US Army Corps
of Engineers
Memphis District

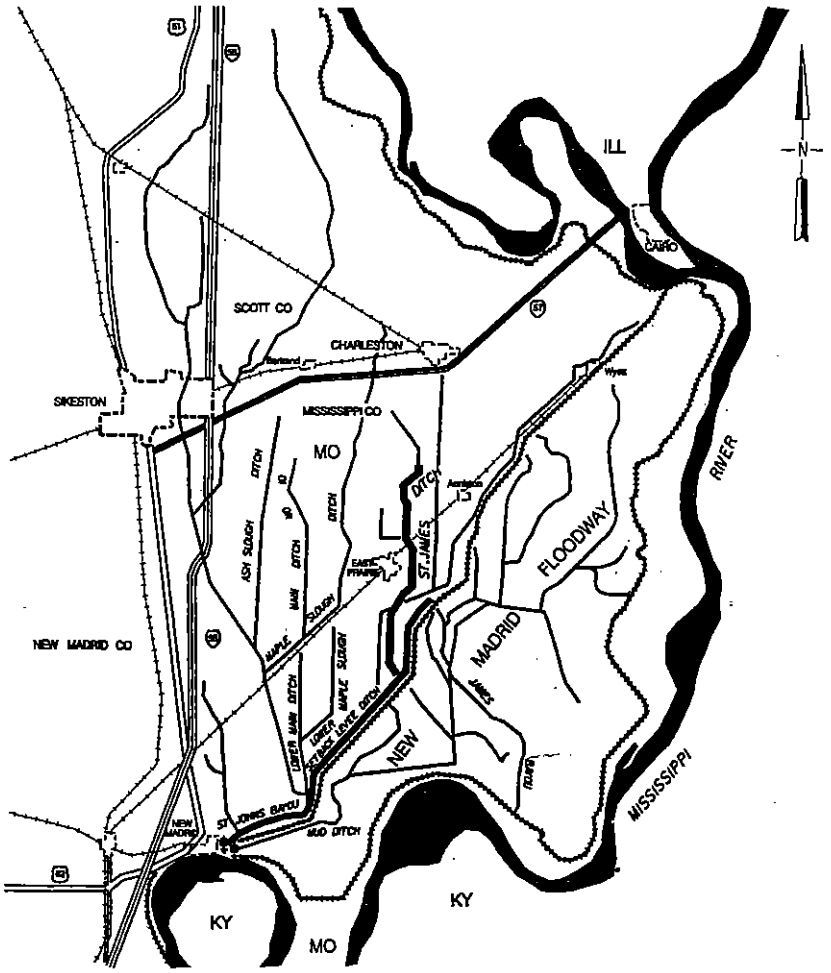
Flood Control, Mississippi River & Tributaries
St. Johns Bayou and New Madrid Floodway, MO
First Phase
Supplemental Environmental Impact Statement

Cooperating Agency:
U.S. Fish and Wildlife Service
Columbia, Missouri

Rumancik

FINAL

SEPTEMBER 2000



VOLUME I:

FINAL SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

SUPPLEMENT TO THE 1982 ST. JOHNS BAYOU-NEW MADRID FLOODWAY FINAL SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT AND THE MISSISSIPPI RIVER AND TRIBUTARIES PROJECT-MISSISSIPPI RIVER LEVEE AND CHANNEL IMPROVEMENT 1976 FINAL ENVIRONMENTAL IMPACT STATEMENT

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St. Johns Bayou and New Madrid Floodway, Missouri, First Phase
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The responsible lead agency is the Memphis District, U.S. Army Corps of Engineers. The responsible cooperating agency is the U.S. Fish and Wildlife Service, Columbia, Missouri.

