-round.

(6) Initiate pumping at 90 feet, NGVD, year-round.

(7) Initiate pumping at elevation 80 feet, NGVD, during the cropping season and initiate pumping at elevation 85 feet, NGVD, during the period 1 December to 1 March.

23. The economic analyses were conducted at the authorized interest rate of 2-1/2 percent. The designated National Economic Development (NED) Plan was a 25,000-cfs pumping station at Steele Bayou with pumping initiated at 80 feet, NGVD, during the cropping season and 85 feet, NGVD, during the period 1 December to 1 March. The NED plan had a first cost of \$210,900,000, annual excess benefits of \$18,661,000, and a benefit-cost ratio of 3.0. The designated Environmental Quality (EQ) Plan was a 15,000-cfs pumping station at Steele Bayou with pumping initiated at 85 feet, NGVD, year round. The EQ Plan also included the acquisition of 30,000 acres of wooded lands. The first cost for the EQ Plan was \$162,800,000. The excess benefits were \$4,662,000 and the benefit-cost ratio was 1.8. The plan recommended as best meeting the area's flood control needs with minimal environmental impact was a 17,500-cfs pumping station at Steele Bayou with pumping initiated at 80 feet, NGVD, during the cropping season and 85 feet, NGVD, during the period 1 December to 1 March. The recommended plan had a first cost of \$147,200,000, excess annual benefits of \$15,441,000 and a benefit-cost ratio of 3.3. At the then current interest rate of 7-5/8 percent, the recommended plan became the NED Plan with excess annual benefits of \$4,689,000 and a benefit-cost ratio of 1.3. The recommended plan also included the acquisition of perpetual easements on 6,500 acres of wooded lands or 6,000 acres in fee simple purchase or some combination of the two for the mitigation of potential environmental impacts from the pump project.

24. The plan recommended in the 1982 reevaluation was altered during OMB review. In December 1985, budgetary guidance from OMB directed that the work allowance for Fiscal Year 1986 should be used only to fully fund channel work and related real estate acquisition, to finance engineering and design for a pumping plant of approximately 10,000 cfs in lieu of the current 17,500 cfs, and to pay any outstanding commitments related to the current design.

25. Design documents completed for the alternate pumping plant include the following:

- a. Pump and Driver Feasibility Study, May 1984.
- b. Design Memorandum No. 18 - Site Selection, January 1985.
- c. Channel Work Report, February 1985.
- d. General Design Memorandum (GDM) No. 20, April 1985.
- e. Supplement No. 1 to GDM No. 20, June 1987.
- f. Design Memorandum No. 19 - Pump and Prime Mover, November 1988.

26. Technical Reports prepared by the U.S. Army Engineer Research and Development Center (ERDC) (formerly the Waterways Experiment Station) for the alternate pumping plant include the following:

- a. Pumping Plant Inflow-Discharge Hydraulics, Generalized Pump Sump Research Study, HL-88-2, February 1988.
- b. Formed Suction Intake Approach Appurtenance Geometry, HL-90-1, February 1990.

c. Yazoo Backwater Pumping Station Discharge Outlet, HL-90-4, May 1990.

27. In conjunction with the 1982 reevaluation efforts, the Yazoo Area Pump Project and Yazoo Area and Satartia Area Backwater Levee Projects, Fish and Wildlife Mitigation Report dated July 1982 was also prepared. The purpose of the report was to present the results of studies conducted to determine the modifications that should be made to achieve a balance in the use of the backwater area's natural resources. The report included the mitigation analyses for the construction and operation of the Yazoo Area and Satartia Area backwater levees projects, including the connection channel, the Big Sunflower and Steele Bayou structures, and any other associated construction work, as well as the recommended, yet unconstructed, Yazoo Area Pump Project. The recommended plan for mitigation was the acquisition of perpetual easements on 40,000 acres of wooded lands in the project area. Thirty-three thousand acres were for the mitigation of environmental impacts due to the construction of the Yazoo Area and Satartia Area levees; 6,500 acres were for the mitigation of the potential environmental impacts due to the recommended 17,500-cfs pumping station. No mitigation land was purchased as a part of this mitigation report. Mitigation requirements for all the Yazoo Area and Satartia Area levees were reevaluated by the October 1989 report as discussed in paragraph 28.

28. The Water Resources Development Act (WRDA) of 1986 authorized the acquisition of perpetual easements on 40,000 acres for mitigation of project-induced fish and wildlife losses within the Yazoo Backwater Area as recommended by the Vicksburg District in the July 1982 Reevaluation Report. WRDA 1986 also changed the cost-sharing provisions of local interests for Corps projects nation-wide. Under the new provisions, the local project sponsor would provide the lands, easements, rights-of-way, relocations and disposal areas for the project or 25 percent of the construction cost whichever is greater. These new provisions were applicable

to all projects or separable elements thereof, on which construction was initiated after April 30, 1986. The Rocky Bayou features, the Carter Area features, and the uncompleted features for the Yazoo Area were all deemed to be separable elements of the Yazoo Basin Backwater Project, and therefore, subject to the new cost-sharing provisions.

29. In October 1989, the Vicksburg District prepared the Yazoo Backwater Area, Mississippi, Yazoo Basin, Mississippi, Mitigation Plan report. The report presented a proposal to implement mitigation through compensation for terrestrial wildlife losses that resulted from the construction and operation of the Yazoo Area and Satartia Area levees. Potential environmental impacts for the Yazoo Area pumping station feature were not considered. Alternatives considered included:

- a. Development of existing public lands.
- b. Fee title acquisition and management of wooded lands.
- c. Perpetual land use easement acquisition of wooded lands.
- d. Fee title acquisition of cleared lands with reforestation/regeneration.

Fee title acquisition of 8,400 acres of frequently flooded cleared lands with reforestation was selected as the best plan for mitigating the wildlife losses in lieu of the mitigation plan approved by WRDA 1986. The report recommended the acquisition of lands from willing sellers and identified several properties that were currently available. The recommendation was implemented with the acquisition of the 8,800 acres of frequently flooded cleared lands referred to as the Lake George Property in 1990.

30. The WRDA of 1996, Section 102(a)(2) amended Section 103(e)(1) of WRDA 86 by defining physical construction as the date of construction contract award (25 March 1986 for the authorized backwater pumping station). Since a contract on the pumping plant was awarded before April 30, 1986, this modification in effect changed local cooperation requirements for the pumping plant to those of the original authorized project.

STATUS OF OTHER PROJECTS

SATARTIA AREA

31. The Satartia Area is south of the town of Satartia, Mississippi, between the Yazoo River on the west and the hill line on the east. The area comprises 45 square miles including the town of Satartia. Protection of this area was completed in November 1976. Completed works include about 20 miles of loop levee tying into the hill line and a gravity structure with floodgate.

SATARTIA EXTENSION AREA

32. This area is south of the Satartia Area between the Yazoo River on the west and the hill line on the east. The area comprises only 5 square miles. Protection could be provided by a loop levee 8.2 miles long, tying to the hills. Drainage would be provided through a floodgate. No flood control measures are authorized at this time.

ROCKY BAYOU AREA

33. The Rocky Bayou Area is south of the city of Yazoo City, Mississippi, between the Yazoo River on the west and the hill line on the east. The area comprises about 22 square miles. The area is now afforded a fair degree of protection by a locally constructed levee which is deficient

in both grade and section. Drainage is provided by a floodgate through this levee near its southern tie to the hills. Protection for this area, equal to that provided other areas in the Backwater Area, would be provided by enlarging the section, raising the levee grade, and replacing the existing floodgate. Enlargement of about 2 miles of the levee along the hill line has been completed in conjunction with relocation work by the Mississippi Department of Transportation on Mississippi State Highway 3, but no work on the remainder of the project features has been initiated.

CARTER AREA

34. The Carter Area contains about 160 square miles, approximately 102,000 acres, and is bounded by the Yazoo River on the east and the Will M. Whittington Auxiliary Channel on the west. The area begins just upstream of the confluence of the Big Sunflower and the Yazoo Rivers and extends northward to the latitude of Yazoo City. Yazoo Basin Headwater Project levees are located along the Will M. Whittington Auxiliary Channel and along the west bank of the Yazoo River upstream of Yazoo City. In recent years, a large portion of the project area has been dedicated to environmental uses. The U.S. Fish and Wildlife Service (FWS) manages the 28,600-acre Panther Swamp National Wildlife Refuge (NWR) for fish and wildlife purposes, 20,300 acres of which are in the Carter Area. About 1,200 acres of the 8,800-acre Lake George Wildlife Wetland Restoration Project are within the Carter Area.

35. Proposed flood control features include a levee along the west bank of the Yazoo River extending from the east bank levee of the Will M. Whittington Auxiliary Channel on the south to the intersection of the west bank Yazoo River headwater levee at Yazoo City. Interior drainage would be evacuated through a drainage structure at the southern end of the project area. No work on the flood control features has been initiated.

YAZOO AREA

36. The Yazoo Area is located between the east bank Mississippi River levee and the Will M. Whittington Auxiliary Channel. The area comprises about 926,000 acres. The project area under consideration in this report is that part of the Yazoo Area inundated by the 100-year flood event and includes about 630,000 acres in parts of Humphreys, Issaquena, Sharkey, Warren, Washington, and Yazoo Counties in Mississippi and part of Madison Parish in Louisiana. The area extends north from Vicksburg, Mississippi, a distance of about 65 miles to the latitude of Belzoni, Mississippi. About 60 percent of the project area is cleared and about 40 percent is in woodlands. Public wooded areas within or adjacent to the project area include (a) Delta National Forest (59,000 acres), (b) Yazoo NWR (10,200 acres), (c) Issaquena County Game Management Area (13,000 acres), (d) Twin Oaks Mitigation Area (5,800 acres), (e) Mahanna Mitigation Area (12,000 acres), (f) Panther Swamp NWR (28,600 acres), and (g) Lake George Wildlife Management Area (WMA) (8,800 acres). Big Sunflower and Little Sunflower Rivers, Deer Creek, and Steele Bayou flow through the area. The high ground along Deer Creek forms a natural divide between Steele Bayou and the Sunflower River Basins. About 80 percent of the drainage into the Yazoo Area is from the Sunflower River Basin.

37. Completed flood control works for the Yazoo Area include a levee system approximately 27 miles in length, extending from the south end of the east bank Mississippi River levee generally along the west bank of the Yazoo River to a connection with the west bank levee of the Will M. Whittington Auxiliary Channel. This levee system is complete to a grade of 107 feet, NGVD, and includes two structures (one with 19,000-cfs design capacity at the mouth of Steele Bayou and one with 8,000-cfs design capacity at the mouth of Little Sunflower River). A 15.2-mile-long channel was completed in 1978 from the Big Sunflower River to the Little Sunflower River and from there to Steele Bayou, connecting the Sunflower River and the Steele Bayou interior ponding areas. The levee feature was also completed in 1978. The Little Sunflower structure was completed in 1975. The Steele Bayou structure was completed in 1969.

The entrance and exit channel for the authorized pumping station and coffer dam were completed in 1987 at a cost of about \$2,500,000. As a part of the construction of the inlet and outlet channel, the Corps acquired 385.12 acres in fee title and 2.13 acres in perpetual easements. A major portion of this area has been maintained under a licensing agreement with the Board of Mississippi Levee Commissioners.

MITIGATION

38. The environmental impacts from the completed flood control features (levees, structures, and connecting channel) of the Yazoo Basin, Backwater Area Project have been partially mitigated. The completion of the Muddy Bayou Structure in 1978 mitigated the projected backwater project impacts to the fishery resources. To mitigate the terrestrial losses resulting from the constructed levees, structures, and connecting channel, four greentree reservoirs and five slough control structures have been constructed on the Delta National Forest lands and the acquisition and reforestation of 8,800 acres of frequently flooded cleared lands (Lake George WMA) was completed in 1998. Due to the timing of the acquisition of the Lake George WMA in relationship to when the terrestrial losses occurred in the construction of the Yazoo Backwater levees and reviewing those areas within Lake George WMA that could not be reforested, the Vicksburg District in consultation with the FWS agreed to relook at the compensatory mitigation requirements as a part of this reformulation of the Yazoo Backwater Area. This analysis is included in the mitigation appendix.

WILL M. WHITTINGTON AUXILIARY CHANNEL

39. The Will M. Whittington Auxiliary Channel, completed in 1962, is an integral part of the flood control plan for the Yazoo Basin allowing a major portion of the floodflow in the Yazoo River near Silver City, Mississippi, to pass down and reenter the Yazoo River near the mouth of the Big Sunflower River. This leveed floodway splits the flows of the Yazoo River providing reduction in flood stages on the Yazoo River. Constructed works consist of 30.8 miles of channel work, 61.3 miles of levees, and associated landside channel work and weirs.

MISSISSIPPI RIVER LEVEES

40. The Mississippi River Levees project was authorized by the FCA of 15 May 1928, as modified and amended in subsequent Acts of 23 April 1934, 15 June 1936, 18 August 1941, 24 July 1946, and 27 October 1965. The Mississippi River levees prevent inundation of the alluvial valley of the lower Mississippi River which begins at Cape Girardeau, Missouri, and gently slopes to the Gulf of Mexico. The main stem levees protect a number of major cities and towns as well as highly developed industrial areas and very valuable farmlands, including wildlife habitats of woodlands and marshes. The Mississippi River levees protect the alluvial valley against the project flood by confining flow to the leveed channel except where it enters natural backwater areas or is diverted purposely into floodway areas.

41. A major Mississippi River flood in 1973 led to the development of the Refined 1973 MR&T Project Flood Flowline which enabled levee deficiencies along the main stem levees to be identified. An EIS was prepared in 1976 to address environmental impacts of the work needed to address the identified deficiencies. A reevaluation of the project was completed in 1998 on the remaining work along with a Supplement to the Final EIS. This report documented that of the 460.4 miles of levee in the Vicksburg District, 216.8 miles need to be enlarged and raised to grade with placement of approximately 57.4 miles of seepage control measures. Of these amounts, 69.4 miles of levee enlargement and approximately 30 miles of associated seepage control are required in Mississippi generally in the area south of Greenville, Mississippi. This work is ongoing. During high stages on the Mississippi River, seepage enters into the Backwater Area from beneath the Mississippi River levee. Although the Corps cannot prevent the seepage, it is managing it by construction of relief wells and seepage berms to protect the integrity of the Mississippi River levee.

BIG SUNFLOWER RIVER

42. The Big Sunflower River Basin project was first authorized by the FCA of 22 December 1944 and subsequently amended by the FCA's of 24 July 1946 and 17 May 1950. These Acts

provided for channel improvement for flood damage reduction in the alluvial valley of the Mississippi River.

43. The primary purpose of the Big Sunflower River Basin project was to alleviate flooding in the basin through channel improvements on the Big Sunflower, Little Sunflower, Hushpuckena, and Quiver Rivers and their tributaries, and on Hull Brake-Mill Creek Canal, Bogue Phalia, Ditchlow Bayou, Deer Creek, and Steele Bayou. The authorized channel improvement works were incorporated into the MR&T Project by the FCA of 24 July 1946. The 1946 Act also altered the project to include upstream and downstream extensions as required. The FCA of 1950 modified local sponsor cooperation requirements by changing project right-of-way requirements from a non-Federal to Federal expense. The FCA of 23 October 1962 authorized improvements to Gin and Muddy Bayous in the Quiver River Basin. Additional work in the Steele Bayou area and water control structures in nine lakes for fish and wildlife purposes was authorized by the FCA of 27 October 1965. Expanded flood damage reduction work in Steele Bayou, Main Canal, and Black Bayou was approved by Congressional Public Works Committees on 15 and 17 December 1970.

Project History

44. The Big Sunflower River Basin project area encompasses approximately 4,093 square miles of alluvial flood plain (delta). The area is drained primarily by Steele Bayou, Deer Creek, Bogue Phalia, and the Quiver, Big Sunflower and Little Sunflower Rivers and their tributaries. The original Big Sunflower River Basin project provided for flood damage reduction and runoff improvements on 592 miles of rivers and streams within the Big Sunflower River Basin. Construction measures within the Big Sunflower River Basin began in 1947.

45. Approximately 194 miles of the Big Sunflower River were modified as authorized by the 1944, 1946, and 1950 FCA's. Modifications to Dowling Bayou and other tributaries of the Big Sunflower River were made under the same authority. Project works on the Big Sunflower River were completed in 1968. On the Little Sunflower River, channel modification work on

21.6 miles was completed in 1959. Most of the channel improvement works on the Big Sunflower and Little Sunflower consisted of clearing and snagging. Channel work on the Bogue Phalia involved clearing and snagging, limited channel enlargement, and channel cutoff work, all of which was completed by 1964. A comprehensive summary of historical channel maintenance work within the lower Big Sunflower River Basin is given in Table 1.

TABLE 1
HISTORICAL CHANNEL IMPROVEMENT WORK
BIG SUNFLOWER RIVER BASIN, MISSISSIPPI

Location	Construction Dates	Type of Maintenance	River Mile
Big Sunflower River	09/22/47-11/17/47	Clearing and snagging	0.00 - 11.36
Big Sunflower River	10/06/47-11/13/48	Clearing and snagging	11.36-19.22
Holly Bluff Cutoff	06/05/56-03/01/59	Cutoff and weir	19.22-3.5
Little Sunflower River	11/05/56-10/15/59	Clearing and grubbing	6.14-27.75
Big Sunflower River	09/01/58-11/22/59	Clearing and snagging	33.50-99.00
Bogue Phalia	07/18/58-08/14-59	Channel enlargement & realignment	8.50-20.87
Bogue Phalia	02/10/59-02/24/60	Channel enlargement & realignment	30.00-47.0
Big Sunflower River	11/14/60-07/02/63	Clearing and snagging	99.00-169.5
Bogue Phalia	09/01/61-09/29/62	Clearing and snagging	60.27-82.78
Big Sunflower River	03/12/62-06/02/62	Channel enlargement & cleanout	33.50-35.82
Bogue Phalia	08/24/62-05/21/63	Clearing/snagging, cleanout, cutoff and enlargement	0.00-8.50
Bogue Phalia	08/24/62-07/10/63	Clearing/snagging & cleanout	23.84-30.00
Big Sunflower River	08/28/62-11/12/62	Clearing and snagging	28.30-57.00
Big Sunflower River	08/13/62-11/12/62	Clearing and snagging	57.70-78.13
Big Sunflower River	08/26-63-06/06/64	2 cutoffs	86.50-92.00
Bogue Phalia Cutoff	06/21/64-08/01-64	Clearing and snagging	0.00-4.16
Dowling, Ditchlow, and Twin Lakes	09/14/64-08/05/65	Clearing/snagging & cleanout	0-7.88, 0-4.16, 0-2.0
Big Sunflower, Mill Creek	11/15/64-11/02/65	Clearing/snagging & cleanout	199.42-210.78, 0-7.0

BIG SUNFLOWER RIVER MAINTENANCE PROJECT

46. Since completion of the original work in the 1960's on the Big Sunflower River Basin, the Board of Mississippi Levee Commissioners and Yazoo-Mississippi Delta Levee Board have been responsible for minor maintenance such as vegetation control, removal of drift material, and removal of sedimentation at the mouth of small tributaries. However, these local sponsors are not responsible for major maintenance.

47. In recent years, extensive annual flooding has occurred in the Big Sunflower River Basin. Numerous complaints from local sponsors, flood control interests, residents, and landowners were received by the Vicksburg District. Concerns were expressed that the project was not operating as intended and the District was asked to investigate the situation. Surveys taken and engineering data collected indicated the lower reaches of the basin's streams had experienced loss of design capacity due to vegetation and sedimentation in the channels.

48. To lessen the impact of flooding, channel maintenance is planned on approximately 133.1 miles of streams. This includes the removal of approximately 8.42 million cubic yards of material along 104.8 miles of channel and clearing and snagging on 28.3 miles of channel.

49. Adverse environmental impacts as a result of the above work will be mitigated by avoidance and minimization through project design and the acquisition and reforestation of 1,912 acres of frequently flooded agricultural lands. Construction began on this project in 1999 and is scheduled to take approximately 7 years to complete. For additional information on this project, see the Project Report and Supplement No. 2 to the Final Environmental Impact Statement of the Big Sunflower River Maintenance Project.

STEELE BAYOU

50. The Steele Bayou project was authorized by the Flood Control Act of 1944 and is a feature of the MR&T, Big Sunflower unit of the Basin. Subsequent modifications to the 1944 FCA provided for additional channel enlargement on Steele Bayou, extension of the channel work to the Steele Bayou tributaries, Main Canal and Black Bayou and waterfowl measures in the Yazoo NWR. The work on Steele Bayou is essentially complete except for the work around the Yazoo NWR. The waterfowl features have been completed except for establishment of the final levee grades in the refuge.

51. Work on Main Canal and Black Bayou was reformulated in 1992 under the same reformulation authorization used in the Yazoo Backwater Area. This reformulation effort resulted in 25.3 miles of channel enlargement to Main Canal and improvements to two laterals in Greenville, Mississippi, 6.3 miles of selective clearing and snagging, and 30.2 miles of channel cleanout on Black Bayou.

52. Environmental losses were minimized through project design; however, remaining losses will be compensated by the acquisition and reforestation of 5,250 acres of frequently flooded agricultural lands. Construction of the improvements on Main Canal and Black Bayou was begun in 1992 and is currently ongoing. Mitigation lands are being purchased concurrently with construction.

STUDY AREA

LOCATION

53. The Yazoo Backwater Area, as depicted on Plate 4-1, lies in west-central Mississippi between the Mississippi River east bank levee and the hill line on the east. The triangular shaped area extends northward about 60 miles to the latitude of Hollandale and Belzoni, Mississippi, and comprises about 1,446 square miles. Big Sunflower and Little Sunflower Rivers, Deer Creek, and Steele Bayou flow through the project area. These streams have a total drainage area of 4,093 square miles of the alluvial valley of the Mississippi River, commonly called the Mississippi Delta. The area extends from the confluence of Steele Bayou with the Yazoo River north to the vicinity of Clarksdale, Mississippi, and has an average width of approximately 30 miles. The Mississippi Delta alluvial plain is generally flat with slopes averaging 0.3 to 0.9 foot per mile. Drainage areas of the four basins are shown in the following tabulation:

Stream	Drainage Area (square mile)
Big Sunflower River	2,832
Little Sunflower River	309
Deer Creek	200
Steele Bayou	<u>752</u>
Total	4,093

Interior drainage of the area is accomplished by structures at Little Sunflower River (upper ponding area) and Steele Bayou (lower ponding area).