ABSTRACT:

The St. Johns Bayou and New Madrid Floodway Project area is located in southeast Missouri and includes all or portions of New Madrid, Mississippi, and Scott counties. The study area extends from northeast of East Prairie, Missouri, southward to New Madrid, Missouri. The Memphis District and the U.S. Fish and Wildlife Service have investigated the environmental impacts associated with implementing the First Phase of this project. The First Phase includes channel enlargements and a 1,000 cubic feet per second (cfs) pumping station for the St. Johns Bayou Basin. In the New Madrid Floodway, the project includes closing the 1,500-foot gap in the Mississippi River levee, with a 1,500 cfs pumping station and gravity outlet in the closure. The purpose of the project is to provide flood control in both the St. Johns Bayou Basin and the New Madrid Floodway. In addition, the project is designed to eliminate the physical and economic impediments created by frequent flooding in East Prairie, Missouri, and the surrounding area. Nine alternatives were investigated in detail and are presented as the final array of alternatives.

The Avoid and Minimize Alternative is the preferred plan and incorporates several environmental features to reduce project impacts. These include reducing the width of channel work in St. Johns Bayou from 200 feet (with two-sided excavation) to 120 feet (with one-sided excavation); changing work to the right-descending bank along a portion of the St. James Ditch to avoid high quality woodlands; and eliminating work proposed on the upper 3.7 miles of the St. James Ditch to avoid the State-endangered golden topminnow. In addition, nine transverse dikes would be placed in the lower four miles of St. Johns Bayou, and conservation easements would be placed along all improved channels and allowed to revegetate to bottomland hardwoods. Gate operations were modified to facilitate fish passage between the river and the two basins. Mussels would be relocated prior to construction, and a nine-foot strip of mussel habitat along one side of the Setback Levee Ditch would be avoided. A 10-year mussel-monitoring plan will also be developed. Water levels in the lower project area would be managed, providing up to 6,400 acres of flooded land for winter and early spring waterfowl.

There would be direct impacts from project construction on 706.5 acres, of which 167 acres are wetlands. The major impact of the project would be reduced flooding in the New Madrid Floodway and the St. Johns Bayou Basin. The area of reduced flooding includes 36,056 acres of wetlands, most of which are in crop production. Although these wetlands would not be drained, there would be some impairment of functional value based primarily on reduced

connectivity to the river. To compensate for project impacts, 9,557 acres of seasonally inundated agricultural land would be restored to bottomland hardwoods. Additionally, flood easements would be purchased on 765 acres of herbaceous land to benefit shorebird and fish habitat.

This Final Supplemental Environmental Impact Statement evaluates the effects of each project component on the study area's significant resources. Economic costs and benefits vary with each component and alternative. The estimated cost of the preferred plan, including mitigation, is $65,133,000. The levee closure has a benefit-to-cost ratio of 2.6 to 1. All other project features have a benefit-to-cost ratio of 1.2 to 1. The preferred alternative is also the National Economic Development (NED) Plan.

Send your comments to the District Engineer by _____ at the following address:

District Engineer, U.S. Army Engineer District, Memphis
ATTN: Environmental and Economics Analysis Branch
167 North Main Street, B-202
Memphis, Tennessee 38103-1894

If you would like further information on this statement, please contact Mr. John Rumancik at (901) 544-3975.

SUMMARY

S.1 SUMMARY OF IMPACTS

Construction of the New Madrid levee closure and channel enlargement in St. Johns Bayou would directly impact 706.5 acres, consisting of 484.5 acres of wooded ditchbank and BLH and 222 acres of cropland. Of the total acres, 167 acres are classified as wetlands.

The primary impact of the project would be reduction of flooding in both basins. The Corps determined, based on criteria of the 1987 Wetlands Delineation Manual for 5 percent continuous inundation or saturation during the growing season, that there is a total of 67,396 wetland acres in both basins. It was further determined that project implementation could cause a reduction in flooding on 36,056 acres that meet this criteria (6,680 acres in the St. Johns Bayou Basin and 29,376 acres in the New Madrid Floodway).

Of these 36,056 impacted acres, 5,703 acres are bottomland hardwood forest, 27,425 are cropland, 1,846 are herbaceous fields, and 1,082 are pasture, marsh, and open water. Although the project would cause a reduction in inundation of these lands, they would still retain wetland characteristics and maintain either inundation or saturation requirements for wetlands based on the Wetland Delineation Manual criteria. The habitat on the majority of croplands during springtime flooding is predominantly bare earth and six-inch soybean stubble. When planted in crops, the land is regularly irrigated throughout the summer.

A major concern of reviewers of the draft EIS was that many of these lands might no longer meet jurisdictional criteria for wetlands after project implementation and, thus, no longer be subject to regulatory controls. Also, jurisdictional status for farmlands is regulated by the NRCS based on criteria established by the Food Security Act. This criteria is more stringent than that used by the Corps and mandates that croplands be inundated for 10 percent, or 15 consecutive days, during the growing season (whichever identifies the most wetland acres) to be classified a jurisdictional "farmed wetland". Croplands with wetland characteristics that did not meet this inundation criterion are classified as prior converted or PC farmlands and are not subject to regulatory controls. Based on mapping methodology used by the NRCS for the project area, very few of the acres received a farmed wetland classification.

There was much concern that most of the croplands were actually farmed wetlands which would no longer meet the criterion for inundation following project construction and, thus, lose jurisdictional status and regulatory oversite. Because of this, the Corps performed additional hydrological analysis to determine the amount of area that was subject to 15 consecutive days of inundation and determined that of the 27,425 acres of croplands, 9,526 acres meet this criterion and are potentially classifiable as FW. The remaining 17,899 acres of cropland do not meet the requisite inundation criteria under the FSA, thus, validating their PC classification. Further analysis revealed that of the 9,526 acres potentially eligible for FW classification, 7, 263 acres may no longer receive this level of inundation post-project and, thus, may no longer meet criteria for farmed wetland.

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Jurisdictional status of all other project lands would not change. Forestlands would still meet requirements of the Wetlands Delineation Manual and would continue to be subject to the Corps 404 regulatory program. Although wetlands would not be drained, there would be some impairment of functional value based primarily on reduced connectivity to the river. Reduced inundation is the major impact of the proposed project and the focus of the mitigation effort.

The interagency Habitat Evaluation Procedure (HEP) team determined that impacts of reduced inundation would be assessed by measuring mid-spring impacts on fish spawning and rearing habitats within the 2-year floodplain in both basins. The method considers the life history requirements of most fish throughout the entire spawning season and best represents the frequent flood events and habitat changes for a larger number of floodplain and riverine species. As a consequence, mitigation based on these impacts would benefit most of the fish and wildlife. High fish diversity generally represents high quality of the wetland environment. Therefore, mitigation of fishery habitat impacts would also serve to compensate for many other impacts relating to wetland function and value.

The mitigation plan includes restoring 9,557 acres of frequently flooded cropland to BLH and acquiring spring flooding easements on 765 acres of herbaceous land to benefit both shorebirds and fish. Water levels could be manipulated on up to 6,400 acres to maximize winter waterfowl habitat. Furthermore, restrictive easements along the channel ROW, instream structures, and other avoid and minimize measures were included in the environmental design. The mitigation plan also includes measures to benefit the management of the Big Oak Tree State Park. The environmental features incorporated into the Avoid and Minimize Alternative would fully mitigate significant fish and wildlife losses.

S.2 PROJECT OVERVIEW

The purpose of the project is to provide flood control in the St. Johns Bayou Basin and New Madrid Floodway. In addition, the project is designed to reduce the physical and economic impediments created by frequent flooding in East Prairie, Missouri, and the surrounding area.

The overall St. Johns Bayou and New Madrid Floodway Project was originally authorized for construction by the Water Resources Development Act of 1986 (PL 99-662), Section 401(a). The authorized project is based on the Report of the Chief of Engineers, dated January 4, 1983, which is part of the Phase I General Design Memorandum (GDM) documents prepared in response to Section 101(a) of the Water Resources Development Act of 1976 (PL 94-587). The Phase II GDM is based on the Phase I GDM project recommendations and was prepared under the Office of the Chief of Engineers authority for continuing planning and engineering studies on a viable project while awaiting project authorization.