CLIMATE

54. The climate of the Yazoo Backwater area is primarily humid, subtropical with abundant precipitation. The summers are long and hot; the winters are short and mild. The average annual temperature is about 65 degrees F. Average monthly temperatures range from 44 degrees F in January to 82 degrees F in July and extremes range from about -10 degrees F to 110 degrees F. The normal length of the frost-free growing season is slightly longer than 7 months.

PRECIPITATION

55. The average annual rainfall over the Yazoo Backwater Area is approximately 51 inches. Normal monthly rainfall varies from 5.81 inches in March to 2.58 inches in October. However, severe rainfall, producing locally intense runoff, can occur at any time of the year. Snowfall occurs about once a year with an average of approximately 2 inches.

PHYSIOGRAPHY

56. The study area lies in the alluvial valley of the Mississippi River. The topography is characterized by relatively flat, poorly drained land with slopes of 0.3 to 0.9 foot per mile. Elevations range from 120 to 75 feet, NGVD, from north to south.

57. The alluvial valley was formed during the early Pleistocene epoch, or glacial period, at which time the Mississippi River became deeply incised in the coastal plain. The river gradually filled the valley with deposits of sand, silt, clay, and gravel during the Quaternary period. The deposits generally grade from coarse to fine, proceeding from deep to shallow with a clay cap typically found on the slopes. This material has been reworked as streams have meandered

throughout the area. Depositional features resulting from this activity include abandoned course, abandoned channel, point bar, backswamp, braided stream, and natural levee. The relationship of streams under investigation to these feature is discussed in the more detail in Appendix 6.

PLAN FORMULATION

EXISTING CONDITIONS

Socioeconomic Setting

58. An economic base area was selected for this study to determine the existing economic conditions and project future economic conditions with or without a flood control project. This area includes Humphreys, Sharkey, Warren, Washington, and Yazoo Counties in Mississippi and Madison Parish in Louisiana. The area affected by this project is essentially all of the lower Yazoo Backwater Delta area. The entire drainage area that flows through the area is approximately 4,093 square miles.

59. Because of the fertile soil and mild climate of the Mississippi Delta, agriculture (primarily cotton) became the economic mainstay for the region beginning in the early 1800's. This resulted in clearing and draining of the forested bottom lands to facilitate agricultural production. Catfish production in recent years has also become an important agricultural activity in the study area accounting for 3 percent of the farmland acres. Other nonurban lands, including forest lands, wetlands, water bodies, etc., represent approximately 37 percent of the study area with urban lands less than 1 percent.

60. Other natural resources in the study area include water, forestry, and mineral resources. Surface water resources other than project rivers and their tributaries include numerous lakes, ponds, and wetland areas. Ground-water resources are dominated by the Mississippi River

alluvial aquifer, a prolific water-bearing strata used for irrigation, catfish production, and municipal and industrial (M&I) supplies. Deeper aquifers are primarily reserved for M&I use. Forestry resources are comprised of bottom-land hardwoods which support numerous wildlife species. Although significant reductions in forested acreage have occurred in the last 50 years, sufficient acreage remains to support several timber-related industries in the study area. The most important mineral resources in the study area are sand and gravel which are mined in numerous locations throughout the area. Of minor importance are clays and oil and gas reserves.

61. Human and cultural resources for the economic base area can be identified in terms of population, housing, transportation, communication, and utilities. The population of the Yazoo Backwater area has decreased from 21,550 in 1940 to approximately 8,975 in 1990.

62. In contrast to the total area, urban population has generally been on the increase, ranging from 15 percent of the total in 1940 to 35 percent in 1986. This reflects a broad trend of increased mechanization in agricultural operations and increased industrial employment opportunities near urban centers.

63. Transportation facilities provide access throughout the project area in the form of highways. Rolling Fork serves as a transportation hub since the major highways converge on the city.

64. Economic conditions can be described by parameters such as labor force and employment, earnings and income, agricultural activity, and industrial and business activity. The civilian labor force; i.e., nonmilitary, ranged from 3,980 in 1980 to 3,272 in 1990. This was accompanied by unemployment figures ranging from 11.3 to 14.5 percent during the same period. Industrial employment has traditionally centered around activities related to agriculture in the Backwater area. In 1990, four industry groups accounted for the majority of total employment in the Backwater area. These include government (13.8 percent), services (18.1 percent), retail and wholesale trade (11.4 percent), and manufacturing (17 percent). Actual agricultural employment comprised 4.4 percent of total employment in 1990.

65. Earnings and income patterns provide further insight into the area economy. Earnings from agricultural activities have declined percentage-wise over the last decade yielding to manufacturing as the major contributor to earnings in 1990 with 19.4 percent of the total. Trade and services comprised 12.1 and 15.4 percent, respectively, of total earnings in 1990, compared to 20 percent for farm earnings. The government sector accounted for more than 14.7 percent of total earnings in 1990. Earnings by county show Sharkey County with 85 percent of the total. Per capita income was approximately \$9,951 in 1990, an increase of 163 percent from 1969.

66. Agriculture continues to be of major importance to the area economy, although the trend is toward fewer farms with larger acreage. The number of farms decreased from 2,036 in 1954 to 234 in 1992, while the average size increased from 76 to 736 acres during the same period. Land in farms increased from over 250,000 acres to 295,680 acres during this period also. Cropland represented 54.9 percent of total farmland in 1992. The value of farm products sold fluctuated with a high of 87.4 million in 1992. Principal field crops are soybeans, cotton, wheat, sorghum, and corn. Soybeans and cotton represent 52 and 36 percent, respectively, of the total harvested acreage in 1988.

67. The "sunbelt movement" of the 1970's resulted in the emergence of the services, trade, and manufacturing sectors which helped to stimulate the economy of the area by creating more industry and jobs. Manufacturing has contributed to the diversified industrial base of the Backwater area. There were 10 manufacturing establishments in the area in 1987. Manufacturing ranked fourth in employment, but second in earnings for the area in 1990. Value added by manufacture increased from \$5.0 million in 1972 to \$8.6 million in 1982. The number of establishments fluctuated during this period resulting in an overall increase of 25 percent.

Hydrologic Setting

68. As previously mentioned, the following features have been completed in the Yazoo area.

a. Backwater levee extending from the end of the east bank mainline Mississippi River levee to the downstream end of the west side of the Will M. Whittington Channel levee along the Yazoo River.

b. Structures at Steele Bayou and the Little Sunflower River. These structures allow interior runoff to be released when the ponding area stages are higher than the river stages and prevent backwater flooding from the Mississippi and Yazoo Rivers when the river is higher than the ponding areas.

c. A 200-foot bottom width connecting channel between the Big Sunflower and Little Sunflower Rivers and an enlarged Little Sunflower River channel between this connecting channel and the Little Sunflower drainage structure.

d. A 200-foot bottom width connecting channel between the Little Sunflower River and Steele Bayou, which also intercepts Deer Creek flow.

e. A gated structure in Muddy Bayou which controls Eagle Lake inflows and outflows for environmental purposes.

69. The Mississippi River mainline levees are designed to protect the alluvial valley from the Project Design Flood (PDF) by confining floodflows within the leveed floodway, except where it enters the backwater areas or is diverted intentionally into the floodway areas. The mainline levee system is comprised of levees, floodwalls, and various control structures. When major

floods occur and the carrying capacity of the Mississippi River leveed channel is threatened, additional conveyance through the Bird's Point-New Madrid Floodway, and relief outlets through the Atchafalaya Basin, Morganza, and Bonnet Carre Floodways are utilized as well as the storage capacity of flat lowlands at the junctions of tributaries with the Mississippi River. These "backwater areas" are in effect reservoirs that store water during times of floods. They are protected from lesser floods by backwater levee systems that are designed to be overtopped near the crest of the PDF in order to reduce the peak flow of the PDF and allow safe passage within the mainline levee system. The system design which utilizes backwater storage at appropriate times in the PDF hydrograph has significantly reduced the need for even higher mainline levees. The Yazoo Backwater levees are designed to overtop by the PDF.

70. Ponding of runoff from the Big Sunflower River, Little Sunflower River, Deer Creek, and Steele Bayou is provided by two ponding areas connected by a 200-foot bottom width channel. The lower ponding area, formerly referred to as the Lower or Steele Bayou ponding area, lies in the lower end of the Steele Bayou Basin while the upper ponding area, formerly called the Upper or Sunflower River ponding area, is located in the lower portion of the Little Sunflower River Basin.

71. Under present conditions, the Backwater flooding in the study area results primarily from interior ponding behind the Backwater levee when the Steele Bayou structure is closed during high Mississippi River stages. The interior ponding areas are primarily agricultural and forested lands with several developed areas existing in the Yazoo Backwater Area. Interior flooding begins at approximately 80 feet, NGVD. The interior area is protected from high stages of the Mississippi River and Yazoo River by levees; however, the area is subject to flooding resulting from inflow into the ponding areas from Steele Bayou, Deer Creek, and Big and Little Sunflower Rivers.

72. During the rising and falling stages of a flood hydrograph, the water surface elevations in the upper ponding area are generally significantly higher than the water surface elevations in the

lower ponding area. This difference is due primarily to slope through the connecting channel and head losses across bridges and overbank openings along Deer Creek ridge and the divide between the two areas. Near the peak of the flood event, there is little difference in water surface elevations between the two ponding areas.

73. The Muddy Bayou control structure was constructed primarily as a means of controlling inflows to and discharge from Eagle Lake during nonflood conditions in order to enhance the lake's water quality. However, due to the relatively high topography surrounding the lake, flood protection is provided as well.

74. During flood conditions, the Muddy Bayou structure is opened to allow water to pass from the lower ponding area into Eagle Lake only if it becomes apparent that this line of protection will be overtopped (about elevation 96 feet, NGVD).

75. Since the storage available in the lake is very large compared to the drainage area, essentially no flooding results from local rainfall in the Eagle Lake area alone. Similarly, two private levee systems (Floweree and Brunswick) provide protection to comparatively small areas.

76. The Steele Bayou Floodgate is the principal drainage structure for the Yazoo Backwater Project. Any time the stage on the landside of the Steele Bayou and Little Sunflower structures is higher than the riverside and above 70 feet, NGVD, the gates are opened. With a rising river, the interior ponding areas are normally allowed to rise to an elevation of 75 feet, NGVD. The floodgates are closed when the river elevation is higher than the interior ponding levels.

77. The Steele Bayou structure is operated to control minimum water levels in the Steele Bayou and Little Sunflower ponding areas. The current operation plan calls for holding minimum water levels in the ponding areas between 68.5 feet, NGVD, and 70 feet, NGVD.

Environmental Setting

78. The study area contains significant environmental resources. These resources have previously been described in the Final EIS, Flood Control, Mississippi River and Tributaries, Yazoo River Basin, Mississippi, filed with the Council on Environmental Quality (CEQ) on 29 December 1975. Extensive background information is also provided in the Environmental Inventory and Assessment (EIA), Yazoo River Basin, June 1980, prepared for the U.S. Army Corps of Engineers, Vicksburg District, by Howard, Needles, Tammen and Bergendoff. This information has been updated through investigations undertaken in support of the Yazoo Basin Reformulation Study. These resources were also described in the Big Sunflower Maintenance Supplement No. 2 to the Final Supplemental Environmental Impact Statement, July 1996. A description of these resources is presented in the accompanying Supplemental EIS (SEIS). Evaluations of wetlands, terrestrial, and aquatic resources; water quality; waterfowl; cultural resources; and endangered species were conducted along with consideration of nonstructural, structural, and a combination of structural and nonstructural flood control measures. The complete analyses of these resources are presented in the draft SEIS and accompanying appendixes.

79. Preproject conditions as discussed above are the basis for evaluating overall changes to the environment. Agriculture dominated the rural economy which led to extensive land clearing and increased production of row crops such as cotton and soybeans. However, major stands of bottom-land hardwoods still remain in areas such as the Delta National Forest, Issaquena County Game Management Area, Yazoo and Panther Swamp NWR, Mahanna and Twin Oaks and Lake George mitigation areas, and Delta Wildlife and Forestry, along with various other smaller tracts. Forested areas, comprised primarily of bottom-land hardwoods, cover approximately 37 percent of the study area. Most of these remaining areas are rated high in commercial timber value and also wildlife value. These bottom-land hardwoods provide essential and highly productive

habitat for whitetail deer, wild turkey, squirrels, raccoons, opossums, mink, cottontail and swamp rabbits, nesting and migratory waterfowl, herons, egrets, hawks, owls, and many species of nesting and wintering songbirds. Various species of turtles, snakes, and amphibians and the American alligator are native to the area. Land use within the 100-year flood of the Yazoo Area is shown in Table 2.

TABLE 2
LAND USE WITHIN THE 100-YEAR FLOOD OF THE YAZOO AREA

Land Use	Acres	Adjusted Acres ^{a/}	Wetlands	Acres	Adjusted Acres ^{a/}
Cotton	71,939	70,179	Nonhydic	73,300	71,843
Soybeans	205,287	176,083	Prior Converted	240,337	221,102
Corn	418	337	Farmed Wetlands	46,142	21,471
Rice	44,793	34,282	Unclassed		1,199
Herbaceous	28,723	25,620			
Pasture	9,889	9,110			
Total Cleared	361,049	315,611	Total Cleared	361,055	315,615
Bottom-land Hardwoods	204,218	121,525	Bottom-land Hardwoods	204,218	121,526
Swamp	29,651	22,146	Swamp	29,651	22,145
Total Forested	233,869	143,670	Total Forested	233,869	143,671
River	3,791	3,225	River	3,791	3,225
Lake	12,377	10,869	Lake	12,377	10,877
Pond	18,628	18,216	Pond	18,628	18,215
Cloud/Sandbar	7	5	Cloud/Sandbar	0	0
Total Water	34,803	32,315	Total Water	34,796	32,317
WMA	0.0	89,927	WMA		89,923
NWR	0.0	22,184	NWR		22,183
WRP	0.0	22,535	WRP		22,534
CRP	0.0	3,478	CRP		3,477
Total Managed	0.0	138,124	Total Managed		138,117
Total	629,721	629,721	Total	629,721	629,721

NOTE: WMA - Wildlife Management Area
NWR - National Wildlife Refuge
WRP - Wetland Reserve Program
CRP - Conservation Reserve Program

^{a/} Adjusted acres - the land use acres were adjusted by removing all lands managed by state and Federal agencies or under Federal programs.

80. The Food Security Act of 1985 discourages the clearing of bottom-land hardwoods for agricultural purposes. Prior to this legislation, clearing of wooded tracts was a common practice influenced to a great extent by agricultural commodity prices. Also, Section 404 of the Clean Water Act has served as a deterrent to land clearing since mitigation for wetland losses could be required.

81. Extensive studies were conducted by FWS, the U.S. Army Engineer Research and Development Center (ERDC), and the Vicksburg District to determine base environmental conditions. Detailed hydrologic data were required to complete the base conditions analysis. A Geographic Information System (GIS) was also used to determine cover type, reach boundaries, and facilitate the evaluation of economic data and project features.

82. To determine land use changes, 1988 satellite imagery was classified using the GIS. This information indicates that approximately 273,000 acres of bottom-land hardwoods remain in the study area. Although much of this acreage is in public ownership, a significant amount remains in private ownership. Most of these remaining bottom-land hardwoods are classified as wetlands and are protected by provisions of the Food Security Act of 1985. The remaining cleared land is classified primarily as "prior converted" cropland in accordance with the Food Security Act, and thus, has lost much of the functional wetland value as opposed to "farmed" wetlands which still exhibit some wetland characteristics even though they have been cleared.

83. Base aquatic habitat conditions were determined by sampling streams, existing borrow areas, lakes, and flood plain habitats for juvenile and adult fishes. Fifty-seven species of fish were identified, including flathead catfish, freshwater drum, gizzard shad, common carp, bigmouth buffalo, white crappie, gar, bowfin and bull heads, and sunfishes. The species collected represent those tolerant of degraded environments. High turbidity and uniformly shallow water were found to be significant factors inhibiting species diversity. Spawning habitat was the highest in the fringe flood plain connecting to the inlet/outlet channel to the Steele

Bayou structure and in the oxbow lakes contiguous with the Big Sunflower River or one of its tributaries. Overall, permanent water bodies on the flood plain provide higher habitat value to rearing fishes than cleared lands. Species richness of larval fish is low compared to other flood plain river systems with large tracts of contiguous bottom-land hardwoods. Thermal stratification is pronounced during late spring and summer, particularly in the flood plain behind the Steele Bayou structure. Low dissolved oxygen along with high water temperatures contributes to physiological stress and may result in substantial mortality of fishes.

84. Water quality studies conducted tend to support the conclusions of the aquatic studies. Physical and chemical data indicate that water quality in the project area is poor for southern alluvial streams. Low flows are common during the summertime, resulting in high water temperatures, low dissolved oxygen levels, and stagnation. State criteria for suspended solids, total solids, nitrogen, and phosphorous are exceeded most of the time. Pesticide levels were surprisingly low compared to previous data. Of 41 pesticides tested, only 9 were detected, with one-half of the detections at the detection limits for the respective pesticides. The State of Mississippi lists the waters as partially supporting the designated use of fish and wildlife propagation, which is the general classification for most surface waters in the state.

85. Sediment samples were analyzed and compared to historical data. DDT and its derivatives were the most frequently observed pesticides. Their source is agricultural runoff from agricultural fields. Sufficient levels of DDT and its derivatives were found to maintain high levels in the aquatic environment for years to come. Accumulation of these pesticides in aquatic organisms should be expected since the predominant type of macroinvertebrate upon which fish survive is the oligochaete, or aquatic earthworm, which lives in the sediment. Fish tissue

samples are generally high in chlorinated pesticides with 80 percent exceeding EPA screening values for total DDT and 12 percent exceeding FDA action limits for that pesticide. The State of Mississippi lists the primary source of pollutants as nonpoint.

86. Waterfowl studies were conducted by FWS to determine base conditions and project impacts on waterfowl. Using food as an index of carrying capacity, the study area was evaluated to determine changes resulting from the proposed project. This area is an important wintering waterfowl area comprised of large tracts of bottom-land hardwoods and soybeans. The area often floods during the winter and early spring to provide abundant foraging habitat for waterfowl. Forested wetlands fulfill special waterfowl habitat requirements not provided by open lands. These bottom-land hardwoods produce nutritious foods for waterfowl and provide secure roosting areas, cover during inclement weather, resting sites, protection from predators, and isolation for pair formation. Whereas much of the foraging and nutritional requirements can be met by flooded agricultural fields, a variety of habitats are needed to satisfy the total biological requirements of wintering waterfowl. Eight species of waterfowl regularly utilized the bottom-land hardwood forests in the Mississippi flyway.

87. Historically, the Mississippi Alluvial Valley (MAV) served as a major wintering area for waterfowl. Waterfowl population numbers began to decline in 1960's as a direct result of extensive droughts and loss of nesting habitats in the prairie pothole region of North America, and the conversion of wintering area in the MAV to agricultural production. Recently, waterfowl populations have recovered to the long-term average primarily because of 2 years of exceptional breeding conditions. According to FWS, the net effect of wetland conversion and drainage has been that under normal conditions, natural habitat is no longer sufficient to meet the needs of this number of wintering waterfowl and other migratory birds.

88. Two endangered/threatened species were identified by FWS as potentially occurring in the project area. These include the pondberry plant (Lindera melissifolia) and the Louisiana black bear (Ursus americanus luteolus). The pondberry is a low deciduous plant growing in

bottom-land hardwood communities. It usually grows in close proximity to water and is more dependent upon local hydrology than overbank flowing. Pondberry studies have previously been undertaken as part of other studies in the Yazoo Basin. These studies developed a profile of this species. A literature search, consultation with experts, field data collections, and hydrologic analyses of existing colonies were used to develop this profile. Based on this reformulation, it was determined that a survey of project rights-of-way with an additional buffer strip would be conducted to identify any plants that would be directly impacted by flood control alternatives. A survey at the pump site has been conducted and no pondberry colonies were found. The Louisiana black bear is a generally recognized subspecies of the American black bear. It historically occurred in bottom-land hardwood forests from eastern Texas through all of Louisiana to southern Mississippi. The Louisiana black bear became a threatened species primarily because the habitat of the bear has suffered extensive modification with suitable habitat having been reduced by more than 80 percent as of 1980. The remaining habitat has been reduced in quality by fragmentation due to intrusion of man and his structures. A survey of the pump site was conducted and found no evidence of bear activity.

89. An on-the-ground survey for historic/archeological sites at the backwater pump site has been conducted. No evidence of historic/archeological sites was discovered.

90. A literature and record search was conducted to ascertain whether any previously recorded or known prehistoric and historic cultural resources were located in or adjacent to the project study area. This search was also conducted to determine what types of cultural resources might be expected in the study area. The search recorded approximately 1,515 archeological sites within the study area along with 11 National Register of Historic Places (NRHP) eligible properties and numerous NRHP listed properties. This included all of the six counties/parishes involved in the study area--Humphreys, Issaquena, Sharkey, Warren, Washington, and Yazoo Counties, Mississippi; and Madison Parish, Louisiana.

91. Wildlife-based recreation is an important part of the Yazoo Backwater Area culture. This includes both consumptive and nonconsumptive activities. Consumptive activities include hunting, trapping, fishing, etc. Nonconsumptive activities include photography, birdwatching, nature study, etc.

92. The following paragraphs show clearly the ecological significance of this area to the environment through the efforts of state and Federal agencies and private organizations. The economic needs of the area have previously been documented.

93. The Yazoo Backwater area is one of four functional backwater flood plain complexes within the Lower Mississippi Valley, the Nation's largest flood plain, which are the "ecological engines" responsible for its renowned biological productivity. It is not surprising, then, that historically, the wetland habitats of the Yazoo Backwater area supported an exceptional diversity and abundance of fish and wildlife resources. In the broadest sense, the Federal trust fish and wildlife resources (i.e., those subject to Federal or international laws and treaties) of the Yazoo Backwater area include migratory birds, interjurisdictional fishes, endangered and threatened species, and the backwater flood plain habitat on which they depend.

94. Today, nearly 75 percent of the Lower Mississippi Valley's historic forest cover and 90 percent of its historic flood plain have been lost. Within the Yazoo Backwater area, approximately 107,000 acres of backwater habitat in the 2-year flood plain were converted to agricultural production. As a result, many flood plain habitat restoration efforts have been implemented by Federal and state agencies, and private conservation organizations. For example, the Mississippi Alluvial Valley Migratory Bird Conservation Initiative designated the Yazoo Backwater area as a high priority migratory bird conservation zone. In 1986, the North American Waterfowl Management Plan recognized the role of the Nation's largest flood plain in

conserving continental waterfowl populations by naming the Lower Mississippi Valley as one of seven priority conservation areas in the United States. Its value to Neotropical forest-breeding birds and migratory shorebirds returning from Central and South America wintering grounds also give the Lower Mississippi Valley transcontinental significance. The Lower Mississippi Valley Joint Venture has established ecosystem-wide habitat restoration objectives for each of the three species groups targeted by the North American Waterfowl Management Plan, Partners in Flight, and the U.S. Shorebird Conservation Plan. Accomplishment of the habitat restoration goals set for the Yazoo Backwater area also supports the long-range natural resource management objectives of the Lower Mississippi River Conservation Committee.

95. In concert with these plans, the Black Bear Conservation Committee has established the goal of reversing those factors that have brought about the steady decline of the Louisiana black bear (listed as threatened under the provisions of the Endangered Species Act). The primary factor in the decline of the Louisiana black bear has been the loss and fragmentation of large tracts of bottom-land hardwood habitat. The past decade of wetland restoration in the Yazoo Backwater area, its potential for future restoration, and the presence of one large tract of bottom-land hardwoods have resulted in this area being targeted for the establishment of a subpopulation of the Louisiana black bear. Reforestation of the 1-year flood plain will result in additional large contiguous tracts of wooded habitats that would greatly enhance habitat value for the black bear and other bottom-land hardwood birds, ducks, and mammal species including Neotropical and migratory birds.

FUTURE WITHOUT-PROJECT CONDITIONS

96. The future without-project conditions serve as a baseline from which alternative improvements are evaluated.

Socioeconomic Setting

97. From a national perspective, socioeconomic trends are assumed to reflect reasonably full employment; the absence of natural disasters, wars, epidemics, etc.; long-term growth in output; and continued migration into the sunbelt states. Regionally, earnings and income should continue their current relatively slow growth, paralleling technological improvements in the agricultural sector.

98. Population in the Yazoo Backwater economic base study area was estimated to be 8,279 persons in 1998 and is projected to be 9,353 by the year 2055. Rural population will remain almost constant with an insignificant increase projected in the distant future. Anticipated increases in employment, earnings, value added by manufacturing, and farm products sold will be coupled with the continuing emergence of the services, manufacturing, and trade sectors in the future.

99. Current land use trends in the Yazoo Backwater project area are projected to continue. Agricultural production will remain stable, but industrial growth has the potential to increase due primarily to the available labor base that exists in the economic base study area. Rural land use will not change significantly, except for possible cropping patterns and technological changes in the agricultural sector.

100. Urbanized development exists and will be hindered in some circumstances and instances by lack of capital investment because of flood risks due to the absence of flood control measures for the economic base study area. This situation leads to instability in earnings and employment, resulting in residents forced to accept substandard levels of living; i.e., income, housing, etc.

101. Many lands dedicated to agricultural use and public use lands will continue to be at risk of flooding without a flood control project. Lands successfully farmed for many years are at risk due to rising production costs and steady to decreasing commodity prices. The ability to recover

from even occasional flooding depends on many factors beyond farm owners' and operators' control. These conditions will persist as farmers move into world market competition and lending institutions place more restrictions on agricultural financing. While there are increasing pressures on agriculture, there are not likely to be significant shifts in land use unless there are major changes in agricultural policy. Current farm supports will expire within the next few years unless Congress acts; however, there is considerable speculation at the present time that Congress will enact new legislation that will extend current benefit levels. Also, the CRP and WRP programs are at or near current program limits in the two counties that make up the majority of the study area.

Hydrologic Setting

102. Without additional project construction in the Yazoo Backwater Area, future hydrologic conditions are not expected to change. Periodic flooding will continue to plague communities, agricultural lands, rural residences, and the local infrastructure. With the reforestation of agricultural lands under the CRP and WRP programs, water quality could improve as well as a reduction in the amount of sediment carried into local streams.

Environmental Setting

103. As discussed previously, land clearing for agricultural development is being discouraged and since most of the remaining forested lands are classified as wetlands which fall under "Swampbuster" provisions of the 1985 farm bill, land clearing has essentially stopped. Timber harvesting will continue on both public and private lands in the project area. In addition, current economic conditions are not conducive for any conversion of bottom-land hardwoods to agricultural lands. Section 404 of Clean Water Act also serves as a deterrent to land clearing. Therefore, the terrestrial and wetland resources of the area should at least stabilize. However, with the reforestation of agricultural land currently enrolled into the CRP and WRP programs,

these terrestrial and wetland resources should increase. As bottom-land hardwoods grow and mature, additional recreational opportunities will become available. Should some of this reforestation take place around lakes, fishery resources would improve for that site as sediments are held on the land. At the present time, the ceiling for WRP and CRP enrollment in Sharkey and Issaquena Counties has been reached. Local citizens have expressed reservations on raising these ceilings due to the impact on the tax revenue in the affected counties. Based on local action to date and on recent congressional actions, future expansion of these programs is not likely in the opinion of the Vicksburg District.

PROBLEMS AND OPPORTUNITIES

104. The following problems and opportunities exist in the Yazoo Backwater Area: (a) to reduce the problem of urban flood damage, (b) to reduce the problem of rural and agricultural flood damage, (c) to find opportunities to increase terrestrial, wetland, aquatic, and waterfowl habitat, (d) to find opportunities to improve water quality in the study area, and (e) to find opportunities to enhance/increase recreational opportunities in the study area.

105. Flooding of urban and rural structures, as well as agricultural properties, constitutes a major problem to residents and presents a primary detriment to the orderly economic development of the study area. A definite need exists for the reduction of this flooding. Flood protection would benefit all sections of the economy, thereby contributing to the total well-being of area residents. An estimated 1,555 structures are affected by the flooding. Approximately 360,220 acres of agricultural lands of the total 630,022 acres are impacted by the 100-year frequency flood event, with 231,450 agricultural acres inundated on an average annual basis. Average annual acres is determined by a statistical analysis of historic flood events and results in the cumulative probability of each of the flood events occurring in any given year and the associated number of acres flooded. Total annual flood damage is estimated at \$17.5 million. Flood damages to nonagricultural properties which include urban and rural structures, emergency

costs, streets and public roads and bridges total \$4.3 million annually. Damages to agricultural properties including agricultural crops, noncrops, and catfish operations total \$13.2 million per year.

106. Three important factors which affect flood losses to agricultural properties are time of year, duration, and frequency of flooding. Frequent or intermittent floods can occur any time of the year; however, flood records indicate that the majority of floods occur during the land preparation and spring planting months (March-June). Average flood duration above the damage elevation is in excess of 30 days and the frequency of occurrence is approximately 1.5 times annually.

107. Terrestrial, wetland, aquatic and waterfowl resources have generally declined in the study area with the clearing of bottom-land hardwoods during the 1950's, 1960's, and early 1970's. As more of this area has become dedicated to wildlife by the acquisition of large tracts by the Federal government, these resources have stabilized and with reforestation efforts that have been introduced in the 1990's, land are being converted back to bottom-land hardwoods. As a part of this reformulation, increasing these resources under a nonstructural alternative will be considered.

108. Water quality in the study area is generally of poor quality due to contamination from sedimentation, pesticides, and herbicides. With the consideration of nonstructural alternatives or any combination plans that include nonstructural measures, reforestation would occur on agricultural land, thereby reducing the amount of pollutants present in the aquatic system.

109. Recreational opportunities have already increased in the study area with purchases by the Federal government of large tracts of bottom-land hardwoods and some agricultural lands that have been reforested. As a part of the reformulation, the opportunity exists to increase the amount of bottom-land hardwood available to both public and private interests.

PLANNING OBJECTIVES

110. Planning objectives stem from national, state, and local water and related land resource management needs specific to the Yazoo area of the Yazoo Backwater Area. These objectives have been developed through problem analysis and a public involvement program and have provided the basis for formulation of alternatives, impact assessment, environmental design, evaluation and selection of a recommended plan. The planning objectives are as follows:

- a. Reduce flood damage to urban and rural structures as well as agricultural properties resulting from prolonged flood stages on the Mississippi River and when the Steele Bayou structure is closed with waters above flood stage on the landside of the structure.
- b. Provide reduced levels of agricultural intensification.
- c. Minimize adverse environmental impacts through design.
- d. Compensate 100 percent for unavoidable environmental impacts.
- e. Restore bottom-land hardwoods on frequently flooded agricultural lands.
- f. Complete mitigation requirements for Yazoo Backwater Area Levee.

PLANNING CONSTRAINTS

111. Legislative and executive authorities specify the range of impacts to be assessed and have set forth the planning constraints and criteria that must be applied when evaluating alternative plans.

112. A number of constraints were considered in the Yazoo Backwater Reformulation study. The physical characteristics of the study area with the previously constructed levees, connecting channels, structures and previously disturbed pump site serve to limit the options available for planning purposes. The lowering of the damage elevation has been dictated by past economic activities in the basin. Any recommended plan must be structured so that there will be no reduction of the tax base in any of the affected counties.

FORMULATION AND EVALUATION CRITERIA

113. Alternative plans were formulated and evaluated in accordance with various technical, economic, environmental, and socioeconomic criteria. When applied, these criteria provide the means for responding to the problems and needs of the area by selecting a plan in the best public interest consistent with other developments in the area, and developing an economically feasible solution. The guidance for conducting civil works planning studies requires the systematic development of alternative plans that contribute to the Federal objective. Alternative plans are formulated in consideration of four criteria: completeness, effectiveness, efficiency, and acceptability.

114. Federal policy on multiobjective planning, derived from both legislative and executive authorities, establishes and defines the national objectives for water resources planning, specifies the range of impacts that must be assessed, and sets forth the conditions and criteria which must be applied when evaluating plans. Plans must be formulated considering benefits and costs, both tangible and intangible, and effects on the environment and social well-being of the community.

115. Plan formulation criteria include published regulations and principles adopted by the Water Resources Council and Corps of Engineers regulations. Other criteria used are in compliance with the Principles and Guidelines, the National Environmental Policy Act, Executive Orders 11988 and 11990, and other appropriate engineering standards, regulations, guidelines, and guidance from OMB.

116. The Satartia Extension, Rocky Bayou, Carter, and Yazoo Areas all have uncompleted and/or proposed features. The reformulation efforts for each area are discussed below.

117. Although some flooding problems have been reported in the Carter area, local interests have not requested this area be reformulated. Likewise in the Rocky Bayou and Satartia Extension project areas, no local support exists at this time for reformulation.

118. By letter, 21 August 1992, the Board of Mississippi Levee Commissioners indicated their willingness to participate as the local sponsor for the uncompleted Yazoo Area Pump Plant and requested that reformulation of the project be expedited. Based on the commitment of the Mississippi Levee Commissioners, reformulation studies were conducted for this uncompleted feature.

Public Involvement

119. The public was extensively involved during the reformulation study. A scoping meeting was held early in the study process (November 1993) in Rolling Fork, Mississippi. The purpose of the meeting was to solicit public assistance in identifying significant environmental resources within the study area that should be considered in the evaluation of alternative plans. Between the time of scoping meetings and the workshops, the Corps was collecting economic and environmental data to evaluate the initial array of alternatives.

120. Three public involvement workshops were held in May 1997 to solicit information regarding alternative nonstructural and/or environmental measures. Participants included environmental organizations, non-Federal sponsor (Board of Mississippi Levee Commissioners), local interests from the project area, and Federal and state agencies. A joint briefing--Corps, Environmental Protection Agency (EPA), and FWS--was held on 7 August 1997 as requested by

the participants at the May 1997 public involvement workshop. The participants requested information be presented regarding the study history, study process, remaining activities, and data on the alternative plans. Vicksburg District presented information regarding the study and provided a handout on alternative plans. The data included descriptions of plan features and preliminary cost estimates. The FWS briefed their perspective on the study, authorized project, and structural and nonstructural alternatives. After the briefing, the participants selected alternative plans for more detailed evaluation.

121. Vicksburg District, Mississippi State University (MSU), and FWS participated in a study conducted by Virginia Polytechnic Institute (VPI) under contract with EPA to evaluate costs and benefits associated with a nonstructural alternative for the Yazoo Backwater Area. Although the Vicksburg District, MSU, and FWS were listed as participants in the study, the participation was limited to furnishing data to VPI. The study was funded by EPA who reviewed and coordinated the findings. The results of the study were published on 7 February 2000, and a copy of the study is included in this report (Appendix 17).

122. The CEMRC and Vicksburg District staffs and the Regional Directors for FWS and EPA and their staffs participated in an effort to build consensus from a Federal agency perspective.

123. A committee composed of project area residents, local elected officials, State elected officials, State resource agencies, Federal resource agencies, and environmental organizations was established by the local non-Federal sponsor to reach consensus on a balanced plan to address the water resource problems in the project area.

124. The major consensus activities conducted during the reformulation study are outlined in Table 3. Additional information concerning these activities is included in Appendix 5.

TABLE 3
CONSENSUS CHRONOLOGY

Number	Event
1	Public Involvement Workshops (PIW) - May 97 (3)
2	EPA, FWS, CEMVK Briefing of PIW Participants - Aug 97
3	Vicksburg District (CEMVK)-EPA teleconference - May 97
4	CEMVK/CEMRC Status Briefing for EPA and FWS (Atlanta) - Sep 98
5	ASA(CW), EPA and FWS meeting (Washington) - Oct 98
6	EPA, FWS, and CEMVK staff meeting (Vicksburg) - Oct 98
7	CEMVK/CEMRC Briefing for EPA and FWS (Atlanta) - Dec 98
8	ASA(CW), CEMRC, EPA, and FWS (Atlanta) - Jan 99
9	Backwater Project presented to Congressman Bennie Thompson in Rolling Fork - Jan 99
10	FWS Briefing for EPA, CEMVK, and CEMRC on FWS Plan (Vicksburg) - Feb 99
11	FWS Planning Aid Letter defining FWS Plan - Mar 99
12	First Consensus Committee Meeting in Greenville - Mar 99
13	Followup Consensus Committee Meetings (19 Apr 99, 11 May 99, 26 May 99, 22-24 Jun 99)
14	EPA Briefing for FWS, CEMVK, CEMRC on VPI Study (Atlanta) - Jul 99
15	Consensus Committee Meeting (Raymond, MS) - Jul 99
16	FWS Planning Aid Report - Sep 99
17	Consensus Committee Meeting (Raymond, MS) - Sep 99
18	Consensus Committee Meeting (Raymond, MS) - Mar 00
19	MS Levee Board Public Meeting (Rolling Fork, MS) - Mar 00

Technical Criteria

125. The following criteria were adopted in developing the plans:

a. The existing Backwater levee, plus the Steele Bayou and Little Sunflower drainage structure and connecting channels, will continue to function under future conditions.

b. The rate of which flows from the Steele Bayou and Sunflower River watersheds enter into the Backwater area's ponding area may be changed slightly if the conveyance capacity of the channels is modified; however, the same volume of flow from a storm event will arrive in the Backwater area.

c. During the nonflood season, the Muddy Bayou Control Structure will continue to be operated to provide the water levels in Eagle Lake established in cooperation with the Mississippi Department of Wildlife Conservation.

d. The elevation of flooding will be maintained, if possible, below elevation 96.0 feet, NGVD, so as to alleviate the need for opening the gates on the Muddy Bayou Control Structure and allowing Eagle Lake to flood. This would prevent the overtopping of Highway 465 and the inundation of 107 buildings (homes, businesses, recreation structures, etc.) at Eagle Lake.

e. Plans developed should be consistent with provisions of the National Flood Insurance Program.

f. The economic life of the project was assumed to be 50 years.

g. The Yazoo Backwater Area project will be reformulated to identify, display, and evaluate plans which consider:

(1) Greater level of flood protection for urban areas.

(2) Reduced level of agricultural intensification.

(3) Reduced adverse impacts on the environment.

Economic Criteria

126. Economic criteria for formulation of the plans are summarized as follows:

a. The benefits and costs should be expressed in comparable terms as fully as possible. All evaluations of alternatives were based on October 1999 prices, an interest rate of 6-5/8 percent, and a 50-year expected project life for flood control alternatives.

b. Each alternative considered in detail must be "justified" as total beneficial effects (monetary and nonmonetary) associated with the objectives are equal to or exceed the total adverse effects (monetary and nonmonetary) associated with the objectives.

c. The maximization of net benefits should be determined in sizing a project; however, environmental quality and intangible considerations could dictate a project larger or smaller in size.

d. Project benefits should be based on analysis of with- and without-project conditions, using methodology described in Corps regulations.

e. Benefit categories are dictated under Corps regulations.

Environmental Criteria

127. The following environmental criteria are applicable to the formulation and evaluation of plans.

a. Plans should be formulated to the maximum extent practicable to avoid and minimize impacts to environmental resources.

b. The environmental impacts of any proposed action should be evaluated. Any adverse environmental effects which could not be avoided would be identified for compensation.

c. Unavoidable environmental impacts will be mitigated concurrently with construction at 100 percent Federal cost.

d. Environmental losses that have remained from construction of the backwater levees and the previous construction in the pump site will be included in the Yazoo Backwater reformulation effort.

e. Environmental values are the same whether the land is acquired in fee title or encumbered with a conservation easement after reforestation has occurred.

Socioeconomic Criteria

128. The following socioeconomic criteria are applicable in this study:

a. Laws and regulations require that consideration be given to evaluating and preserving historical, archeological, and other cultural resources.

b. Consideration should be given to safety, health, community cohesion, and social well-being.

c. Displacement of people by the floods and/or the project should be minimized to the extent possible. This includes displacement as a result of a nonstructural land use change.

d. Improvement of leisure activities and public facilities should be evaluated.

e. Effects of a project on regional development, including income, employment, business and industrial activity, population distribution, and desirable community growth, should be considered.

f. General public acceptance of potential plans should be determined by coordination with interested Federal and non-Federal agencies, various groups, and individuals by means of public meetings, field inspections, informal meetings, letters, and other public involvement procedures.

g. The plans should be implementable considering the present and potential constraints of the local sponsoring agency in regard to its structure, function, relationships, and associations in the study area.

ALTERNATIVE PLANS

GENERAL

129. A full range of alternative plans was considered that included nonstructural measures, structural measures and combined nonstructural and structural measures. Alternative plans were formulated so as to minimize and/or avoid potential adverse project impacts on the environment and ensure identification of the NED/National Environmental Quality (NEQ) plan. These alternatives were developed and evaluated by an interdisciplinary team of planners representing disciplines such as engineering, hydrology and hydraulics, socioeconomics, and environmental. Each of the alternatives was developed through a multiobjective process to satisfy the specific needs identified in this report. Water management and mitigation measures were evaluated to minimize and compensate for unavoidable adverse environmental impacts. A "no-action" alternative was evaluated to display future conditions in the absence of a Federal project.

130. All practicable nonstructural measures to reduce flood damages were considered during the screening of alternatives. While some were eliminated during early formulation of alternatives, others were evaluated in detail to determine if a combination of structural and nonstructural measures would comprise the best solution for the overall project area.

131. Basically, two types of nonstructural measures for flood protection exist--those which reduce existing damages and those which reimburse for existing damages and reduce future damage potential. Those nonstructural measures which reduce damages and were investigated to varying degrees in this study include the following:

- a. Floodproofing by waterproofing of walls and openings in structures.
- b. Raising structures in place.
- c. Constructing walls or levees around structures.
- d. Permanent flood plain evacuation.
 - (1) Relocate structures and contents to flood-free area.
 - (2) Relocate contents and demolish structures. Provide replacement housing.
- e. Flood forecasting and warning systems with temporary evacuation.

132. Nonstructural measures which compensate or reimburse for existing damages and/or reduce future damages include:

- a. Acquisition of flood-prone property by fee title or easement.

- b. Flood plain regulation by zoning ordinances, regulations, and building codes.
- c. Flood insurance.

133. Residential, commercial, and public structures in the flood plain are primarily slab-on-grade construction. Raising such structures through normal jacking procedures is impractical; permanent flood plain evacuation was not considered a viable alternative by the public who live in the area. Flood forecasting and warning systems with temporary evacuation are in essence what are being utilized now and are not satisfactory. Floods in this area are slow to occur and people have sufficient time to evacuate the area, but it could be months before they could return to their structures.

134. Table 4 shows a summary of the economic analysis of several nonstructural measures by hydrologic reach. Based on field observations by Corps economic and real estate personnel, structures were located in the field, marked and numbered on a map, and an approximate size and value determined. Then using a digital elevation model, the elevation of the structures was determined. Using the above data, hydrologic data, and computer models, the first cost, annual cost, annual benefits and benefit-cost ratios were determined for the various nonstructural measures. Table 4 was based on current existing structures in the study area. It includes no projection as to future growth because while the population of Mississippi has increased over the past several decades, the counties of the lower Yazoo Basin have experienced very little growth. The populations of Sharkey and Issaquena Counties have been flat or slightly decreasing. As far as structures are concerned, there has been some increase in recreational and weekend homes in the area, as well as some new primary homes built in the Eagle Lake area. It is unlikely that the population of these counties will increase significantly under current economic conditions. President Clinton's Delta Initiative that is being undertaken could have more impacts over time, but any increase based on this would be speculative. Based on the above analysis, the nonstructural measures which reduce damages were eliminated from further consideration.

TABLE 4
 ECONOMIC ANALYSIS SUMMARY
 OF NONSTRUCTURAL MEASURES BY PROJECT REACH ^{a/}
 BASE (WITHOUT-PROJECT) CONDITIONS
 YAZOO BACKWATER AREA, MISSISSIPPI
 (Current Year, 1996 Values)

Item/Reach	No. of Structures	First Cost (\$000)	Annual Cost (\$000)	Annual Benefit (\$000)	Benefit-Cost Ratio
Reach 1					
Floodproofing	545	9,317.0	728.9	127.4	0.17
Structure Raising	412	10,637.2	832.2	127.4	0.15
Small Walls	657	10,663.1	834.2	127.4	0.15
Relocation	412	20,024.6	1,566.5	100.9	0.06
Acquisition/Demolition	413	27,708.8	2,167.7	100.9	0.05
Reach 2					
Floodproofing	191	4,113.8	321.8	31.9	0.10
Structure Raising	149	4,219.2	330.1	31.9	0.10
Small Walls	205	4,122.5	322.5	31.9	0.10
Relocation	149	8,716.0	681.9	25.4	0.04
Acquisition/Demolition	149	11,291.4	883.3	25.4	0.03
Reach 3					
Floodproofing	75	985.3	77.1	13.7	0.18
Structure Raising	29	392.3	30.7	13.7	0.45
Small Walls	64	788.8	61.7	13.7	0.22
Relocation	29	701.5	54.9	12.8	0.23
Acquisition/Demolition	18	596.6	46.7	12.8	0.27
Reach 4					
Floodproofing	251	4,824.3	377.4	43.3	0.11
Structure Raising	142	3,450.2	369.9	43.3	0.16
Small Walls	260	5,027.6	393.3	43.3	0.11
Relocation	142	6,669.5	521.8	34.8	0.07
Acquisition/Demolition	139	7,885.1	616.9	34.8	0.06
Total For All Reaches					
Floodproofing	1,062	19,240.4	1,505.2	216.3	0.14
Structure Raising	732	18,698.9	1,462.9	216.3	0.15
Small Walls	1,186	20,602.0	1,611.7	216.3	0.13
Relocation	732	36,11.6	2,825.1	173.9	0.06
Acquisition/Demolition	719	47,481.9	3,714.6	173.9	0.05

^{a/} Nonstructural analysis based on 7-5/8 percent discount rate and no other project improvements in place inclusive of built-up and rural structures in each reach.