Revisions were made in the Phase II GDM to indicate the non-Federal cost-sharing requirements reflected in the authorizing Act, PL 99-662. The project was suspended in 1989 because the local sponsor could not meet the cost-sharing requirements. The designation of East Prairie, Missouri, as an Enterprise Community by the Administration provided momentum toward implementation of the First Phase of the overall project. Throughout this document, the First Phase of the overall project will be referred to as either the Authorized Project or the Authorized Plan. The Water Resources Development Act (WRDA) of 1996 authorized the use

of U.S. Department of Agriculture (USDA) funds to reduce the local non-Federal share of project costs to five percent. In late FY 96, funds were reprogrammed to the project to initiate Pre-construction, Engineering and Design (PED) activities associated with this phase. In FY 97, the House of Representatives Energy and Water Development Appropriations Bill urged the completion of pre-construction activities within six months and provided new-start construction funds.

The St. Johns Bayou and New Madrid Floodway Project is composed of two interrelated parts: (1) the St. Johns Bayou Basin part; and (2) the New Madrid Floodway part. This supplemental environmental impact statement evaluates impacts for the total project, but also includes separate analyses for each basin. The authority for closing the New Madrid Floodway gap in the Mississippi River levee was granted under the Flood Control Act of 1954 as part of the Mississippi River Levee feature of the Mississippi River and Tributaries (MR&T) Project. Construction of this component of the mainline levee system was suspended because of difficulties in obtaining rights-of-way (ROW) and lack of local support.

The Draft Supplemental Environmental Impact Statement (DSEIS) was prepared to supplement both the 1982 St. Johns Bayou/New Madrid Floodway Project Final Supplemental Environmental Impact Statement (FSEIS) and the 1976 Mississippi River Levees and Channel Improvement FEIS. The DSEIS incorporated environmental resource information and related significant resource priorities and mandates not reflected in previous documents. The impacts of the 1,500-foot New Madrid Floodway levee closure were included for detailed evaluation in the DSEIS for the St. Johns Bayou and New Madrid Floodway Project because the closure is interdependent with the construction of other components of the project.

The DSEIS was submitted to the public for review and comment in April 1999. Comments were received from the Department of the Interior U.S. Fish and Wildlife Service (USFWS), Missouri Department of Conservation (MDC), Missouri Department of Natural Resources (MDNR), private environmental groups, the Environmental Protection Agency (EPA), and the public. In these comments, the agencies requested the Corps to expand and clarify portions of the main report and various appendices such as Alternatives Considered, Water Quality, Wetlands, Economics, and Mitigation. As a result, changes were made to the appropriate sections and are now part of this Final Supplemental Environmental Impact Statement (FSEIS). A copy of the Comments and Responses document is included in Appendix L of this report. After the comments on the FSEIS have been reviewed and analyzed, Section 401 Water Quality Certification will be requested from the State of Missouri.

The First Phase of the St. Johns Bayou and New Madrid Floodway Project (Authorized Project) consists of channel enlargement and improvement in the St. Johns Bayou Basin along the lower 4.5 miles of St. Johns Bayou, beginning at New Madrid, Missouri, then continuing 8.1 miles along the Birds Point New Madrid Setback Levee Ditch and ending with 10.8 miles along the St. James Ditch. The first item of work, consisting of selective clearing and snagging, has already been completed along a 4.3-mile reach of the Setback Levee Ditch beginning at the confluence with St. James Ditch (Plate 1). The impacts of that work were evaluated in the Limited Reevaluation Report (LRR) and supporting Environmental Assessment for the First Phase of the overall project (U.S. Army Corps of Engineers 1997).

The project also includes a 1,000 cubic feet per second (cfs) pumping station that would be located a few hundred feet east of the existing gravity outlet at the lower end of St. Johns Bayou. The 1,500-foot gap in the Mississippi River levee at the lower end of the New Madrid Floodway would be closed. A 1,500 cfs pumping station and gravity outlet structure would be built in the levee closure at the lower end of the New Madrid Floodway (Plate 2). The channel enlargement work and pumping stations are features of the St. Johns Bayou and New Madrid Floodway Project, and the levee closure is a Mississippi River Levee Project feature. The impacts attributed to the St. Johns Bayou and New Madrid Floodway Project will be cost shared with the local sponsor, and other features will be funded under the Mississippi River Levee Project.

The Avoid and Minimize Alternative is the preferred plan and incorporates several environmental features to reduce project impacts. These include reducing the width of channel work in St. Johns Bayou from 200 feet (with two-sided excavation) to 120 feet (with one-sided excavation); changing work to the right-descending bank along a portion of the St. James Ditch to avoid high-quality woodlands; and eliminating work proposed on the upper 3.7 miles of the St. James Ditch to avoid the State-endangered golden topminnow. In addition, nine transverse dikes would be placed in the lower four miles of St. Johns Bayou, and conservation easements would be placed along all improved channels and allowed to revegetate to bottomland hardwoods (BLH). Gate operations were modified to allow fish passage between the river and the two basins. Mussels would be relocated prior to construction, and a nine-foot strip of mussel habitat along one side of the Setback Levee Ditch would be avoided. A 10-year mussel-monitoring plan would also be developed. Water levels in the lower basin and floodway can be managed to provide up to 6,400 acres of flooded land for winter and early spring waterfowl.

Direct impacts that would result from project construction total 706.5 acres, of which 167 acres are classified as wetlands. The major negative impact of the project is reduction of natural spring backwater flooding into the New Madrid Floodway from the Mississippi River. The project would reduce the duration and frequency of Mississippi River backwater and St. Johns Basin headwater flooding on a total of 55,000 acres in the St. Johns Bayou Basin and 75,078 acres in the New Madrid Floodway. Of these, there are 6,680 acres of wetlands in the St. Johns Bayou Basin and 29,376 acres of wetlands in the New Madrid Floodway, for a total of 36,056 acres. Most of the wetlands are croplands. Total acres affected by various flood events are shown in Table S-1.

To compensate for project impacts, 9,557 acres of seasonally inundated agricultural land would be restored to bottomland hardwoods. Additionally, flood easements would be purchased on 765 acres of herbaceous land. The mitigation land would be located as large tracts in the lower reaches of both basins or adjacent to the project area. Specific mitigation sites will be selected in cooperation with the USFWS and the MDC after the Record of Decision has been signed.

Table S-1. Existing Flood Frequencies and Inundated Acres in St. Johns Bayou Basin and New Madrid Floodway

St. Johns Bayou Basin		New Madrid Floodway	
Event	Acres	Acres	Total
2-yr.	13,200	17,293	30,493
5-yr.	30,032	35,381	65,413
10-yr.	34,155	53,519	87,674
25-yr.	40,073	70,108	110,181
30+yr.	55,000	75,078	130,078

The Memphis District asked that the USFWS (on April 16, 1997) serve as a cooperating agency in preparation of the DSEIS to evaluate the impacts of construction of the East Prairie feature of the St. Johns Bayou Basin and New Madrid Project and a 1,500-foot levee closure at the southern end of the New Madrid Floodway. The USFWS agreed to serve in this capacity in a May 6, 1997, letter from the Columbia, Missouri, Field Office. The stated USFWS role was one of technical assistance to the Corps within their areas of special expertise and authority. USFWS activities included providing scoping comments, assistance in developing and approving scopes of work for contract environmental studies, conducting wildlife resource studies and analyses, and review and comment on environmental studies, preliminary drafts, and final SEIS. The USFWS analyses regarding the effects of the project on fish and wildlife resources were incorporated into this document. The USFWS Coordination Act Report is presented as Appendix C. The USFWS played the same role with respect to this FSEIS.