135. Two types of easements were proposed--conservation and flowage--to compensate for existing damages and reduce future damages. Conservation easements were used to control future land use. Options under a conservation easement were (a) continue existing land use (wooded or open lands) while restricting future intensification of the land use and (b) reforestation of agricultural lands. A flowage easement is required when existing hydraulic conditions (depth, frequency, and/or duration of flooding) are adversely impacted by a proposed plan/measure. Landowner participation in conservation easements would be strictly on a willing seller basis. Flowage easements would be acquired by direct purchase with the use of condemnation in the event of nonagreement as to just compensation or incurable title problems. All easements would be perpetual in duration. Conservation easements were evaluated further in the intermediate and final analyses.

136. All 7 counties/parishes and 19 communities in the backwater area are participants in the National Flood Insurance Program (NFIP). The unincorporated communities participate in NFIP through the counties/parishes in which they are located. This program allows property owners to purchase flood insurance at subsidized rates and mandates the local government to adopt and enforce flood plain regulations that require all future development within the 100-year flood plain to be elevated above the 100-year flood elevation.

137. Structural measures included a pump plant at Steele Bayou, a levee system along the Big and Little Sunflower Rivers and local protection projects; i.e., ring levees with pumping plants to protect "built-up" residential areas.

138. About 80 percent of the drainage in the Yazoo Area is from the Sunflower River system. The natural divide between the Sunflower River and the Steele Bayou Basins was breached with the construction of the connecting channel in 1978. Construction of levees along each side of the Sunflower River would restore the original division of drainage and result in reductions of flood

stages especially in the Steele Bayou Basin. Drainage from the Sunflower River Basin would continue to be evacuated through the existing Little Sunflower River drainage structure. This structure would be used to regulate low-water conditions for minimum ponding. A fixed overflow section would be required at the existing drainage structure to accommodate large streamflows. Drainage into the Sunflower River would be provided by landside collection ditches through gravity structures.

139. Local protection projects were evaluated for the towns of Rolling Fork, Eagle Lake, Cary, Holly Bluff, and Valley Park. Protection works usually consisted of ring levees, interior structures, and often a pumping plant to remove interior drainage.

INITIAL ARRAY

140. The initial array of alternatives was developed to determine if a typical structural solution was still economically feasible. Five alternative pump capacities (10,500, 14,000, 17,500, 21,000, and 24,500 cfs with a year-round pump operation elevation of 80 feet, NGVD, at Steele Bayou--elevation at which significant flood damages begin to occur) were evaluated. A Sunflower River levee alternative and local protection projects were also evaluated. Estimated compensatory mitigation requirements were included in the analyses. An economic comparison of the alternative plans is presented in Table 5. The costs of the pumping plants shown in Table 5 reflect the use of electric motors to power the pumps. All the alternative pump capacities and the Sunflower River levee alternative were economically feasible with a 14,000-cfs pumping plant providing the greatest excess of benefits over cost. The local protection plan was determined not to be economically feasible by inspection. Damages in the five areas were determined to be \$433,000/year. These damages would only support a first cost of a plan of \$6.3 million, and this assumes that all damages are alleviated. No structural features could be built around any of the areas for this amount. After determining that a 14,000-cfs pumping plant powered by electric motors provided the greatest excess benefits over cost, cost

TABLE 5
ECONOMIC DATA FOR INITIAL ARRAY OF ALTERNATIVES

Benefits <u>a/</u>	Pumping Station					Levee	Local Protection Projects <u>c/</u>
	10,500 cfs <u>b/</u>	14,000 cfs <u>b/</u>	17,500 cfs <u>b/</u>	21,000 cfs <u>b/</u>	24,500 cfs <u>b/</u>		
	Electric						
Agricultural Crop (\$000)	11,400	13,500	14,600	15,300	15,700	10,400	
Agricultural Noncrop (\$000)	2,380	2,800	3,040	3,180	3,280	2,000	
Catfish (\$000)	337	362	404	442	467	325	
Structures (\$000)	1,560	1,790	1,920	1,970	2,000	1,750	108
Road/Bridge (\$000)	697	828	902	950	985	436	
Emergency (\$000)	135	152	161	164	166	90	169
Flood Insurance (\$000)	21	27	30	31	32	25	4
Automotive (\$000)	11	13	14	14	14	13	14
Street (\$000)	68	77	85	89	92	60	138
Total (Rounded) (\$000)	16,600	19,500	21,200	22,100	22,700	15,100	433 <u>d/</u>
Costs							
Construction Cost (\$000)	90,800	109,000	133,000	153,000	169,000	190,300 <u>e/</u>	
Mitigation Cost (\$000)	18,700	22,600	23,100	26,700	30,600	12,600	
Total Construction Cost (Rounded) (\$000)	110,000	131,000	156,000	179,000	200,000	203,000 <u>e/</u>	
Annual							
Amortization (\$000) <u>a/</u>	9,510	11,400	13,600	15,600	17,300	12,700	
Operation and Maintenance (\$000)	2,000	2,530	3,140	3,500	3,800	300	
Major Replacements (\$000)	101	135	169	202	236	0	
Total Annual (Rounded) (\$000)	11,600	14,100	16,900	19,300	21,400	13,500	
Excess Benefits (Rounded) (\$000)	5,000	5,400	4,300	2,800	1,300	1,600	
Benefit-Cost Ratio (%)	1.4	1.4	1.3	1.2	1.1	1.1	

NOTE: Data preliminary subject to revision. Cost and benefit data rounded to three significant figures.

a/ Average annual values at 7-5/8 percent.

b/ Assumes year-round pump operation at 80 feet, NGVD.

c/ Local protection projects were evaluated at Rolling Fork, Eagle Lake, Cary, Holly Bluff, and Valley Park.

d/ This level of damages would support a first cost of \$6,272,000. No project could be constructed for this cost; therefore, this alternative was dropped from further study.

e/ Based on staged levee construction.

engineers evaluated this pump size to determine the cost of a 14,000-cfs pumping plant that was powered by diesel engines. Results showed a savings when the pumps are powered by diesel engines over electric motors. These data are shown in Table 6. Therefore, only diesel engines were evaluated to furnish the power to the pumping plant in future arrays.

SECOND ARRAY

141. The second array of alternatives was a result of the public involvement workshops and the first array. These were more or less concepts that the participants wanted to be considered and economic analyses were performed. Cost data were based on a preliminary analysis and were refined if the alternative was carried forward into the next array. The alternatives are presented in Table 7, along with preliminary cost and environmental data. Nine nonstructural plans, 6 structural plans, and 13 plans combining both nonstructural and structural measures were considered. The data were presented at the 7 August 1997 briefing to assist the public involvement participants in the selection of alternatives to be considered in the next iteration.

142. The nonstructural plans included conservation easements on open and forested lands and flowage easements for water management. Conservation easements were used to (a) preserve the existing woodlands in the project area, (b) reestablish forest on open lands below stage elevations of 85 feet, NGVD (approximately 0.7-year frequency flood event), and 90 feet, NGVD (approximate 2-year frequency flood event), at Steele Bayou, and (c) compensate owners of open lands who would experience continued flooding. Flowage easements were used for water management during the winter waterfowl season. Winter waterfowl water would be provided by closing the gates of the Steele Bayou drainage structure from 1 December to 1 March to induce ponding of interior/landside flows to water stage elevations of 80 and 85 feet, NGVD, at the Steele Bayou structure.

TABLE 6
ECONOMIC DATA FOR ELECTRIC VERSUS DIESEL POWER PUMP STATION

Benefits <u>a/</u>	14,000 cfs	
	Electric <u>b/</u>	Diesel <u>b/</u>
	Agricultural Crop (\$000)	13,500
Agricultural Noncrop (\$000)	2,800	2,800
Catfish (\$000)	362	362
Structures (\$000)	1,790	1,790
Road/Bridge (\$000)	828	828
Emergency (\$000)	152	152
Flood Insurance (\$000)	27	27
Automotive (\$000)	13	13
Street (\$000)	77	77
Total (Rounded) (\$000)	19,500	19,500
Costs		
Construction Cost (\$000)	109,000	102,000
Mitigation Cost (\$000)	22,600	22,600
Total Construction Cost (Rounded) (\$000)	131,000	124,000
Annual		
Amortization (\$000) <u>a/</u>	11,400	10,800
Operation and Maintenance (\$000)	2,530	1,290
Major Replacements (\$000)	135	126
Total Annual (Rounded) (\$000)	14,100	12,200
Excess Benefits (Rounded) (\$000)	5,400	7,300
Benefit-Cost Ratio (%)	1.4	1.6

NOTE: Data preliminary subject to revision. Cost and benefit data rounded to two significant figures.

a/ Average annual values at 7-5/8 percent.

b/ Assumes year-round pump operation at 80 feet, NGVD.

TABLE 7
SECOND ARRAY OF ALTERNATIVES

Plan	Easements			Easements	Reforestation	Mitigation	Structural	Total	Pump	Acres of Mitigation
	Conservation Easements on Woodlands	Reforestation/Open Lands	Flowage/Water Management a/							
NONSTRUCTURAL										
1	Preserved below 100.3 feet	Use Retained below 100.3 feet	N/A	217.0			N/A	217.0	N/A	
2	Preserved below 100.3 feet	Use Retained below 100.3 feet	Below 80.0 feet	235.3	0		N/A	235.3	N/A	
3	Preserved below 100.3 feet	Use Retained below 100.3 feet	Below 85.0 feet	253.2	0		N/A	253.2	N/A	
4	Preserved below 100.3 feet	Reforested below 85.0 feet	N/A	232.1	8.1		N/A	240.2	N/A	
5	Preserved below 100.3 feet	Reforested below 85.0 feet	Below 80.0 feet	255.0	8.1		N/A	263.1	N/A	
6	Preserved below 100.3 feet	Reforested below 85.0 feet	Below 85.0 feet	257.0	8.1		N/A	265.1	N/A	
7	Preserved below 100.3 feet	Reforested below 90.0 feet	N/A	246.5	15.7		N/A	262.2	N/A	
8	Preserved below 100.3 feet	Reforested below 90.0 feet	Below 80.0 feet	269.3	15.7		N/A	285.0	N/A	
9	Preserved below 100.3 feet	Reforested below 90.0 feet	Below 85.0 feet	280.1	15.7		N/A	295.8	N/A	
COMBINATION NONSTRUCTURAL-STRUCTURAL										
10	Preserved below 85.0 feet	Use Retained below 85.0 feet	N/A	48.9	0		102	150.9	14,000 cfs b/	
11	Preserved below 85.0 feet	Use Retained below 85.0 feet	Below 80.0 feet	59.2	0		102	161.2	14,000 cfs b/	
12	Preserved below 85.0 feet	Use Retained below 85.0 feet	Below 85.0 feet	75.1	0		102	177.1	14,000 cfs b/	
13	Preserved below 85.0 feet	Reforested below 85.0 feet	N/A	59.7	8.1		102	169.8	14,000 cfs b/	
14	Preserved below 85.0 feet	Reforested below 85.0 feet	Below 80.0 feet	68.9	8.1		102	179.0	14,000 cfs b/	
15	Preserved below 85.0 feet	Reforested below 85.0 feet	Below 85.0 feet	78.9	8.1		102	189.0	14,000 cfs b/	
16	Preserved below 90.0 feet	Use Retained below 90.0 feet	N/A	82.5	0		102	184.5	14,000 cfs b/	
17	Preserved below 90.0 feet	Use Retained below 90.0 feet	Below 80.0 feet	87.7	0		102	189.7	14,000 cfs b/	
18	Preserved below 90.0 feet	Use Retained below 90.0 feet	Below 85.0 feet	103.6	0		102	205.6	14,000 cfs b/	
19	Preserved below 90.0 feet	Reforested below 90.0 feet	N/A	104.6	15.7		102	222.3	14,000 cfs b/	
20	Preserved below 90.0 feet	Reforested below 90.0 feet	Below 80.0 feet	111.8	15.7		102	229.5	14,000 cfs b/	
21	Preserved below 90.0 feet	Reforested below 90.0 feet	Below 85.0 feet	121.6	15.7		102	239.3	14,000 cfs b/	
22	Preserved below 100.3 feet	N/A	N/A	69.1		22.6	102	193.7	14,000 cfs b/	18,500
STRUCTURAL										
23	N/A	N/A	N/A			18.7	85	103.7	10,500 cfs c/	15,000
24	N/A	N/A	N/A			22.6	102	124.6	14,000 cfs c/	18,500
25	N/A	N/A	N/A			23.1	124	147.1	17,500 cfs c/	19,000
26	N/A	N/A	N/A			26.7	145	171.7	21,000 cfs c/	22,000
27	N/A	N/A	N/A			30.6	158	188.6	24,500 cfs c/	25,000
28	N/A	N/A	N/A			12.6	177	189.6	N/A	10,000

a/ 1 December to 1 March.

b/ A 14,000-cfs pump would be operated to reduce flood damages above easement elevations.

c/ Initiate pumping at 85 feet, NGVD, during 1 December to 1 March; initiate pumping at 80 feet, NGVD, during cropping

Notes:

Plans 1 through 9 are Nonstructural.

Plans 10 through 22 are Combination.

Plans 23 through 27 are standard plans, including a pump while Plan 28 is a structural levee plan along the Sunflower River.

143. The following assumptions were used to formulate the nonstructural alternatives.

a. Conservation easement (Land use retained and reforestation options).

(1) Easement only taken on cleared and/or wooded lands below a given elevation as shown in Table 7.

(2) No public access.

(3) Normal silvicultural practices will be allowed on woodlands.

(4) Future flood damage reduction foregone.

(5) Government has no right to induce flooding.

(6) All encumbrances will be perpetual.

(7) Structures will not be relocated.

(8) All woodlands will be preserved with restrictions preventing conversion to more intensive use.

(9) Reforestation of cleared lands will be a 100 percent Federal cost.

(10) Operation of Little Sunflower structures will continue under current operational guidelines.

b. Flowage easement.

(1) Easement only taken on cleared and wooded lands at or below a given elevation as shown in Table 7.

(2) Residential structures will be relocated.

(3) All encumbrances will be perpetual.

(4) Existing land use will not be allowed to intensify beyond agricultural on open lands.

(5) Operation of Steele Bayou and Little Sunflower structures will be modified to manage water during the period 1 December to 1 March using internal and external sources.

144. The structural plans included the Steele Bayou pumping plant (five alternative pump capacities) and the Sunflower River levee. Estimated compensatory mitigation requirements were included. Pumping would be initiated at 85 feet, NGVD, in the 1 December to 1 March timeframe, but the remainder of the year pumping would be initiated at 80 feet, NGVD. This is the elevation at which significant flood damages begin to occur.

145. The plans combining both nonstructural and structural measures included a 14,000-cfs pumping plant in combination with conservation and flowage easements. Conservation easement elevations were set at 85 and 90 feet, NGVD, at Steele Bayou. Flowage easement elevations were set at 80 and 85 feet, NGVD, at Steele Bayou for water management--induced ponding of water for winter waterfowl. The 14,000-cfs pumping plant would be operated to reduce flood damages above the two conservation easement elevations.

146. The total cost for the nonstructural plans ranged from \$217 to \$295.8 million. The least costly plan was Plan 1 which included conservation easements to preserve all existing wooded lands within the project area and conservation easements on open lands to compensate landowners for continued flooding. The most costly plan (Plan 9) included (a) conservation easements to preserve all existing wooded lands within the project area, (b) conservation easements to reestablish forest on open lands below stage elevation of 90 feet, NGVD, at Steele Bayou, (c) conservation easements on open lands above stage elevation of 90 feet, NGVD, at Steele Bayou to compensate landowners for continued flooding, and (d) flowage easements for water management (during the winter waterfowl season (1 December to 1 March) on lands below stage elevation of 85 feet, NGVD, at Steele Bayou.

147. The total costs for the plans with combined measures ranged from \$151 to \$239 million. The least costly plan (Plan 10) included (a) 14,000-cfs pumping plant to reduce flooding above the stage elevation of 85 feet, NGVD, at Steele Bayou, (b) conservation easements to preserve existing wooded lands below stage elevation of 85 feet, NGVD, at Steele Bayou, and (c) conservation easements to compensate landowners of open land below 85 feet, NGVD, at Steele Bayou for continued flooding. The most expensive plan (Plan 21) included (a) 14,000-cfs plant to reduce flooding above the stage elevation of 90 feet, NGVD, at Steele Bayou, (b) conservation easements to preserve existing wooded lands below stage elevation of 90 feet, NGVD, at Steele Bayou, (c) conservation easements to reestablish forest on open lands below 90 feet, NGVD, at Steele Bayou, and (d) flowage easements for water management during the winter waterfowl season on lands below stage elevation of 85 feet, NGVD, at Steele Bayou.

148. The total costs for the structural alternatives ranged from \$104 to \$190 million. The least costly plan was Plan 22 (10,500-cfs pump). The most expensive plan was Plan 27 (levee alternative).

149. Of the 28 alternatives, two nonstructural plans (Plans 1 and 7), all the plans with combined measures, and three structural plans (Plans 24, 25, and 28) were selected at the 7 August 1997 briefing for more detailed analysis. The Board of Mississippi Levee Commissioners requested that a 17,500-cfs pumping plant also be evaluated in combination with nonstructural measures.

THIRD ARRAY

150. The third array alternatives are presented in Table 8. The third array includes all the alternatives requested by the consensus committee, plus one additional alternative. Table 8 includes 2 nonstructural alternatives; 12 combination alternatives utilizing a 14,000-cfs pump and 12 combination plans utilizing a 17,500-cfs pump; a 14,000-cfs pump structural alternative; a 17,500-cfs pump structural alternative; a levee alternative along the Big Sunflower River; and an alternative utilizing a 14,000-cfs pump while preserving all existing woodlands below elevation 100.3 feet, NGVD. An economic comparison of the alternatives is presented in Table 8. Neither of the nonstructural plans was economically feasible. Five of the plans with combined measures were economically justified--three with a 14,000-cfs pumping plant and two with a 17,500-cfs pumping plant. The combined plan with the greatest excess of benefits over cost was Plan 6 which included (a) a 14,000-cfs pumping plant with a pump operation elevation of 85 feet, NGVD, at Steele Bayou and (b) conservation easements to preserve existing woodlands below elevation 85 feet, NGVD, at Steele Bayou. Two of the structural alternatives were economically feasible. The plan with the greatest excess of benefits over costs was a structural plan (Plan 27), a 14,000-cfs pumping plant with a pump operation elevation of 80 feet, NGVD, during the cropping season (1 March-10 December) and a pump operation elevation of 85 feet, NGVD, during the waterfowl season (1 December-1 March) at Steele Bayou with compensatory mitigation. The 17,500-cfs pumping plant with a pump operation elevation of 80 feet, NGVD, during the cropping season and 85 feet, NGVD, during the waterfowl season with compensatory mitigation was economically feasible.