S.3 MAJOR CONCLUSIONS AND FINDINGS

S.3-1 Needs

The lower part of the New Madrid Floodway has traditionally flooded from Mississippi River backwaters. The St. Johns Bayou Basin has undergone coincidental flooding whenever the St. Johns Bayou control gates are closed at high river stages. While other areas along the Mississippi River Valley obtained flood control benefits from the levees, this area has continued to experience difficulties because the levee gap has never been closed. From 1993 to 1997, heavy rains and high Mississippi River stages increased the urgency for some form of flood control in the project area (Plate 3). Agriculture has been severely impacted as a result of frequent flooding in the area. Planting has sometimes been delayed until July. Net farm income is substantially lower than optimum because of crop yield decreases and production cost increases caused by inefficiencies resulting from flooding. Floodwaters regularly damage public electric, water, and sewer utilities and disrupt businesses, schools, and residences. Flooded roads prevent the normal flow of goods and services within the project area, which results in economic losses, disruption, and adverse quality of life impacts. There is widespread public support for a

project that would provide flood control within the project area. The project is needed to provide both flood control and flood protection to the St. Johns Bayou Basin and the New Madrid Floodway.

East Prairie, Missouri, is of concern to this project, but is only one segment of the overall project for his three-county area. The community identified flooding as the primary impediment to its future prosperity. The town was designated an Enterprise Community (EC) by the Administration in December 1994, one of a handful of such communities across the nation. East Prairie was selected because it met eligibility criteria regarding size, poverty, unemployment, and general distress. As part of its implementation program, the town chose the St. Johns Bayou and New Madrid Floodway Project to improve the quality of life and living conditions for its many underprivileged residents. In addition to East Prairie, several other small communities such as Pinhook, would benefit socially and economically from the flood protection that would be provided by the project.

S.3-2 Rationale for Designation of NED Plan

The National Economic Development (NED) plan is defined as the plan that reasonably maximizes net beneficial contributions to national economic development. In keeping with recommendations by the USFWS, an array of nonstructural and smaller structural alternatives (Alternative 9) was investigated to address the project purpose of flood control. These alternatives were evaluated and found to be infeasible from a benefit-to-cost standpoint, with the exception of Alternative 5, which would provide improvements only in the St. Johns Bayou Basin. Although Alternative 5 is economically feasible, it does not maximize the net positive effect to the nation's economy and therefore was not chosen as the NED plan. However, all of the elements of Alternative 5 are analyzed in Alternative 3 the Avoid and Minimize Alternative. Alternatives that were found to be economically infeasible were not recommended for detailed analyses because they would have a net negative effect on the nation's economy.

Alternative 2 is the Authorized Project Alternative. Alternative 3, the Avoid and Minimize Alternative, avoids many of the potentially environmentally sensitive areas and includes features to lessen the potential detrimental effects when these areas cannot be avoided. After all the environmental effects of Alternative 2 are fully accounted for economically, it becomes evident that Alternative 3 is the NED plan.

S.3-3 Rationale for Designation of the Preferred Plan

Alternative 3, the Avoid and Minimize Alternative, is the preferred plan because it provides a net economic benefit to the area and causes less adverse environmental impacts than the Authorized Plan. Separate economic analyses were conducted for the levee closure feature and all other project features because they would be funded under different project authorities. The estimated cost of Alternative 3, including mitigation, is $65,133,000 ($22,914,000 for the levee closure portion and $42,219,000 for all other project features). This alternative provides annual net benefits of $930,000 for the levee closure portion and $891,000 for all other project features. The benefit-to-cost ratio is 2.6 to 1 for the levee closure and 1.2 to 1 for all other project features. The alternative meets the study objective of flood control, by reducing flooding

problems in both basins. This alternative increases agricultural productivity and satisfies the needs of East Prairie, Missouri, and the overall project area. The alternative includes wetland and fish and wildlife conservation measures and mitigates unavoidable adverse impacts by reforesting 9,557 acres of frequently flooded agricultural land to bottomland hardwood forests. This alternative and the associated mitigation would also improve the water quality of both basins as well as the Mississippi River. The mitigation plan for the proposed action is presented in Appendix B.