TABLE 8
THIRD ARRAY

Plan	Construction Cost											Average Annual Costs (\$000)	Average Annual Benefit (\$000)	Excess Benefits (\$000)
	Easements				Reforestation		Environmental Impacts	Mitigation Cost	Structural Modification	Pump	Total			
	Conservation Woodlands	Reforestation Open Lands ^{a/}	Flowage/ Water Management	Total (\$ Million)	Acres	(\$ Million)	(HU)	(\$ Million)	(\$ Million)	(\$ Million)	(\$ Million)			
NONSTRUCTURAL PLANS														
1	Preserve below 100.3	Use retained	N/A	261.4	0	0	0	0	0	0	261	19,238	0	-19,238
2	Preserve below 100.3	Reforest below 90.0	N/A	307.8	101,800	14.3	80,070	0	0	0	330	24,265	-4,452	-28,717
COMBINATION PLANS - 14,000 CFS PUMP ^{a/}														
3	Preserve below 85.0	Use retained below 85.0	N/A	42.1	0	0	-49,151	31.3	0	120	193	16,365	16,242	-123
4	Preserve below 85.0	Use retained below 85.0	Below 80.0 ^{b/}	63.5	0	0	-41,104	26.2	0.35	120	210	17,548	16,242	-1,306
5	Preserve below 85.0	Use retained below 85.0	Below 85.0 ^{c/}	81.7	0	0	-41,200	26.2	0.35	120	228	18,890	16,242	-2,648
6	Preserve below 85.0	Reforest below 85.0	N/A	56.0	53,000	7.4	10,608	0	0	120	187	15,574	16,900	1,326
7	Preserve below 85.0	Reforest below 85.0	Below 80.0 ^{b/}	70.2	53,000	7.4	21,533	0	0.35	120	202	16,654	16,900	246
8	Preserve below 85.0	Reforest below 85.0	Below 85.0 ^{c/}	81.7	53,000	7.4	21,390	0	0.35	120	213	17,503	16,900	-603
9	Preserve below 90.0	Use retained below 90.0	N/A	85.2	0	0	-30,927	19.1	0	120	224	18,522	13,387	-5,135
10	Preserve below 90.0	Use retained below 90.0	Below 80.0 ^{b/}	102	0	0	-9,232	5.8	0.35	120	228	18,675	13,387	-5,288
11	Preserve below 90.0	Use retained below 90.0	Below 85.0 ^{c/}	117	0	0	-9,223	5.8	0.35	120	243	19,783	13,387	-6,396
12	Preserve below 90.0	Reforest below 90.0	N/A	135	101,800	14.3	36,022	0	0	120	276	22,155	13,883	-8,272
13	Preserve below 90.0	Reforest below 90.0	Below 80.0 ^{b/}	139	101,800	14.3	66,607	0	0.35	120	280	22,466	13,883	-8,583
14	Preserve below 90.0	Reforest below 90.0	Below 85.0 ^{c/}	141	101,800	14.3	66,616	0	0.35	120	282	22,615	13,883	-8,732
COMBINATION PLANS - 17,500 CFS PUMP ^{a/}														
15	Preserve below 85.0	Use retained below 85.0	N/A	42.1	0	0	-53,614	34.2	0	143	219	18,562	18,052	-510
16	Preserve below 85.0	Use retained below 85.0	Below 80.0 ^{b/}	63.5	0	0	-45,832	29.2	0.35	143	236	19,756	18,052	-1,704
17	Preserve below 85.0	Use retained below 85.0	Below 85.0 ^{c/}	81.7	0	0	-45,828	29.2	0.35	143	254	21,097	18,052	-3,045
18	Preserve below 85.0	Reforest below 85.0	N/A	56.0	53,000	7.4	3,932	0	0	143	210	17,532	18,159	627
19	Preserve below 85.0	Reforest below 85.0	Below 80.0 ^{b/}	70.2	53,000	7.4	14,414	0	0.35	143	225	18,612	18,159	-453
20	Preserve below 90.0	Reforest below 85.0	Below 85.0 ^{c/}	81.7	53,000	7.4	14,417	0	0.35	143	236	19,461	18,159	-1,302
21	Preserve below 90.0	Use retained below 90.0	N/A	85.2	0	0	-35,692	22.8	0	143	251	20,783	14,794	-5,989
22	Preserve below 90.0	Use retained below 90.0	Below 80.0 ^{b/}	102	0	0	-11,473	7.3	0.35	143	253	20,763	14,794	-5,969
23	Preserve below 90.0	Use retained below 90.0	Below 85.0 ^{c/}	117	0	0	-11,469	7.2	0.35	143	268	21,855	14,794	-7,061
24	Preserve below 90.0	Reforest below 90.0	N/A	135	101,800	14.3	29,534	0	0	143	299	24,113	14,917	-9,196
25	Preserve below 90.0	Reforest below 90.0	Below 80.0 ^{b/}	139	101,800	14.3	63,519	0	0.35	143	303	24,424	14,917	-9,507
26	Preserve below 90.0	Reforest below 90.0	Below 85.0 ^{c/}	141	101,800	14.3	63,523	0	0.35	143	305	24,573	14,917	-9,656
STRUCTURAL PLANS ^{a/}														
27 (14K P) ^{d/}	N/A	N/A	N/A	0	0	0	-63,743	40.5	0	120	161	13,990	17,539	3,549
28 (17.5K P) ^{d/}	N/A	N/A	N/A	0	0	0	-75,884	48.2	0	143	191	16,636	19,664	3,028
29 (LEV)	N/A	N/A	N/A	0	0	0	-30,081	19.1	0	215	234	19,552	15,102	-4,450
30 (14K P)	Preserve below 100.3	N/A	N/A	73.3	0	0	-63,743	39.4	0	120	233	19,348	17,539	-1,809

^{a/} Pump would be operated to provide flood damage reduction for cleared lands above the easement elevation.
^{b/} 1 December - 1 March.
^{c/} 80 feet, NGVD, 1 December - 1 January and 15 February - 1 March; 85 feet, NGVD, 1 January - 15 February.
^{d/} Pump would be operated to provide flood damage reduction for cleared lands above elevation 80 feet except during 1 December - 1 March when pump would be operated at 85 feet, NGVD.
^{e/} Does not reflect cost of pump but of the levee.

151. After a review of the third array by the consensus committee and the Vicksburg District, flowage easements for water management were eliminated. There was not sufficient interior flow during 1 December to 1 March to consistently achieve a stage elevation between 80 and 85 feet, NGVD. Although there was sufficient interior flow to achieve a stage elevation of 80 feet, NGVD, the measure was not considered to be cost effective. The HU's and associated total cost are presented in Table 9.

152. Also, easements for conservation of woodlands were eliminated from further consideration as a result of this analysis. This provision was adding cost to alternatives with no economic or environmental benefit. The Vicksburg District has long advocated that sufficient laws and policies are available to prevent any substantial conversion of bottom-land hardwoods and this was agreed to by the Consensus Committee. Therefore, the costs for the easements for the conservation of woodland were dropped from further consideration.

153. The 17,500-cfs pump station was dropped from further consideration due to concerns expressed by the consensus committee members and after the Vicksburg District analyzed the data in the third array and found the excess benefits to be greater for the 14,000-cfs pump when compared to the 17,500-cfs pump. Only the 14,000-cfs pump station was carried into the final array.

FINAL ARRAY OF ALTERNATIVES

154. Project measures carried into the final array alternatives included (a) pumping plant to provide flood damage reduction benefits above the pump operation elevation, (b) conservation easements from willing sellers with reestablishment of forest on open land below the pump operation elevation to prevent existing flood damages by converting the land to a use more

TABLE 9
PRELIMINARY AQUATIC SPAWNING RESOURCE SUMMARY
YAZOO BACKWATER REFORMULATION STUDY

	Alternative	Impact	Reforest	Total	Mitigation	Mitigation	Mitigation O&M	Impact/Reforest Ratio	Break Even Easement Reforestation	Break Even Reforestation Cost							
											Habitat Units			Acres	\$	Acres	\$
	No-Action	200,553	0	200,553	0	0	0	0.00	0								
Ease. < 100.3	Alternative 1	0	0	0	0	0	0	0.00	0								
Easements < 90	Alternative 2	0	70,531	70,531	0	0	0	0.00	0								
14,000 Pump	Easements < 85	No	Alternative 3	-49,235	0	-49,235	21,041	32,549,856	315,609	0.00	0						
		80	Alternative 4	-41,170	0	-41,170	17,594	27,218,127	263,912	0.00	0						
		85	Alternative 5	-41,267	0	-41,267	17,636	27,282,316	264,534	0.00	0						
		No	Alternative 6	-49,235	59,759	10,524	0	0	0	0.82	43,650	34,920,365					
		80	Alternative 7	-41,170	62,637	21,467	0	0	0	0.66	34,823	27,858,793					
		85	Alternative 8	-41,267	62,593	21,325	0	0	0	0.66	34,930	27,944,244					
		No	Alternative 9	-20,090	0	-20,090	8,585	13,281,556	128,780	0.00	0						
		80	Alternative 10	-9,242	0	-9,242	3,950	6,110,319	59,247	0.00	0						
	Easements < 90	85	Alternative 11	-9,234	0	-9,234	3,946	6,104,400	59,189	0.00	0						
		No	Alternative 12	-20,090	71,810	51,720	0	0	0	0.28	28,471	11,857,689					
		80	Alternative 13	-9,242	75,839	66,597	0	0	0	0.12	12,402	5,165,418					
		85	Alternative 14	-9,234	75,842	66,609	0	0	0	0.12	12,390	5,160,206					
		Easements < 85	No	Alternative 15	-53,709	0	-53,709	22,953	35,507,643	344,289	0.00	0					
			80	Alternative 16	-45,910	0	-45,910	19,620	30,351,858	294,297	0.00	0					
85	Alternative 17		-45,907	0	-45,907	19,618	30,349,567	294,275	0.00	0							
No	Alternative 18		-53,709	57,544	3,835	0	0	0	0.93	49,450	39,560,066						
80	Alternative 19		-45,910	60,246	14,336	0	0	0	0.76	40,374	32,299,052						
85	Alternative 20		-45,907	60,247	14,340	0	0	0	0.76	40,370	32,296,388						
Easements < 90	No	Alternative 21	-22,333	0	-22,333	9,544	14,764,565	143,160	0.00	0							
	80	Alternative 22	-11,487	0	-11,487	4,909	7,594,383	73,637	0.00	0							
	85	Alternative 23	-11,484	0	-11,484	4,908	7,592,092	73,614	0.00	0							
	No	Alternative 24	-22,333	70,988	48,655	0	0	0	0.31	32,016	13,334,359						
	80	Alternative 25	-11,487	74,992	63,505	0	0	0	0.15	15,589	6,492,502						
	85	Alternative 26	-11,484	74,993	63,509	0	0	0	0.15	15,584	6,490,507						
14000	Alternative 27	-63,859	0	-63,859	27,290	42,217,952	409,353	0.00	0								
17500	Alternative 28	-76,022	0	-76,022	32,488	50,258,960	487,320	0.00	0								
Levee	Alternative 29	-30,081	0	-30,081	12,855	19,886,883	192,827	0.00	0								
14000 Preserve	Alternative 30	-63,859	0	-63,859	27,290	42,217,952	409,353	0.00	0								

compatible to frequent flooding, (c) conservation easements from willing sellers to preserve forest land below the pump operation elevation of 91.0 feet, NGVD (requested by FWS), and (d) compensatory mitigation for unavoidable environmental impacts. Seven alternative plans are included in the final array. Included in the final array is the no-action plan, a nonstructural plan, and a combination of structural and nonstructural plans. Several of these alternatives were modified by further discussions with the consensus committee from what was shown in Array 3. Alternatives were developed which related to the elevation of flood frequency. Elevation 87 feet, NGVD, represents approximately the 1-year event while 91 feet, NGVD, more closely approximates the 2-year event. Elevation 88.5 feet, NGVD, represents the elevation of jurisdictional wetlands. Alternatives have been developed that utilize these elevations for pump operation.

155. A report entitled "An Approach for Evaluating Nonstructural Actions with Application to the Yazoo River (MS) Backwater Area" was prepared for EPA, Region 4, by Dr. Leonard Shabman and Ms. Laura Zepp of Virginia Tech. This report was presented and briefed to the Corps on February 11, 2000, by Dr. Shabman. According to the report, there is no formal protocol for evaluating nonstructural measures in this watershed or elsewhere in the Nation comparable to that currently used for/to evaluate structural flood control benefits. In response, Virginia Tech received grant assistance from EPA to:

- a. Adopt existing economic analysis protocols for evaluating nonstructural alternatives.
- b. Demonstrate the analytical protocol with an evaluation of nonstructural actions for the Yazoo River backwater.
- c. Describe an implementation plan that would provide incentives for landowners' adoption of nonstructural actions.

- d. Review Corps preliminary estimates of agricultural benefits for a pump.

156. Due to the lateness of the report, the Corps had already formulated the final array of alternatives. The Corps reviewed the report as it related to the Corps planning objectives and whether it adhered to current policies and guidance. The Corps also evaluated whether the report recommendations warranted further review as a reasonable alternative. Several of the Shabman objectives were similar to the Corps objectives. The primary difference was that the Shabman recommendations only affect a portion of those lands and property below the 2-year flood event while the Corps plans carried into the final array provided benefits to those lands and properties up to the 100-year flood event.

157. In summary, the report identified 3 findings and 12 implications and these are discussed in more detail in Appendix 17.

158. Based on the Corps understanding of the Shabman report, the recommended plan was a nonstructural plan that included voluntary reforestation of approximately 70 percent of the 2-year flood event (88,000 acres), an income assurance program for farms outside the 2-year flood plain, and relocation or the utilization of local flood protection measures for protecting the limited number of structures. This plan was not economically justified without counting benefits from carbon sequestration and nutrient load reduction. These benefit categories cannot be used by the Corps because they have not been determined to be quantifiable and valid. The Principles and Guidelines do not recognize these benefit categories. To be used, economic markets for these two categories must be found to exist and be predictable. Also, these benefit categories must be extended to all Federal water resource projects where reforestation is combined with a nonstructural approach. In addition to these obstacles, it would appear that these benefit categories have been overstated based on recent information received by the

Vicksburg District (K. Pennington, 1999, "Relationship Between Surface Water Sediment Concentration, Total Phosphorus, and Total Kjeldahl Nitrogen in Mississippi Delta Streams"; Proceedings of the 29th Mississippi Water Resources Conference; and a recent article in the magazine, "Soybean Digest"). In addition, the report appears to have not accounted for all the costs involved with this approach. The cost of acquiring the entire 88,000 acres as proposed by Dr. Shabman was not quantified, but only accounted for that portion above those lands projected to be enrolled in WRP and CRP (approximately 40,000 acres) nor did it account for the administrative cost to acquire these lands, reforest, provide the income assurance program to those lands above the 2-year flood plain, or to relocate any structures.

159. Due to the above-listed reasons and because this plan does not meet the overall objectives of the study, it was found to be an unreasonable alternative and was dropped from further consideration.

160. The alternatives carried into the final array are:

a. Plan 1. No action.

b. Plan 2 - nonstructural plan. No pump with conservation easements from willing sellers on 231,000 acres of open land, below the 100-year elevation of 100.3 feet, NGVD, with reestablishment of forest on 107,000 acres of open land below elevation 91 feet, NGVD, which is the 2-year annual base line flood event, and modified operation of Steele Bayou structure to maintain water levels between 70- to 73-foot, NGVD, elevations during low water periods.

c. Plan 3. The 14,000-cfs pumping plant with pump operation elevation of 80 feet, NGVD (1 March-1 December), at Steele Bayou and 85 feet, NGVD (1 December-1 March); acquisition and reestablishment of forest on 27,435 acres of open land for compensatory mitigation (aquatic spawning habitat losses); and modified operation of Steele Bayou structure to maintain water levels between 70- to 73-foot, NGVD, elevations during low water periods.

d. Plan 4. The 14,000-cfs pumping plant with a year-round pump operation elevation of 85 feet, NGVD, at Steele Bayou; conservation easements from willing sellers and reestablishment of forest on 40,600 acres of open land below the pump elevation; and modified operation of Steele Bayou structure to maintain water levels between 70- to 73-foot, NGVD, elevations during low water periods.

e. Plan 5. The 14,000-cfs pumping plant with a year-round pump operation elevation of 87 feet, NGVD, at Steele Bayou; conservation easements from willing sellers; and reestablishment of forest on 62,500 acres of open land below the pump elevation, modified operation of Steele Bayou structure to maintain water levels between 70- to 73-foot, NGVD, elevations during low water periods.

f. Plan 6. The 14,000-cfs pumping plant with a year-round pump operation elevation of 88.5 feet, NGVD, at Steele Bayou; conservation easements from willing sellers; and reestablishment of forest on 77,300 acres of open land below the pump elevation; modified operation of Steele Bayou structure to maintain water levels between 70- to 73-foot, NGVD, elevations during low water periods and to reintroduce flows from the Mississippi River up to a maximum elevation of 87 feet, NGVD, at Steele Bayou (1-year frequency annual flood event).

g. Plan 7. The 14,000-cfs pumping plant with a year-round pump operation elevation of 91 feet, NGVD, at Steele Bayou; conservation easements from willing sellers; reestablishment of forest on 107,000 acres of open land below the 91-foot, NGVD, elevation; conservation easements on 91,600 acres of existing woodlands below elevation 91.0 feet, NGVD (requested by FWS); modified operation of Steele Bayou structure to maintain water levels between 70- to 73-foot, NGVD, elevation during low water periods and to reintroduce flows from the Mississippi River up to a maximum elevation of 87 feet, NGVD, at Steele Bayou (1-year frequency annual flood event).

SCREENING OF ALTERNATIVE PLANS

161. As outlined in ER 1105-2-100, the criteria to evaluate alternative plans include all significant resources, outputs and plan effects, contributions to the Federal objective and the study planning objective, compliance with environmental protection requirements, the Principles and Guidelines for evaluation (completeness, effectiveness, efficiency, and acceptability), and any other criteria deemed significant by participating stakeholders. These criteria were used in the screening process.

NO-ACTION ALTERNATIVE

162. A no-action alternative was considered, but this would not eliminate any of the damages the area has historically experienced. Impacts would continue to limit the development of the area. Homes and businesses would continue to flood and lower the standard of living for the people of the area. Local governments would continue to expend funds to assist in flood-fight efforts and repair public properties. Agricultural lands would continue to be flooded, thereby flooding fields which have already been planted or delaying the planting past the optimum planting time, and therefore reducing the yields and income of the farms. Under the no-action alternative, environmental resources and water quality would continue in their degraded state. Structural/nonstructural features could assist in a long-term improvement to the environment. This alternative does not improve the lives of the people in the project area through economic or environmental methods.

NONSTRUCTURAL PLAN

163. Table 10 presents the summary of first costs, annual costs, annual benefits, excess benefits over costs and the benefit-cost ratios for Plans 2-7. As can be seen from the table, Plan 2, the nonstructural alternative, is not feasible. The nonstructural plan was assembled to provide

benefits to the same acres in which a pump would provide benefits. This allows one to compare Plan 2 to Plans 3-7 which are the structural-nonstructural plans or combination plans. Since every acre within the 100-year flood plain receives some benefit from a pump, every acre under a nonstructural plan should receive benefits. These benefits would be in the form of a payment to allow the flooding to continue on those open lands below elevation 100.3 feet, NGVD, and to reforest those open lands below elevation 91.0 feet, NGVD. The payment would vary depending on the frequency and duration of flooding, land classification, recent cropping patterns, crop program base acres, and several other factors; i.e., less frequently flooded cropland would receive less money per acre than those lands that flooded more frequently. However, the most frequently flooded lands did not necessarily receive the highest payment because of the classification, cropping pattern, and lack of a crop program base acreage. A composite price for land was developed across the study area to take all this into account. At the same time, this only paid individuals to continue with the current land use between elevation 100.3 and 91.0 feet, NGVD; there was no incentive to change land use on those lowest lands. Therefore, reforestation was included in this alternative on those lands within the 2-year flood plain or 107,000 acres. The 2-year flood plain was chosen because biologists agree that this is the most productive habitat. The cost was included in the cost for Plan 2. Also included was the change in water management at the Steele Bayou structures during the low-water season. This would involve the raising of water level range from 68.5 to 70 feet, NGVD, to 70 to 73 feet, NGVD.

TABLE 10
SUMMARY, ECONOMIC ANALYSIS
FIRST COSTS, ANNUAL COSTS, ANNUAL BENEFITS,
EXCESS BENEFITS OVER COST, AND BENEFIT-COST RATIO
YAZOO BACKWATER AREA REFORMULATION
(6-5/8 Percent Federal Discount Rate)

Item	Alternative Plans (Final Array)					
	2	3	4	5	6	7
<u>Costs</u> (\$000)						
First Cost <u>a/b/</u>	291,001	153,710	154,732	181,595	196,274	274,654
Structural	--	115,233	140,391	134,978	127,913	120,383
Nonstructural	291,001	--	14,341	46,617	68,461	154,271
Interest During Construction	27,731	14,648	14,740	17,305	18,704	26,173
Structural	--	14,648	13,374	12,863	12,180	11,472
Nonstructural	27,731	--	1,366	4,442	6,524	14,701
Mitigation	--	38,477	--	--	--	--
Gross Investment	318,732	168,358	169,472	198,900	214,981	300,827
Structural	--	129,881	153,765	147,841	140,093	131,855
Nonstructural	318,732	--	15,707	51,059	74,985	168,972
<u>Annual Cost a/b/c/</u> (\$000)						
Structural						
Amortization	--	11,623	10,616	10,207	9,665	9,103
O&M Project	--	812	812	812	812	812
O&M Energy	--	379	253	183	142	76
O&M Mitigation	--	334	--	--	--	--
Pump Replacement	--	154	154	154	154	154
Nonstructural						
Amortization	22,005	--	1,085	3,525	5,177	11,666
Total Annual Costs <u>a/b/c/</u>	22,005	13,302	12,920	14,881	15,950	21,811
Structural	--	13,302	11,835	11,356	10,773	10,145
Nonstructural	22,005	--	1,085	3,525	5,177	11,666
<u>Annual Benefits c/</u> (\$000)						
Structural						
Agricultural Crop	--	12,934	10,085	9,763	8,708	6,274
Agricultural Noncrop	--	2,705	2,579	2,241	2,159	1,770
Structures	--	1,967	1,935	1,871	1,788	1,639
Road and Bridge	--	883	863	828	802	766
Urban Streets	--	90	89	83	80	66
Emergency Cost	--	170	168	158	152	126
FIA	--	31	31	30	29	25
Catfish	--	383	377	365	352	319
Total Structural	--	19,163	16,127	15,339	14,070	10,985
Nonstructural						
Agricultural Crop	380	--	1,027	1,162	854	380
Timber/Hunting Leases	2,488	--	608	936	1,158	2,488
Total Nonstructural	2,868	--	1,635	2,098	2,012	2,868

TABLE 10 (Cont)

Item	Alternative Plans (Final Array)					
	2	3	4	5	6	7
Employment						
Structural	--	438	417	376	351	395
Nonstructural	841	--	43	130	188	384
Total Employment	841	438	460	506	539	683
Annual Benefits (All Benefit Categories) (\$000)						
Structural	--	19,601	16,544	15,715	14,421	11,380
Nonstructural	2,410	--	1,678	2,228	2,200	3,252
Total Annual Benefits (All Benefit Categories) (\$000)	2,410	19,601	18,222	17,943	16,621	14,536
Annual Benefits (With Employment Excluded) (\$000)						
Structural	--	19,163	16,127	15,339	14,070	10,985
Nonstructural	1,569	--	1,635	2,098	2,012	2,868
Total Annual Benefits (With Employment Excluded) (\$000)	1,569	19,163	17,762	17,437	16,082	13,853
Excess Benefits Over Cost (All Benefit Categories) (\$000)	(19,595)	6,299	5,302	3,063	670	(7,181)
Excess Benefits (With Employment Excluded) (\$000)	(20,436)	5,861	4,842	2,557	131	(7,960)
Benefit-Cost Ratio (All Benefit Categories)	0.11	1.47	1.41	1.23	1.07	0.67
Benefit-Cost Ratio (With Employment Excluded)	0.07	1.44	1.37	1.19	1.03	.64

a/ February 2000 price levels.

b/ Includes costs for mitigation for Plan 3; Plans 2 and 4-7 include conservation easement and reforestation costs.

c/ Annualized using 50-year project life.

164. The cost of this plan still does not include the cost of the damage to agricultural noncrop categories, floodproofing of structures, or the road and bridge damage that would be expected to continue for the range of frequencies. Even if one removed the costs expected to occur in the more frequent flooded areas such as the 2-year event, those damages will continue to occur on those areas between the 2-year and 100-year events and these are the more developed agricultural lands and have more roads and bridges. These costs would be substantial. Since the benefit-cost ratio is below unity, there was no need to add any additional costs. In addition, two variations of the nonstructural plans had previously been evaluated under Array 3 and these were not feasible either.

165. This plan was rejected not only for the cost, but also its local unacceptability. Flooding is usually of a long duration in the Yazoo Backwater area. Homes and structures within this area cannot be flood proofed to sustain weeks or months of inundation, and even if they could, families do not live like this today. Water supplies and electric service would be interrupted. Sewage systems would not work in the prolonged saturated and flooded condition of a backwater flood. Rural roads would be severed because of the ridge and swale topography of the area.

166. On the agricultural landscape, flooding would prevent the germination of early weeds and grasses in the fields; however, the prolonged floods in the Yazoo Backwater area cause a delay in optimum planting dates of the crops or damage to crops that have been planted. Often the floods come after the land has been tilled and preemergence herbicides have been sprayed on the field. Flooding allows movement of these herbicides into other parts of the environment instead of staying bonded to the soil particles where it would be absorbed by the vegetation or allowed to decay. Repeated and prolonged flooding of bottom-land hardwoods also damages timber and wildlife production in the area. Although this plan would improve the environment, it would be at a cost to some of the area residents since all payments would go to the landowners and would

not be distributed throughout the local economy. Therefore, due to the high costs, a benefit-cost ratio below unity, lack of local acceptability, and the reduction in flexibility of a nonstructural plan, it was eliminated from further consideration.

STRUCTURAL PLANS

167. Plan 3 was strictly a structural plan with compensatory mitigation included. The plan includes the 14,000-cfs pump station with a pump operation elevation of 80 feet during the cropping season and 85 feet during the winter waterfowl season. Also included was the modified operation of Steele Bayou structure during low-water periods. No additional real estate requirements are needed to modify the operation elevation of the Steele Bayou structure. This plan would require the acquisition and reforestation of 27,435 acres of open land for compensatory mitigation. An additional 40 acres of rights-of-way are required in the vicinity of the proposed pump site to accommodate the construction of the bridge and highway across the outlet channel on Highway 465. This plan, while allowing for the maximum protection to the rural and urban structures and the existing agricultural land, provides the least amount of environmental benefit of the remaining plans. It provides for no net loss to the environment, but does not offer any environmental improvements.

168. Plans 4 through 7 were combinations of the structural and nonstructural flood damage reduction measures that generally varied only in the elevation at which pumping began. Under Plan 4, pumping would begin at elevation 85 feet, NGVD, year-round with conservation easements from willing sellers secured on approximately 40,600 acres of open land below elevation 85 feet, NGVD. Those easement lands will be reforested, thereby adding improved wildlife habitat to the area. Plan 5 consists of the 14,000-cfs pump with a 87 foot, NGVD, pump elevation. Also as a part of this plan, conservation easements from willing sellers on those lands below 87 feet, NGVD, with reforestation were included. The 87-foot, NGVD, elevation is a close approximation of the 1-year frequency event. This plan would allow for the reforestation

of potential habitat for the Louisiana black bear and also the pondberry. Plans 6 and 7 allow for reintroduction of Mississippi River flows up to a maximum elevation of 87 feet, NGVD, with a pumping elevation of 88.5 feet under Plan 6 which corresponds to the elevation of hydrological effects on jurisdictional wetlands while Plan 7 allowed a pumping elevation at 91.0 feet. Those areas below the pumping elevation would have a conservation easement from willing sellers with reforestation included on them. An additional 40 acres of rights-of-way are required in Plans 4-7 in the vicinity of the proposed pump site to accommodate the construction of the bridge and highway across the outlet channel on Highway 465. In Plans 2-7, the operation plan for the Steele Bayou structure would be modified from 68.5 to 70 feet, NGVD, to 70 to 73 feet, NGVD.

169. Table 10 also shows a breakdown of the benefits and costs for Plans 2-7 between the structural component and the nonstructural flood damage reduction feature. The costs shown for the nonstructural features include only those costs associated with acquiring the conservation easements from willing sellers and reforesting those lands above the mitigation requirements. The structural component includes the cost of the pump station, the compensatory mitigation required to offset the environmental impacts from the construction of the pump and the inlet and outlet channel, and also the remaining compensatory mitigation for the Yazoo Backwater levee. It also includes the cost to reforest these features.

170. Table 11 shows a breakdown of the environmental benefits between the structural and nonstructural features for the four resource categories of wetland, terrestrial, waterfowl and aquatics. These data are used to calculate the incremental National Environmental Quality (NEQ) benefits shown in Table 12. A detailed breakdown of these environmental resources is shown in the Draft SEIS and is summarized in Table SEIS-34.

171. Table 12 shows the incremental analysis for Plans 3-7 for the first cost, annual cost, NED benefits and NEQ benefits for both the structural and nonstructural features combined and also the nonstructural feature separately.

TABLE 11
DISTRIBUTION OF RESOURCE UNITS FROM REFORESTATION BETWEEN
STRUCTURAL (S) AND NONSTRUCTURAL (NS) FEATURES
YAZOO BACKWATER AREA REFORMULATION

Alternatives	Wetlands (Functional Capacity Units)			Terrestrial (Average Annual Habitat Units)			Waterfowl (Duck-Use Days)			Aquatics (Average Annual Habitat Units)		
	S	NS	Total	S	NS	Total	S	NS	Total	S	NS	Total
1	0	0	0	0	0	0	0	0	0	0	0	0
2	0	77,919	77,919	0	175,542	175,542	0	-824,505	-824,505	0	80,072	80,072
3	53,251	0	53,251	13,876	0	13,876	-191,100	0	-191,100	63,886	0	63,886
4	39,932	23,295	63,227	11,136	67,337	78,473	-467,532	-282,825	-750,357	49,293	10,466	59,759
5	19,042	51,520	70,562	10,200	100,478	110,678	-216,092	-574,736	-790,828	30,061	37,428	67,489
6	463	82,855	83,318	7,304	126,608	133,912	-120,262	-837,915	-958,177	12,801	61,754	74,555
7	463	91,899	92,362	7,304	170,411	177,715	-1,765	-971,455	-973,220	142	81,058	81,200

TABLE 12
 INCREMENTAL ANALYSIS
 (STRUCTURAL AND NONSTRUCTURAL FEATURES COMBINED)
 ALTERNATIVE PLANS (FINAL ARRAY)
 YAZOO BACKWATER AREA REFORMULATION

Item	Alternative Plan 3	Alternative Plan 4	Alternative Plan 5	Alternative Plan 6	Alternative Plan 7
First Costs (\$000)	--	1,022	26,863	14,679	78,380
Annual Costs (\$000)	--	(383)	1,961	709	6,221
NED Benefits (excluding employment) (\$000)	--	(1,401)	(325)	(1,355)	(2,229)
NEQ Benefits ^{a/}					
Wetlands (FCU's)	--	23,295	28,225	31,335	9,044
Terrestrial (AAHU's)	--	67,337	33,141	26,130	43,803
Waterfowl (DUD's)	--	-282,825	-291,911	-263,179	-133,540
Aquatics (HU's)	--	10,466	26,962	24,326	19,304

^{a/} NEQ benefits are the same for both incremental analyses since NEQ benefits are derived from the nonstructural component only.

172. A review of Table 10 shows Plans 3, 4, and 5 economically feasible, Plan 6 marginally feasible, and Plan 7 not economically feasible. Excess benefits over cost are greatest on Plan 3 but the excess benefits of Plan 4 are within 14 percent of Plan 3. The excess benefits of Plan 5 are 51 percent less than those shown for Plan 3. However, Table 10 does not show the environmental benefit gained with each increment of cost and benefits.

173. Table 12 shows the incremental first costs, annual costs, NED benefits, and NEQ benefits for Plans 4 and 7 for the combination of plans. Table 13 shows the incremental first cost, annual costs, NED benefits, and NEQ benefits for Plans 4-7 for the nonstructural component only. The NEQ benefits are the same for both tables since NEQ benefits are derived from the nonstructural component only.

TABLE 13
 INCREMENTAL ANALYSIS
 NONSTRUCTURAL ONLY
 YAZOO BACKWATER AREA REFORMULATION

Item	Alternative Plan 3	Alternative Plan 4	Alternative Plan 5	Alternative Plan 6	Alternative Plan 7
First Costs (\$000)	--	14,341	32,276	21,844	85,810
Annual Costs (\$000)	--	1,085	2,440	1,652	6,489
NED Benefits (excluding employment) (\$000)	--	1,635	463	(86)	856
NEQ Benefits <u>a/</u>					
Wetlands (FCU's)	--	23,295	28,225	31,335	9,044
Terrestrial (AAHU's)	--	67,337	33,141	26,130	43,803
Waterfowl (DUD's)	--	-282,825	-291,911	-263,179	-133,540
Aquatics (HU's)	--	10,466	26,962	24,326	19,304

a/ NEQ benefits are the same for both incremental analyses since NEQ benefits are derived from the nonstructural component only.

174. A careful review of Table 12 shows the first cost of Plan 4 increasing by \$1,022,000 over Plan 3 while the annual costs decrease by \$383,000. NED benefits are reduced by \$1,401,000 over Plan 3, but some sizable NEQ benefits are gained over Plan 3. Plan 3 has no NEQ benefits because the compensatory mitigation requirement for Plan 3 only achieves a no net loss. Comparing Plan 5 with Plan 4 in Table 12 shows the first cost increasing by \$26,863,000 and the annual cost increasing by \$1,961,000. However, the NED benefits were only reduced by \$325,000 and the NEQ benefits essentially doubling in the wetland and aquatic resources, while the terrestrial resources increased by 50 percent and waterfowl decreased. The decrease in waterfowl habitat was due to the fact that foraging habitat is being removed from the area. As previously stated, FWS is not concerned with this reduction in foraging habitat when compared to the gain in restored bottom-land hardwood wetlands. Comparing Plan 6 with Plan 5 in

Table 12 shows the first cost to increase another \$14,679,000 with annual cost increasing another \$709,000. NED benefits lose \$1,355,000 annually while NEQ benefits continue to rise. Comparing the various plans in Table 12 and 13 shows that the incremental NED benefits are essentially the same for Plans 4 and 5 with a large incremental change between Plans 5 and 6.

175. Plan 6 would reforest 77,300 acres below elevation 88.5 (elevation for jurisdictional wetland backwater hydrology). This plan would be more desirable than reforesting 62,500 acres in the 1-year flood plain (Plan 5) and even though the NEQ benefits continue to rise with Plan 6, according to Table 10 the plan is marginally justified economically. Plan 4 would reforest 40,600 acres and would produce greater excess economic benefits than Plan 5, but would not provide as many environmental benefits while Plan 3 only achieves a no-net-loss to the environment. Plan 5 more completely addresses the environmental opportunities through the nonstructural flood damage reduction feature than Plan 4 for the following reasons:

a. The structural component of Plan 5 has no impact on the size of the 1-year flood plain. It is the same size with and without the project. The structural component of Plan 4 reduces the 1-year flood plain elevation approximately 2 feet, which results in the loss of 41,823 acres.

b. The structural component of Plan 5 affects 23,200 acres of jurisdictional wetlands, while the structural component of Plan 4 affects 44,000 acres.

c. Plan 5 would reforest 58 percent of the agricultural lands within the ecologically sensitive 2-year flood plain. Whereas, Plan 4 would reforest only 38 percent, less than half of the available agricultural lands.

d. Increasing the pumping elevation from 85 to 87 feet increases the probability of successful fish egg incubation. The fish spawning model uses an 8-day duration as an average incubation period. The range is from 1 to 14 days. Increasing the size of the flood plain would benefit those fishes that are at the upper end of the incubation range.

e. The shorter duration and higher frequency of inundation of the 85-foot flood plain versus the 1-year flood plain (87 feet) would result in greater variability and instability of inundation of forests with Plan 4. Not reforesting lands between 85 and 87 feet could result in significantly reduced habitat value.

f. A greater area of inundation results in better connectivity between aquatic flood plain habitat types, particularly between agricultural lands and bottom-land hardwoods. This is especially important because the predation rate on larval fish is higher in agricultural lands. Better connectivity allows larval fish to disperse into the structural cover of bottom-land hardwoods.

g. Particulate organic matter, mainly leaf detritus from the flood plain forests, is the basis of the food chain in heterotrophic systems such as the Yazoo River and Lower Mississippi River. Reforestation of the hydrologically unchanged 1-year flood plain would result in a significant increase in export of particulate organic matter to the aquatic system, which would increase benthic invertebrate and zooplankton production.

h. The fish-carrying capacity of a river system is dependent in part on the habitat quantity and quality during annual low flow conditions. The increased amount of low flow aquatic habitat provided with Plan 5 could significantly increase standing stock and production for many fish species. Reforestation of the 1-year flood plain (versus the 85-foot elevation flood plain) would better ensure the supply of organic matter and fish food organisms to young-of-the-year fish necessary to support increased standing stock from the increased low-flow habitat.

i. Water quality improvement would be greater with reforestation of the 1-year flood plain. A larger area would be removed from agricultural production, and therefore, greater decreases in suspended sediments and nutrients would occur.

j. Reforestation of the 1-year flood plain (as opposed to the 85-foot flood plain) will result in additional larger contiguous tracts of wooded habitat, which would greatly increase habitat value for the black bear and other bottom-land hardwood bird and mammal species, including Neotropical birds.

Therefore, based on the above stated reasons and reviewing the data in Tables 10-13, the NED/NEQ recommended plan is Plan 5.

RECOMMENDED PLAN

GENERAL

176. Plan 5 is the best combined NED/NEQ plan and is the recommended plan. It produces both National Economic Development benefits and National Environmental Quality benefits and therefore is the recommended plan. It maximizes the sum of net NED and NEQ benefits and offers the best balance between the two Federal objectives.

177. Plan 5 is a comprehensive plan that combines both structural and nonstructural measures and provides flood damage reduction benefits for the entire project area (open lands and structures) while protecting the environment. The pumping plant will provide protection for open lands and structures above the pump elevation by reducing flood stages. Conservation easement (willing sellers) with reforestation will prevent existing flood damages on open land below the pump elevation. Conservation easements from willing sellers would control future

land use and reduce the agricultural intensity on the lands, and the reforestation would not only offset the adverse impacts of the pump operation, but would also result in a net positive contribution to the environment of the project area. This plan offers the opportunity to both improve people's lives and improve the environment and therefore justifies the additional cost. The plan conforms to the OMB directive to (a) provide greater levels of flood protection for urban areas, (b) reduce levels of agricultural intensification, and (c) reduce adverse impacts on the environment, and it meets the planning objective.

Hydraulic Impacts

178. The pumping plant would not affect annual baseline peak flood stages below the pump elevation. The pumping plant would affect 23,200 acres of jurisdictional wetlands between the pump operation elevation 87 feet and 88.5 feet--the elevation at which lands in the project area are inundated or saturated to the surface for at least 5 percent of the growing season in most years. The pump effect on annual baseline peak stages by frequency and reach are shown in Table 14.

TABLE 14
RECOMMENDED PLAN STAGE-FREQUENCY REDUCTIONS

Frequency Years	Base Conditions Stages (ft)	Recommended Plan Stages (ft)	Stage Reductions (ft)
Lower Ponding Area (Reach 1)			
1	87.0	87.0	0.0
2	91.0	87.8	3.2
3	92.9	88.5	4.4
5	94.6	89.6	5.0
10	96.3	91.2	5.1
20	97.6	92.7	4.9
25	98.0	93.0	5.0
50	99.2	94.4	4.8
100	100.3	95.7	4.6
Upper Ponding Area (Reaches 2, 3, and 4)			
1	87.8	87.8	0.0
2	91.6	88.9	2.7
3	93.4	89.7	3.7
5	95.0	90.7	4.3
10	96.8	92.0	4.8
20	98.1	93.5	4.6
25	98.5	93.8	4.7
50	99.5	95.1	4.4
100	100.3	96.4	3.9

179. Currently, the gates of the Steele Bayou drainage structure are operated to evacuate flows whenever landside and/or Mississippi River stages permit except during low-flow periods when the gates are closed to maintain elevations between 68.5 and 70 feet in adjacent water bodies. The operation modifications would maintain higher water elevations (70-73 feet) in the adjacent water bodies during low-flow periods. The gates would still be operated so that when Mississippi River/Yazoo River stages are higher, the gates would be closed, preventing water from backing through the Steele Bayou structure. Once stages on the interior are predicted to exceed 87 feet, NGVD, pump operation would be initiated.

180. From the hydraulic and hydrologic data, it is estimated that peak stages downstream of the 14,000-cfs pump would observe a maximum increase of .25 foot for conditions near the initial pump start-up elevation. This increase is below major damage elevations for developmental areas. Once the Mississippi River stages rise and the Yazoo River overflows its banks, the impacts of the pump become minimal.

Economic Impacts

181. Due to the time that has elapsed during the preparation of this report, the agricultural benefits were updated to include 1999 crop budgets and 1999 current normalized prices. In addition, the data for the urban analysis were initially collected almost 10 years ago and this too needed to be updated. A structure inventory for the 100-year flood plain was completed in June 2000. This updated inventory identified a number of new structures within the study area. The structures inventory showed an increase from 1,555 structures to 1,642 structures with 1,487 structures being residential. Based on the latest structure inventory, only one structure is impacted at the 2-year flood frequency elevation. However, at the 5-year flood frequency 351 structures are impacted. Although this updated structure inventory points out that the projection of no growth in the study area may understate growth somewhat over the project life, the rate of growth found in some portions of the area over the past few years is not likely to

continue throughout the 50-year projection period. Therefore, Table 15 reflects the above-stated changes. This update will not change the comparisons shown in Table 10 nor the recommended plan. The first cost remains at \$181.5 million. The average annual benefits will increase from \$17.4 million to \$22.0 million. The annual excess benefits over cost increase from \$3.1 million to \$7.1 million and the benefit-cost ratio increases from 1.23 to 1.48. The completed updated benefit categories for the recommended plan are shown in Table 15. When comparing the recommended plan, Plan 5, to Plan 3 or the plan that provides the greatest level of protection, the recommended plan will provide 88 percent of the flood damage reduction benefits for open lands and 95 percent of the benefits for structures and associated categories such as streets and emergency costs.

Environmental Impacts

182. The impact to terrestrial resources from the construction of the pump station will result in the removal of 38 acres of bottom-land hardwoods or the loss of 108 average annual habitat units (AAHU's) and the decrease in flooding or hydrologic change from the operation of the pump will result in a loss of 2,896 AAHU's. This direct terrestrial loss includes the 40 acres of additional right-of-way that is required. The nonstructural features of the recommended plan, the conservation easement from willing sellers and reforestation on 62,500 acres of frequently flooded agricultural lands will result in a gain of 110,678 AAHU's. Therefore, there is a total gain of 107,674 AAHU's or 17.4 percent increase to the terrestrial resource with the project.

183. Direct wetland losses due to the construction of the pump feature of the recommended plan will be 38 acres of bottom-land hardwoods and 110.5 acres of farmed wetlands or a reduction of 463 functional capacity units (FCU's). This direct wetland loss includes the 40 acres of additional right-of-way that is required. The hydrologic impact from the operation of the pump results in a loss of 18,579 FCU's. The nonstructural feature, the reforestation of 62,500 acres of frequently flooded agricultural land, will result in an increase of 70,562 FCU's. Therefore, the recommended plan has a 23.5 percent or 51,520 FCU increase in wetland resources.

TABLE 15
SUMMARY ECONOMIC ANALYSIS
YAZOO BACKWATER RECOMMENDED PLAN
(6-5/8 Percent Discount Rate)

Item	Plan 5
Benefits (\$000)	
Structural	
Agricultural Crop <u>a/</u>	11,639
Agricultural Noncrop	2,241
Structures <u>b/</u>	2,256
Road and Bridge	828
Urban Streets	83
Emergency Costs	158
FIA	30
Catfish	365
Nonstructural	
Agricultural Crop <u>c/</u>	2,960
Timber/Hunting Leases	936
Subtotal Nonstructural	3,896
Employment	506
Total Annual Benefits (\$000)	
(Excluding Employment)	21,496
(Including Employment)	22,002
First Cost (\$000)	181,595
Interest During Construction (\$000)	17,305
Gross Investment (\$000)	198,900
Annual Costs (\$000)	
Amortization	13,732
O&M Project	812
O&M Energy	183
Pump Replacement	154
Total	14,881
Excess Benefits (\$000)	
(Excluding Employment)	6,615
(Including Employment)	7,121
Benefit-Cost Ratio	
(Excluding Employment)	1.44
(Including Employment)	1.48

a/ Agricultural crop benefits include FY 99 Current Normalized Guideline II Commodity Prices and 1999 agricultural crop budgets published by MSU MAFES.

b/ Structure data based on updated structure surveys conducted in the spring of 2000 (current year 2000 values).

c/ Benefits consist of insurable losses.

184. Direct flood plain aquatic losses due to the construction of the pump feature of the recommended plan will be 38 acres of bottom-land hardwoods or a loss of 142 HU's. This direct flood plain aquatic loss includes the 40 acres of additional right-of-way that is required. The hydrologic loss from the operation of the pump resulted in a loss of 29,919 HU's on various habitats. The reforestation of 62,500 acres of frequently flooded agricultural lands will result in a gain of 67,489 HU's. Therefore, the recommended plan has a 18.7 percent or 37,428 HU increase in flood plain spawning habitat value.

185. Waterfowl foraging habitat losses are the result of loss of habitat and a reduction in flooding. The construction of the pump station would result in a reduction of foraging habitat on 38 acres or the loss of 2,166 duck-use days (DUD) and a hydrologic loss of 80,438 DUD's from the operation of the pump. This direct waterfowl foraging habitat loss includes the 40 acres of additional right-of-way that is required. The conservation easements from willing sellers and reforestation of 62,500 acres of frequently flooded agricultural land results in a loss of 790,828 DUD's. The total impact of the recommended plan on waterfowl is a 42.1 percent or 873,432 DUD reduction in waterfowl foraging habitat value. However, FWS states that the overall benefit from reforestation far exceeds losses of foraging habitat.

186. Construction of the pump station will have an effect on site and this will be minimized by onsite measures installed by the contractor. The pump itself will have no impact on water quality because the same water, if not pumped, would eventually exit the basin by the Steele Bayou structure. However, with the reforestation of 62,500 acres of cleared agricultural lands under the nonstructural feature, water quality should improve as these lands are removed from production.

187. Two threatened/endangered species (the Louisiana black bear (*Ursus americanus luteolus*) and pondberry (*Lindera melissifolia*)) were identified as occurring in the area. Both of these species are generally found in association with bottom-land hardwood wetland habitats. A field

survey was conducted and found neither of these species in the pumping station site. A biological assessment prepared for these species concluded that implementation of the proposed project is not likely to adversely impact either species. Integral to the proposed project is the utilization of conservation easements to reforest 62,500 acres. This project feature would beneficially impact both the pondberry and Louisiana black bear. The biological assessment for the pondberry and Louisiana black bear is found in Appendix 14.

188. A preliminary assessment for hazardous, toxic, and radioactive waste (HTRW) was conducted at the pump station site. No indication of any HTRW contamination was found. HTRW evaluations will be conducted on the 62,500 acres of conservation easement land prior to purchase of an easement. Should a site be found, the appropriate remedial treatment will have to be undertaken by the landowner prior to purchase of the easement.

189. A literature and record search was conducted to ascertain whether any previously recorded or known prehistoric and historic cultural resources were located in or adjacent to the project study area. This search was also conducted to determine what types of cultural resources might be expected in the study area. The search recorded approximately 1,515 archeological sites within the study area along with 111 National Register of Historic Places (NRHP) eligible properties and numerous NRHP listed properties. This included all of the six counties/parishes involved in the study area--Humphreys, Issaquena, Sharkey, Warren, Washington, and Yazoo Counties in Mississippi and Madison Parish, Louisiana.

190. No prehistoric or historic cultural sites were located at the site of the pump station. Prior to purchase of the conservation easements, a cultural resources survey will be conducted on those tracts. If NRHP eligible properties are identified in the project rights-of-way or area of potential effect, the effects of the project to the resources will be assessed. Efforts will be taken to avoid or mitigate appropriately for any adverse effects created by the undertaking.

MITIGATION

191. Although compensatory mitigation is not a part of the recommended plan, it has been calculated as requested by members of the Consensus Committee. Compensatory mitigation was only required under Plan 3 since no nonstructural flood damage reduction feature was included with it. The cost of the compensatory mitigation has been included in the first cost for Plan 3. The remaining Plans 4-7 include sufficient lands under the flood damage reduction feature to more than offset any compensatory mitigation requirements. The Corps of Engineers is committed to the fee title acquisition and reforestation of lands should insufficient conservation easement lands become available to mitigate for the unavoidable losses from construction of the pump plant.

192. The following shows the compensation mitigation requirement to offset construction of a pump station without the use of conservation easements from willing sellers.

Plan 2 - 0
Plan 3 - 27,435 acres
Plan 4 - 21,199 acres
Plan 5 - 12,980 acres
Plan 6 - 5,604
Plan 7 - 194

193. In addition, the Vicksburg District agreed with the local ecological office of FWS to review mitigation required for the previously constructed Yazoo Backwater levee project. This project had been partially mitigated by the acquisition and reforestation of the Lake George WMA; however, FWS countered that the Corps had failed to account for the difference in time of loss and the time of the acquisition and for those areas within Lake George that could not be reforested. The Corps agreed to display and mitigate for these losses under the Yazoo Backwater reformulation study effort. Therefore, an additional 3,617 acres of land will be needed to offset the loss from the Yazoo Backwater levee construction.

194. Also included is the environmental loss from the construction of the inlet and outlet channel to the pump site that was completed in 1987. This work involved the clearing of 296 acres of bottom-land hardwoods. The compensatory mitigation required for this conversion is 481 acres, which does include the difference in the time of the loss and the time of acquisition. The environmental losses from the Yazoo Backwater levee and previous construction on the inlet and outlet channel will be offset by the purchase of conservation easements from willing sellers as part of the recommended plan. Habitat units offset by conservation easements from willing sellers is the same as if purchased in fee title. The first conservation easements purchased will be used to offset the losses unmitigated by Lake George and previous channel work at the pump site and then the pump station and finally to remove those remaining flood damages below elevation 87 feet, NGVD.

195. The conservation easements from willing sellers attributable to the nonstructural feature for the various plans are:

- Plan 4 - 15,303 acres
- Plan 5 - 45,422 acres
- Plan 6 - 67,598 acres
- Plan 7 - 102,708 acres

These acres are calculated by deducting the mitigation requirements for the structural feature and the Yazoo Backwater Levee. For example, for Plan 5:

Mitigation requirements for 14,000-cfs pump at elevation 87 feet	12,980 acres
Mitigation requirements for inlet and outlet channel	481 acres
Mitigation requirements for Backwater Levee	3,617 acres
Conservation easements from willing sellers attributable to nonstructural feature	<u>45,422</u> acres
Conservation easements from willing sellers	62,500 acres

196. Should the District not be able to secure enough conservation easements to offset the compensatory mitigation requirements of these three features, then the difference between the

compensatory mitigation required and the amount of conservation easements from willing sellers will be purchased in fee title from willing sellers. The District will first seek these lands in the study area; however, if sufficient lands are unavailable, then the District will look to other areas in the Mississippi Alluvial Valley. Acquisition and reforestation of frequently flooded agriculture lands should not affect any threatened or endangered species. However, should the District pursue any lands outside the study area, then the District will contact FWS to see if any threatened or endangered species could be involved, and if so, a biological assessment will be conducted. Although acquisition of mitigation lands outside of the study area would reduce the potential habitat available for the Louisiana black bear and pondberry, it would have no adverse effect on these species. Tracts will have to be of sufficient size to allow for management or adjacent to state wildlife management areas or national wildlife refuges. Reforestation will occur after acquisition. Management of any compensatory mitigation will be turned over to other State or Federal agencies who do this type of management. Management funding will be a part of compensatory mitigation.

COMPARISON OF PLANS AFTER REFORMULATION

197. The recommended plan is a 14,000-cfs diesel pumping station, with a year-round pump elevation of 87 feet, NGVD, at Steele Bayou. The nonstructural flood damage reduction features include conservation easements from willing sellers and the reestablishment of bottom-land hardwoods on 62,500 acres of open land below the pump elevation. Also included is the modification of the operation of the Steele Bayou drainage structure to maintain water in existing water bodies between 70-73 feet, NGVD, at Steele Bayou during low-water periods. The first cost of this plan is \$181.6 million with an annual cost of \$14.9 million and annual operation and maintenance (O&M) cost of \$995,000. This plan has a 71 percent reduction in agricultural flood damages and 85 percent reduction to urban and rural structures. The benefit-cost ratio for the currently recommended plan using the current interest rate of 6-5/8 percent is 1.5.

198. The previously recommended plan (July 1982) consisted of a 17,500-cfs electric pump station, with pumping initiated at elevation 80 feet, NGVD, March through November, and at 85 feet, NGVD, from 1 December to 1 March. Mitigation for the project consisted of the purchase of 6,500 acres of woodlands in land use easements or 6,000 acres in fee simple purchase or some combination of easement and fee. The first cost of this plan shown in the 1982 report was \$150 million with an annual cost of \$14.95 million and an O&M cost of \$1,021,400. This plan had a 69 percent reduction in base flood damages. The benefit-cost ratio shown in the 1982 report using the then current interest rate of 7-5/8 percent was 1.4.

199. A plan similar to the previously recommended plan (Plan 28) was evaluated in Array 3. Although it was feasible, it was screened out of the final array. Preliminary costs showed the cost of the pump to be \$143 million with a mitigation cost of \$34 million for a total cost of \$177 million. The annual O&M for the pump was estimated at \$1.2 million and \$334,000 for the mitigation lands. Approximately 22,000 acres of land would be required to offset unavoidable environmental losses from this plan.

200. Table 16 shows a comparison of the reduction in stages of the previously recommended plan versus the currently recommended plan.

TABLE 16
 CURRENT YAZOO BACKWATER REPORT VERSUS
 1982 YAZOO BACKWATER REPORT
 RECOMMENDED PLANS
 STAGE-FREQUENCY DEPARTURES

Frequency Years	2000 Report Recommended Plan 14,000-cfs Pump Elevation (ft)	1982 Report ^{a/} Recommended Plan 17,500-cfs Pump Elevation (ft)	Difference (ft)
Lower Ponding Area (Reach 1)			
1	87.0	81.3	5.7
2	87.8	82.7	5.1
3	88.5	84.9	3.6
5	89.6	86.5	3.1
10	91.2	88.7	2.5
20	92.7	90.3	2.4
25	93.0	90.8	2.2
50	94.4	92.5	1.9
100	95.7	94.0	1.7
Upper Ponding Area (Reaches 2, 3, and 4)			
1	87.8	83.0	4.8
2	88.9	85.7	3.2
3	89.7	86.9	2.8
5	90.7	88.4	2.3
10	92.0	90.1	1.9
20	93.5	91.6	1.9
25	93.8	92.1	1.7
50	95.1	93.3	1.8
100	96.4	94.3	2.1

^{a/} Updated to 1943-1997 period of record (Plan 28, Array 3).

201. While the previously recommended plan only achieved a no-net-loss to the environment, the use of the nonstructural flood damage reduction feature in the currently recommended plan achieves a gain in three of the four environmental resource categories. Reforestation under the recommended plan results in a loss of waterfowl foraging habitat. However, other important waterfowl habitat requirements are met with reforestation that are notably absent in agricultural fields. According to FWS, the overall benefit from reforestation far exceeds the loss of foraging habitat. Under the currently recommended plan, the nonstructural damage reduction feature allows for the purchase of conservation easements from willing sellers and reforestation of 62,500 acres below the 87-foot pumping elevation.

202. In addition, Table 17 displays a comparison of the recommended plan cost to the latest approved project cost estimate (PB-3) that was carried for the previously authorized project.

TABLE 17
COMPARISON OF PB-3 COST OF
AUTHORIZED PLAN TO RECOMMENDED PLAN COST
YAZOO BACKWATER REFORMULATION

Feature	Item	Amount Remaining in Latest Approved PB-3 1 Oct 99 (\$000)	Revised Estimate (\$000)	Difference +/- (\$000)
1.01	Lands and damages	38,657	55,434	16,777
1.02	Relocations	1,692	1,668	-24
1.06	Fish and wildlife facilities	6,047	9,625	3,578
1.09	Channels and canals	4,302	2,881	-1,421
1.08	Roads, railroads, and bridges	549	0	-549
1.11	Levees and floodwalls	747	998	251
1.13	Pumping plant	93,182	88,534	-4,648
1.18	Cultural resource	525	0	-525
1.90	Buildings, grounds & utilities	3,741	1,142	-2,599
1.20	Permanent operation equipment	506	669	163
1.31	Planning engineering and design	13,645	14,889	1,244
1.31	Construction management	8,766	5,754	-3,012
Total	Yazoo Backwater Pumps 14,000 cfs	172,359 <u>a/</u>	181,594 <u>a/</u>	9,235

a/ Does not include sunk cost for constructing the inlet and outlet channels.

DESIGN AND CONSTRUCTION CONSIDERATION

203. Construction is scheduled to be initiated in 2005 and is estimated to be physically complete in the year 2008. Design of the project pump plan will be based on the current technical guidelines and any additional engineering or surveys that may be necessary. Coordination of the design and construction of both pump and relocation phases will be accomplished so as to reduce any further loss of bottom-land hardwoods, jurisdictional wetlands, and known cultural resources sites to the maximum extent practicable. The pump construction area as shown in Appendix 4 has been surveyed for environmental impacts, impacts to cultural

resources, and impacts to endangered species. The environmental impacts have been fully offset by reforestation on the conservation easement lands. There are no impacts to any cultural resources or the two endangered species in the area.

204. The design of this project has been estimated to take 3 years with a 4-year construction time. The design phase would begin in 2001 and would conclude in 2004. The relocation of the road and bridge will be accomplished by the Mississippi Department of Transportation (MDOT) under a cost reimbursable contract and could be advanced should MDOT complete plans and specifications sooner than 2004.

205. The remaining channel excavation on the inlet and outlet channel will be accomplished by dragline and will be hauled to the disposal sites shown in the plans. Any sedimentation that has occurred in the completed inlet and outlet channel work will also have to be removed by either dragline or dredge and moved to the disposal sites. Structure excavation will be accomplished by dragline and placed in the disposal sites as presented on the plans. Suitable material from the above listed excavation will be used to backfill around the pump structure and used to build the connecting levee to the pump structure and also by MDOT to construct the approach to the newly relocated bridge.

206. Minor work around the Steele Bayou and Little Sunflower structures is anticipated. Relief wells will be installed to relieve the uplift pressure with the raising of the minimum pool from the 68.5 to 70 foot, NGVD, range to the 70 to 73 foot, NGVD, range. This work will be relatively minor and will be accomplished prior to work on the pumping station.

207. On the nonstructural flood damage reduction measure, several criteria will have to be documented prior to the purchase of the conservation easements and eventual reforestation. A Real Estate Design Memorandum will have to be prepared by the Vicksburg District in which estimated values of the easements are approved by higher authority on those lands offered by

willing sellers. A cultural resource survey will be conducted on those lands which show the most potential for having sites and a HTRW survey will also be conducted. Once all these criteria are satisfied, Real Estate Division will begin negotiations with the landowner as to the price to be paid for the conservation easements. As easements are secured, these lands will have to be evaluated as to the most suitable species of trees that will grow and mature on that particular site. Seeds and/or seedlings will be ordered from nurseries and planted by the Corps generally in the late fall and winter. Tree survival will be monitored by the Corps to ensure success in the early years; however, after successful establishment, monitoring will primarily be conducted by remote sensing techniques with occasional visual onsite inspections. Planting of the conservation easement lands will be accomplished as rapidly as manpower and seedlings are available.

208. The process of securing conservation easements will begin in the year 2001 or after the signing of the Record of Decision. Purchasing of the easements will be undertaken as quickly as the real estate process can be completed and as funds become available. The first easement purchased will be used to offset those remaining environmental losses from the construction of the Yazoo Backwater levee and the previous work on the inlet and outlet channel that was completed in 1987. Representatives from the Vicksburg District and the local FWS office had agreed in 1998 that the previous Yazoo Backwater area mitigation plan that was completed in 1991 did not take into account the time of the environmental loss versus the time of mitigation acquisition. It also did not take into account those areas on Lake George that were not reforested. The Vicksburg District agreed to reanalyze this under the Yazoo Backwater reformulation study. Also included will be the environmental losses from the previous construction of the inlet and outlet channel.

209. As more conservation easements are purchased, these would be counted toward any compensatory mitigation requirements on the Yazoo Backwater pump station.

210. Under the recommended plan, the Vicksburg District has committed to the purchase of conservation easements from willing sellers on 62,500 acres of agricultural lands below elevation 87.0 feet, NGVD. As previously stated, the purchase of easements will begin as soon as real estate work could be completed and funds are made available. This process will run concurrently with the design of and construction of the pump station. One year after physical completion of the pump station, the Vicksburg District will evaluate its success in securing conservation easements from willing sellers. No additional conservation easements will be purchased after this timeframe. Should the District be unsuccessful in securing enough conservation easements to cover the compensatory mitigation requirements of the Yazoo pump station, the previous work on the inlet and outlet channel, those remaining losses from the timing of the mitigation for the Yazoo Backwater levee, and unforested areas within Lake George WMA, then the difference between the amount of conservation easements and the required compensatory mitigation will be purchased in fee title from willing sellers. This purchase in fee would first be evaluated in the Yazoo-Mississippi Delta, but if sufficient agricultural lands are not available, then the District would look elsewhere in the Mississippi Alluvial Valley. These lands would be reforested and eventually turned over to a state or Federal agency to manage.

OPERATION AND MAINTENANCE REQUIREMENTS

211. The Corps will be responsible for 100 percent of the O&M of the Yazoo Backwater pump. The local sponsor will be responsible for the minor maintenance of the inlet and outlet channel. This would consist of spraying or removal of woody growth from the channel. Some siltation in the inlet and outlet channel is anticipated and would be the responsibility of the Corps. During certain prolonged periods when the pumps are not in operation and river stages are at moderate levels (80-87 feet), some minor sedimentation is expected to occur in the approach to the inlet

channel of the pumps and in the outlet channel near the confluence with the Yazoo River. While sedimentation is not expected to be of any major concern, the control of growth in the deposited areas will need to be pursued possibly on an annual basis. Also, it is likely that removal of sediment accumulations (averaging about 1 foot in depth over the extent of the channels) once or twice in the life of the project may be necessary depending upon the sequence of hydrologic events which could result in deposition in the channels as described above. Material deposited in the outlet channel by the secondary currents of the Yazoo River may be returned to the Yazoo River without any significant impacts. Material deposited in the inlet channel will likely be disposed of in disposal areas adjacent to the pumping plant.

212. The pumping cost for the recommended plan was based on 31 days being the average annual days pumped which would utilize approximately 212,000 gallons of diesel fuel. Based on February 2000 fuel quotes, fuel costs were estimated at \$.86 per gallon. This generates a fuel cost of approximately \$183,000 annually. The pump station maintenance cost was estimated at \$812,000 annually.

213. Structural maintenance was estimated for the pump station with a major replacement scheduled at year 35 during the 50-year life of the project. Major replacement was estimated to cost \$21,083,000. The net present value of this cost was \$154,000 annually. The major replacement would involve the renovation or replacement of the diesel engines, axial flow pump, speed reducer, backstop device, and high and low speed couplings.

214. Once constructed, the pumping plant would be operated according to a pump operation manual. This operation plan would have to account for several factors. One factor would be that the diesel-driven pumps could not be instantaneously turned on all at the same time nor would all the pumps be utilized every time stages were predicted to exceed 87.0 feet, NGVD. Other factors that would have to be accounted for would be the forecast of inflows due to Mississippi River conditions, interior conditions (stages and ground conditions) and forecasted flooded and

weather conditions. In order to achieve the level of protection projected by the recommended plan, it is anticipated that some of the pumps would have to be turned on prior to stages reaching 87.0 feet, NGVD.

215. No O&M will be required on the 62,500 acres of easement lands since they will remain in private ownership. As stated earlier, these lands are presently open; and once an easement is secured, then reforestation will be initiated. The Corps will monitor these tracts after the initial reforestation effort, but once reforestation is determined to be successful, only occasional visual on-the-ground monitoring will be conducted. The District will primarily use remote-sensing techniques to monitor the land use of these easement tracts. However, if the Corps is unsuccessful in securing enough easements to cover the compensatory mitigation requirements of the pump and those remaining environmental losses from the construction of the Yazoo Backwater levee, the Lake George WMA, and inlet and outlet channel work, then the Corps will purchase in fee those lands above what has been offered for easements. O&M costs for the management of these compensatory mitigation lands will be funded. The annual costs will be based on how many acres had to be purchased in fee. O&M will be prorated based on the acres purchased times the O&M costs shown in the mitigation appendix.

PLAN ACCOMPLISHMENTS

216. The recommended plan has been formulated to meet the OMB's study directives. The plan provides for reduced agricultural intensification in that the pump size will be less than previously planned and the inclusion of the nonstructural feature. Although the recommended plan does not provide the same level of urban protection as the previously authorized plan, substantial urban flood control benefits will occur with construction of this plan. The recommended plan reduces urban and rural structure damage by 85 percent. Agricultural damages are reduced 39.4 percent. The recommended plan results in approximately \$324,000 of residual damages to urban and rural structures annually. The recommended plan also reduces adverse impacts on the environment. Through incorporation of a revised operation plan at Steele Bayou structure and the nonstructural

flood damage reduction feature, a net gain to environmental resources would occur. The nonstructural flood damage reduction feature will be accomplished concurrently with project construction. The nonstructural flood control measures will provide benefits to the national economy as the forest matures, landowners harvest the timber, and the cycle is repeated. Therefore, the recommended plan is environmentally sustainable, and as such, meets the requirements of the National Environmental Policy Act--"to create and maintain conditions under which man and nature can exist in productive harmony and fulfill the social, economic, and other requirements of present and future generations of Americans." This plan supports the Administration's Clean Water Action Plan by the restoration of wetlands through reforestation of agricultural lands. It also supports efforts to restore habitat in order to help the recovery of the two threatened/endangered species in the area. The plan provides an acceptable level of flood protection with a net gain to the environment and will allow residents of the area to pursue an orderly process of economic development and to improve their quality of life. The plan represents a rare opportunity to obtain significant bottom-land hardwood/wetland restoration, thus helping to achieve the management/ecosystem goals that have been established for this important area. It also fulfills the mitigation requirements for the Yazoo Backwater (3,617 acres) levee.

SUMMARY OF ECONOMIC, ENVIRONMENTAL AND OTHER SOCIAL EFFECTS

217. Table 18 shows the total first costs, annual costs, annual benefits, excess benefits, and benefit-cost ratio for the recommended plan under both the current interest rate and the authorized rate.

TABLE 18
ECONOMIC SUMMARY
RECOMMENDED PLAN
YAZOO BACKWATER REFORMULATION

Item	Alternative 5 <u>a/</u>	
	6-5/8 Percent	2-1/2 Percent
First Costs (\$000) <u>b/</u>	181,595	181,595
Annual Costs (\$000) <u>b/c/</u>	14,881	7,938
Annual Benefits (\$000) <u>c/</u>		
All benefit categories	22,002	23,114
Benefits with redevelopment benefits excluded	21,496	22,870
Excess Benefits Over Costs (\$000)		
All Benefit Categories	7,121	15,176
Benefits with redevelopment benefits excluded	6,615	14,932
Benefit-Cost Ratios		
All benefit categories	1.48	2.91
Benefits with redevelopment benefits excluded	1.44	2.88

a/ Recommended plan.

b/ February 2000 price levels.

c/ Annualized with use of appropriate discount rate factors and a 50-year expected project economic life.

218. Table 19 illustrates the environmental impacts for construction of the recommended plan.

219. Table 20 shows the System of Accounts. Four accounts, the NED, EQ, Regional Economic Development (RED), and Other Social Effects (OSE), are used to display impacts. These four accounts encompass all significant effects of a plan as required by the National Environmental Policy Act of 1969 and social well-being as required by Section 122 of the FCA of 1970. The NED account shows effects on the national economy. The EQ account shows the effects on ecological, cultural, and esthetic attributes of significant natural and cultural resources that cannot be measured in monetary terms. The RED account shows the regional incidence of NED effects, income transfers, and employment effects. The OSE account presents the urban and community impacts and effects on life, health, and safety.

TABLE 19
SUMMARY OF ENVIRONMENTAL IMPACTS FOR RECOMMENDED PLAN a/
YAZOO BACKWATER AREA REFORMULATION

Plan	Terrestrial Resources <u>b/</u>	Aquatic Resources <u>c/</u>	Wetland Resources <u>d/</u>	Waterfowl Habitat <u>e/</u>	Water Quality	Endangered Species
Completed Backwater Levee	Remaining loss of 173,288 AAHU's <u>f/</u> ; requires 3,617 acres of reforestation to offset.	No impacts remaining.	No impacts remaining.	No impacts remaining.	Past levee construction caused short-term increases in turbidity.	Work completed. No impact assessment.
Completed Pump Site	Net direct loss of 21,963 AAHU's <u>a/</u> ; requires 481 acres of reforestation to offset.	No impacts remaining.	No impacts remaining.	No impacts remaining.	Channel excavation caused short-term increases in turbidity.	Work completed. No impact assessment.
Plan 5	17.4 percent increase in terrestrial habitat value or 107,674 AAHU's. 38 acres of bottom-land hardwoods converted or a loss of 108 AAHU's. Hydrologic loss of 2,896 AAHU's on bottom-land hardwoods. Reforestation of 62,500 acres of bottom-land hardwoods or a gain of 110,678 AAHU's.	18.7 percent increase in flood plain spawning habitat values or 37,428 HU's. 38 acres of bottom-land hardwoods converted or a loss of 142 HU's. Hydrologic loss of 29,919 HU's on various habitats. Reforestation of 62,500 acres of bottom-land hardwoods or gain of 67,489 HU's.	23.5 percent gain of wetland functional value or 51,520 FCU's. 38 acres of bottom-land hardwoods and 110.5 acres of farmed wetlands converted or a loss of 463 FCU's. Hydrologic loss of 18,579 FCU's. Reforestation of 62,500 acres of bottom-land hardwoods or gain of 70,562 FCU's.	42.1 percent loss of waterfowl foraging habitat value or 873,432 DUD's. Direct loss of 38 acres of bottom-land hardwoods or 2,166 DUD's; hydrologic loss of 80,438 DUD's of waterfowl foraging habitat; reforestation of 62,500 acres of bottom-land hardwoods or loss of 790,828 DUD's.	Construction of structural features will cause a short-term increase in turbidity; reforestation of 62,500 acres of agricultural land will improve water quality over time.	An on-ground survey and biological assessment for <i>Lindera melissifolia</i> and <i>Ursus americanus luteolus</i> were completed. No colonies of pondberry were found in rights-of-way and no signs of Louisiana black bear were found. Biological assessment concludes that the project is not likely to adversely affect either species. No indirect or hydrologic impacts on either species. Reforestation of 62,500 acres will provide additional habitat.

a/ Terrestrial, aquatic, wetland, and waterfowl impacts include losses from the completed and reformulated portions of the Yazoo Backwater area. Water quality, ground water, and endangered species apply only to the reformulated portion of the Yazoo Backwater project area.

b/ AAHU = average annual habitat units.

c/ HU = units.

d/ FCU = functional capacity units.

e/ DUD = duck-use-days. Although reforestation results in a loss of waterfowl foraging habitat by all plans, there are other important waterfowl habitat requirements that are met with reforestation (loafing, pair, bonding, shelter, etc.) and that are notably absent in agricultural fields. According to the U.S. Fish and Wildlife Service, the overall benefit that results from reforestation far exceeds losses of foraging habitat.

f/ Utilized on older HEP model which valued the resource between 0 - 100 and measured different categories from the methodology currently being used.

TABLE 20
PROJECT ECONOMIC, ENVIRONMENTAL, SOCIAL, AND OTHER IMPACTS DISPLAY
BY SYSTEMS OF ACCOUNTS (NED, EQ, RED, OSE)
RECOMMENDED PLAN (ALTERNATIVE 5)
YAZOO BACKWATER AREA, MISSISSIPPI
(6-5/8 Percent Discount Rate)

Account/Parameter	Location of Impact	Type Impacts		Total (Net National Impact)
		Beneficial	Adverse	
1. NATIONAL ECONOMIC DEVELOPMENT (NED)				
a. <u>Annual Benefits (\$000):</u> Flood Control <u>6/9/12/ 13/</u>	Project Area	21,496	0	21,496
Employment <u>3/9/12/</u>	Study Area	506	0	506
Total NED Benefits		22,002		22,002
b. <u>Annual Costs (\$000):</u> Project Construction <u>3/6/9/12/</u>				
Federal	Rest of Nation	0	14,727	14,727
Operation Rehabilitation <u>3/5/9/12/</u>				
Federal	Rest of Nation	0	154	154
Total NED Costs			14,881	14,881
c. <u>Net NED Benefits/Costs (\$000):</u>		7,121	0	7,121 <u>1/</u>
d. <u>Benefit-Cost Ratio</u>		1.48	--	1.48
2. ENVIRONMENTAL QUALITY (EQ)				
a. <u>Environmental Quality Enhanced/Preserved/Protected:</u> * Natural resources <u>3/9/12/</u>	Project Area	Conversion of 62,500 acres of agricultural cropland in the Yazoo Backwater area hardwoods.	None.	
b. <u>Environmental Quality Degraded:</u> (1)* Air <u>3/6/9/12/13/</u>	Project Area	--	Project construction will add to residues in atmosphere from open-air burning, dust, and from operation of internal combustion engines.	Short-term degradation of air quality in the area.
	Study Area	--	Insignificant	No Significant impact.
(2)* Water/water quality <u>3/6/9/12/</u>	Project Area/ Study Area (Flood Plain)	Long-term water quality benefits by conversion of agricultural lands to forest will reduce direct and indirect nonpoint source pollution.	Adverse impact on water quality and aquatic habitat (ecosystem) in streams from project construction. Increased turbidity during construction will be temporary.	Adverse impact on water quality and aquatic habitat in area streams.

TABLE 20 (Cont)

Account/Parameter	Location of Impact	Type Impacts		Total (Net National Impact)
		Beneficial	Adverse	
c. <u>Environmental Quality Destroyed:</u>				
(1)* Natural resources <u>3/9/12/</u>	Project Area	--		
(2)* Manmade resources <u>3/9/12/</u>	Project Area			
3. REGIONAL ECONOMIC DEVELOPMENT (RED)				
a. <u>Income:</u>				
(1) Summary, annual benefits (\$000)				
Flood control <u>6/9/13/</u>	Project Area	21,496	0	21,496
Employment <u>6/9/13/</u>	Study Area	506	0	506
Regional Economic Development Indirect personal income increases with project construction (\$000) <u>6/9/10/13/</u>	Study Area	0	0	0
Total Benefits		22,002		22,002
(2) Excess Benefits Over Cost (\$000)		7,121		7,121
(3) Benefit-Cost Ratio		1.48		1.48
b. <u>Employment/Labor Force:</u> *				
(1) Project construction <u>3/9/11/12/</u>	Project Area	The total number of jobs created over the 3-year construction period is estimated at 1,000. Classification by skill level consists of 48 percent skilled, 24 percent semiskilled, 8 percent unskilled, 20 percent supervisory and administrative. Temporary impact.		Negligible.
	Study Area	Negligible, temporary.	--	Negligible.
(2) Project operation and maintenance <u>6/9/12/</u>	Project Area	Negligible.	--	Negligible.
(3) Indirectly induced jobs <u>3/8/12/</u>	Study Area	Negligible.	--	Negligible.
(4) Other regional employment impacts <u>3/6/8/13/</u>		Insignificant.	--	Insignificant.

TABLE 20 (Cont)

Account/Parameter	Location of Impact	Type Impacts		Total (Net National Impact)
		Beneficial	Adverse	
c. <u>Business and Industrial Activity: 5/8/12/</u>	Project Area	Temporary increase in activity.	--	Activity will increase temporarily.
	Study Area	Temporary stimulation of existing business and industrial activity by income increases, employment opportunities, multiplier, impacts, etc.	--	Temporary stimulation of existing business and industrial activity. Net beneficial effect.
d. <u>Tax Revenues: * 5/7/12/</u>	Study Area	Minor decrease in tax revenues expected, resulting from conversion of cropland to woodland.	--	Minor decrease in tax revenues expected.
e. <u>Property Values (\$000): 6/9/11/12/</u>	Project Area	Protected area land value will increase, particularly lands subject to being converted to nonagricultural use (residential, commercial, etc.).	--	Increase in value of flood-free lands.
f. <u>Desirable Regional Growth: 5/9/12/</u>	Project Area	Consistent with local and regional development plans	--	Compatible with local and regional planning.
	Study Area	--	--	--
	Rest of Nation	Insignificant.	--	Insignificant.
g. <u>Local Government Finance: 5/9/12/</u>	Study Area	--	--	--
h. <u>Public Facilities: * 5/8/12/</u>	Study Area	--	Negligible impact.	Negligible impact.
i. <u>Public Services: * 5/8/12/</u>	Study Area	--	Negligible impact.	Negligible impact.
j. <u>Displacement of Farms/Ownerships: * 3/9/12/</u>	Project Area	--	Potential for impacting farm property ownerships by acquisition requirements for project construction. Impacts on ownerships affected not expected to adversely impact existing farming operations of affected ownerships. <u>5/8/13/</u>	Negligible.
k. <u>Tax Rates: 6/8/12/</u>	Project Area	--		
	Study Area	--		

TABLE 20 (Cont)

Account/Parameter	Location of Impact	Type Impacts		Total (Net National Impact)
		Beneficial	Adverse	
4. OTHER SOCIAL EFFECTS (OSE) a. <u>Community Cohesion</u> : * <u>5/8/12/</u>	Project Area	Strengthened due to reduced flood threat and reduced flood damages.	--	Should improve standard of living.
	Study Area	Strengthened due to reduced flood threat and reduced flood damages.	--	Should improve standard of living.
b. <u>(Desirable) Community Growth</u> : * <u>5/8/12/</u>	Study Area	Temporary favorable impacts expected with project construction.	--	Insignificant.
c. <u>Population Growth</u> : <u>3/9/12/</u>	Study Area	Insignificant.	--	Insignificant.
d. <u>Noise</u> : * <u>6/9/12/</u>	Project Area	--	Increased noise levels during project construction. Negligible impact, most of construction not adjacent to populated area.	Increase in noise levels expected. Impact negligible.
e. <u>Displacement of People</u> : *	Project Area	--	No families would be displaced.	No displacement of families.
f. <u>Esthetic Values</u> : * <u>3/6/9/12/</u>	Project Area	--		
	Study Area	--	Negligible.	Negligible.
g. <u>Community Growth</u> : <u>5/8/12/</u>	Study Area	Project construction not expected to result in any real population increase. Some minor temporary increase during construction activity only.	--	Insignificant.

NOTE: Costs shown reflect October 1999 levels.

1/ Excludes redevelopment benefits.

2/ Excludes redevelopment benefits.

Timing:

3/ Impact is expected to occur prior to or during implementation of the plan.

4/ Impact is expected with 15 years following plan implementation.

5/ Impact is expected in a longer timeframe 15 or more years following implementation).

6/ Impact is expected over project life.

Uncertainty:

7/ The uncertainty associated with the impact is 50 percent or more.

8/ The uncertainty is between 10 and 50 percent.

9/ The uncertainty is less than 10 percent.

TABLE 20 (Cont)

Exclusivity:

10/ Overlapping entry; fully monetized in NED account.

11/ Overlapping entry; not fully monetized in NED account.

Actuality:

12/ Impact will occur with implementation.

13/ Impact will occur when specific additional actions are carried out during implementation.

14/ Impact will occur because necessary additional actions are lacking.

220. Other social effects are summarized in the following paragraphs.

a. Community cohesion and community growth will be strengthened from construction of the recommended plan due to the alleviation/reduction of flood damages and threat of flooding. No adverse impacts to community cohesion are anticipated.

b. Implementation of the recommended plan is not expected to have any significant impact on study area population trends.

c. Noise created by project construction will be a temporary nuisance with the project area absorbing the impacts of these noises. However, since most of the construction in the project area is not adjacent to a populated area, adverse impacts from noise will be minimal.

Conversion of agricultural cropland to bottom-land hardwoods for the nonstructural features of the recommended plan will provide beneficial impacts to the esthetic value of the area. Land disturbance during project construction will be remedied as construction is completed and vegetation recovers. Reduction in bottom-land hardwoods and wetlands due to project construction will create adverse impacts to esthetic values on the actual construction site. However, the establishment of a conservation easements from willing sellers with subsequent reforestation on 62,500 acres of agricultural lands will more than offset these losses.

PLAN IMPLEMENTATION

INSTITUTIONAL REQUIREMENTS

221. A draft report will be disseminated to Federal, state, and local agencies and concerned members of the public. A public meeting will be held to solicit comments from the affected community on the recommended plan. These comments will be incorporated into the final report to the maximum extent practicable.

MITIGATION MONITORING

222. Although compensatory mitigation is not a part of the recommended plan, it has been calculated. The Corps is committed to the fee title acquisition and reforestation of these lands should insufficient conversion of open land to bottom-land hardwoods be accomplished with conservation easements to ensure mitigation for the unavoidable losses from the recommended plan. Mitigation monitoring will not be a part of the recommended plan. Since 1991, terrestrial monitoring has been ongoing on the Lake George WMA which is within the study area. The Lake George Project is a nationally recognized restoration project. This monitoring project was implemented to evaluate terrestrial habitat replacement by the reforestation of agricultural lands. Projections of the terrestrial HU's gained over time were used to estimate the acres of terrestrial mitigation owed by a project. Should the monitoring efforts show different results than those projected by the biologists, then the amount of terrestrial mitigation owed on a project will be adjusted accordingly.

223. A wetland monitoring program has also been initiated by the Vicksburg District to evaluate not only the Lake George area, but other reforested areas by the Corps and FWS to determine if the wetland projections anticipated by the biologists to be gained under the seven

wetland functions will accrue. These seven wetland functions are short-term water storage, long-term water storage, water velocity reduction, sediment detention, onsite erosion control, nutrient and dissolved substance removal, and organic carbon export. Here too should results be different than projected, then adjustments to wetland mitigation will be undertaken.

DIVISION OF PLAN RESPONSIBILITY

224. Implementation of the recommended plan will be the responsibility of the Federal Government. The project sponsor will perform minor maintenance on the completed project. Minor maintenance on the project will involve the spraying and removal of woody growth from the inlet and outlet channels. This cost has been estimated at \$1,000/year. Acquisition of additional right-of-way required for construction of the pump station and the conservation easements from willing sellers will be the responsibility of the Corps. Should a compensatory mitigation plan become necessary, then the implementation of the mitigation plan will also be the responsibility of the Corps in conjunction with the other Federal and state agencies who assist with environmental resources and the local sponsor.

225. The Board of Mississippi Levee Commissioners for the Mississippi Levee District, a legally constituted body, maintains the existing project and has indicated that they will continue the responsibilities as local sponsor for the recommended plan. They have provided the necessary assurances as required.

a. Maintain the levees and levee drainage channels constructed under the project in accordance with provisions of Section 3 of the Act of May 15, 1928 (Public Law 391, 70th Congress).

b. Not raise said levee above the limiting elevations established therefore by the Chief of Engineers.

VIEWS OF LOCAL SPONSOR AND OTHER AGENCIES

226. Comments pertaining to the reformulation effort will be contained in Appendix 5. FWS has previously furnished a Planning Aid Letter to the Vicksburg District and their Coordination Act Report will be included in this report. As a part of the Planning Aid Letter, FWS indicated that they did not concur with the District's forecast that existing conditions would remain the same throughout the future without-project and have provided an alternative projection.

227. Projecting future land use is very difficult and involves a high degree of uncertainty. The Corps assumed that existing land use conditions would continue over the project life (Table 21). The FWS estimated that 43,432 acres of agricultural lands would be reforested in the study area primarily through the Wetlands Reserve Program over the project life (Appendix 2).

Approximately 30,293 acres would be reforested in the 2-year flood frequency event (=91 feet, NGVD). It was assumed that all reforestation in the 2-year flood frequency would occur on soybean lands. The Corps future without-project projection does not include any additional Wetland Reserve Program or Conservation Reserve Program lands since the two counties that primarily make up the study area, Sharkey and Issaquena Counties, have essentially reached their ceiling under these programs.

TABLE 21
EXISTING LAND USE
CORPS AND FISH AND WILDLIFE SERVICE (FWS)
FUTURE WITHOUT-PROJECT LAND USE
IN THE YAZOO BACKWATER STUDY AREA a/

Land Use	Existing Conditions	Corps Future Without-Project	FWS Future Without-Project
Soybeans	205,287	205,287	162,864
Cotton	71,939	71,939	71,939
Rice	44,793	44,793	44,793
Other Agriculture	39,031	39,031	39,031
Bottom-land Hardwood	204,218	204,218	246,641
Swamp	29,651	29,651	29,651
Rivers and Lakes	16,174	16,174	16,174
Ponds	18,628	18,628	18,628
Total	629,721	629,721	629,721

a/ Study area includes all lands in the 100-year flood frequency.

228. The following tables summarize the changes to the various resource categories under the recommended plan. A complete breakdown of these changes is included in the Supplemental Environmental Impact Statement.

TABLE 22
SUMMARY OF PERCENT CHANGES BY CATEGORIES
RECOMMENDED PLAN ONLY
CORPS FUTURE WITHOUT-PROJECT PROJECTIONS AND
FWS FUTURE WITHOUT-PROJECT PROJECTIONS

Resource Category	Percent Change Corps Future Without-Project Projections	Percent Change FWS Future Without-Project Projections
Bottom-land hardwoods	26.7	7.3
Agricultural lands	-17.3	-6.3
Waterfowl foraging habitat <u>a/</u>	-42.1	-2.2
Terrestrial resource value	17.4	7.0
Forested wetland functional value	29.2	21.1
Farmed wetland functional value	-10.4	-5.2
Aquatic flood plain spawning value	18.7	11.5

a/ FWS states the overall benefit from reforestation far exceeds the losses of foraging habitats.

TABLE 23
SUMMARY OF NET EFFECTS
ALL RESOURCE CATEGORIES
RECOMMENDED PLAN ONLY
CORPS FUTURE WITHOUT-PROJECT PROJECTIONS
AND FWS FUTURE WITHOUT-PROJECT PROJECTIONS

Resource Category	Corps Future Without- Project Projections	FWS Future Without- Project Projections
Terrestrial (AAHU)	107,674	47,417
Wetland (FCU)	51,520	37,936
Waterfowl (DUD) <u>a/</u>	-873,432	-46,761
Aquatic (HU)	37,428	24,825

a/ FWS states the overall benefit from reforestation far exceeds the losses of foraging habitats.

TABLE 24
COMPENSATORY MITIGATION AND MINIMUM THRESHOLD
FOR NONSTRUCTURAL REFORESTATION WITH CORPS
AND FWS FUTURE WITHOUT-PROJECT PROJECTIONS
(ALL PLANS)

Alternative	Corps Future Without- Project <u>a/</u> (Acres)	FWS Future Without- Project <u>a/</u> (Acres)
1	None	None
2	None	None
3	27,435 <u>b/</u>	29,787 <u>b/</u>
4	21,199	23,022
5	12,980	14,015
6	5,604	6,103
7	194	194

a/ Number of acres to reforest to achieve no-net-loss of environmental resource values.

b/ Denotes compensatory mitigation.

229. A review of the above tables reveals that the change in land use projections has only minimal effect on the environmental resource categories. Under the recommended plan, the minimum threshold for nonstructural reforestation to achieve a no-net-loss of environmental resource values would only vary by 1,035 acres.

230. On the economic side, the impacts of the FWS future without-project projections of an additional 43,432 acres of reforestation would tend to increase benefits of the recommended plan and could reduce costs.

231. If these lands are taken out of production and reforested, total returns to agriculture would decrease. Based on available data, it does not appear that returns from timber production or other typical uses of the reforested lands such as hunting leases would yield returns equal to those lost from agricultural production. There is a possibility that in the future some additional revenues could be generated from timber production from expenditures to reduce carbon in the atmosphere or from nitrogen load reduction, but at this time, these benefits are very speculative and were not considered in this analysis. Therefore, there would be a net loss of revenue to the regional economy. If under the conditions that are expected to exist with the recommended plan not all of these acres were reforested, then revenues to the region would be greater than under the without-project condition. This increased revenue would be considered a benefit to the recommended plan.

232. If some of the current agricultural lands below elevation 87 feet, NGVD, are reforested under another program, then the number of acres remaining to be reforested would be reduced. The costs of easements and reforestation costs for the recommended plan should be reduced to account for the lower number of acres to be reforested, and the cost to construct the recommended plan would decrease and the excess benefits over costs would increase.

SUMMARY OF COORDINATION, PUBLIC VIEWS, AND COMMENTS

233. Appendix 5 contains a summary of coordination activities of the Vicksburg District during the reformulation effort. Much additional interaction has occurred during this study in addition to that listed in Appendix 5. Intense coordination has been maintained with state and Federal agencies, local governments, and groups. The Vicksburg District had several facilitated

workshops to gather input into this report. The local sponsor (Mississippi Levee Board) attempted to build consensus on the project by the establishment of a consensus committee to work on this project. This group consisted of the following:

- Mississippi Board of Levee Commissioners
- U.S. Fish and Wildlife Service
- Delta Council
- National Wildlife Federation
- Mississippi Wildlife Federation
- U.S. Forest Service
- Issaquena County Board of Supervisors
- Natural Resources Conservation Service
- U.S. Army Corps of Engineers
- Mississippi Department of Environmental Quality
- Sierra Club
- Gulf Restoration Network
- Audubon Society
- Ducks Unlimited
- Mississippi Department of Wildlife, Fisheries and Parks
- South Delta Flood Control Committee

234. Although several environmental groups dropped out after the first meeting, the committee continued to meet and work on unresolved issues. Although a consensus among all the parties as to a recommended plan was never reached, many issues were discussed and resolved. Consensus building efforts are slated to continue while the draft report is undergoing review.

RECOMMENDATIONS

235. I recommend that improvements for flood control in the Yazoo Backwater Area, as discussed in this report, be approved for implementation as a Federal project with such modifications thereto as in the discretion of the Commander, U.S. Army Corps of Engineers, may be advisable and in accordance with the past cost-sharing and financing agreement which are satisfactory to the President and Congress. The total first cost of the project based on February 2000 price levels is \$181,595,000. O&M costs are estimated at \$995,000 annually. The fully funded cost of this project is \$207,178,000. In addition, I recommend that other Federal agencies develop programs whereby other agricultural lands in this area can be reforested.

236. The recommendations contained herein reflect the information currently available and current Departmental policies governing formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of a national Civil Works construction program nor the perspective of higher review levels within the Executive Branch. Consequently, the recommendations may be modified before they are transmitted to Congress as proposals for authorization and implementation funding. However, prior to transmittal to Congress, the sponsor, the States, interested Federal agencies, and other parties will be advised of any modifications and will be afforded an opportunity to comment further.

Robert Crear
Colonel, Corps of Engineers
District Engineer