S.3-4 Section 404(b)(1) Findings

The project features of the preferred plan were evaluated in keeping with Section 404(b)(1) of the Clean Water Act, Guidelines for Specifications of Disposal Sites for Dredged or Fill Material, published by EPA. These evaluations are included in Appendix G of this report. The potential for environmental impacts of disposal activities from channel enlargement was estimated on the basis of currently available engineering design data and physical, chemical, and biological data resulting from this and other studies. Efforts were made to identify the least environmentally damaging practical alternative for disposal sites.

No violations of applicable State of Missouri water quality standards were found other than for turbidity during construction operations. Construction methods would be employed to minimize the possibility of violating the Toxic Effluent Standards of Section 307 of the Clean Water Act. The Corps has completed formal consultation with the USFWS to address endangered or threatened species issues.

It was found that the proposed material discharges would not cause or contribute to significant adverse effects on human health; the life stages of organisms within the aquatic ecosystem; or ecosystem diversity, productivity, and stability. Also, no significant impacts were identified with respect to recreational, aesthetic, or economic values. All the excavated material disposal sites are found to be in compliance with Section 404 Clean Water Act guidelines.

The project would reduce flooding on 36,056 acres of wetlands for both basins, of which 5,703 acres are forested wetland, 27,425 acres are wet cropland, 1,846 acres are herbaceous fields, and 1,082 acres are pasture, marsh, and open water (Plate 4). Hydrologic, geotechnical, and regulatory functions analyses indicate that these lands will remain wetlands, as defined by current U.S. Army Corps of Engineer (USACE) guidelines, even if periodic river inundation is reduced. Therefore, the primary impact on these lands would relate to the reduction of periodic inundation. Most other wetland and wildlife habitat functions would remain.

The mitigation feature of 9,557 acres of reforested wetlands would provide higher quality habitat than the flooded bean fields in the New Madrid Floodway. In addition to improving wildlife and fishery habitats, the reforested areas may improve water quality in both basins and in the Mississippi River. With the installation of water wells as part of an agreement between the MDNR and USACE, Big Oak Tree State Park could have water available for inundation use earlier than under existing conditions and at times when Mississippi River stages are not high enough to reach the park. Recent water quality analyses indicated that groundwater concentrations of phosphorus and nitrogen were comparable to surface/backwater

concentrations, and the nutrient supply to the park is likely to be adequate with the groundwater supplement. In addition, park managers would be able to manipulate water levels to mimic the natural river flood cycles.

S.3-5 Executive Order 11988, Floodplain Management Findings

Portions of the project would be constructed in floodplains. All non-structural alternatives were eliminated during screening for economic reasons. Section 5 of this report describes the beneficial and adverse impacts of each alternative in the final array of alternatives and describes any expected losses of natural floodplain benefits. Views of the general public and resource agencies have been obtained at numerous meetings. All alternatives were designed to minimize, to the extent practical, adverse impacts to floodplains. The preferred plan is responsive to the planning objectives and is consistent with the requirements of Executive Order 11988. It was selected because it is the most cost-effective means for reducing the hazards associated with the area's flooding. Various operational measures for the proposed pumping facilities (such as increasing start/stop elevations) have been incorporated to minimize impacts to the floodplain.

The recommended mitigation plan includes reforesting 9,557 acres of frequently flooded agricultural land as mitigation for floodplain habitat losses and purchasing 765 acres of shorebird easements. The mitigation plan would also mitigate other losses that may be associated with unmeasurable wetland functional values. If mitigation lands are located within each basin, reforestation would improve overall floodplain habitat and water quality within the New Madrid Floodway and the St. Johns Bayou Basin.

S.3-6 Executive Order 11990, Protection of Wetlands Findings

One objective of flood control projects is to minimize adverse impacts to the long-range productivity of wetlands and forests. Although efforts were made to minimize direct construction impacts to 167 wetland acres required for direct construction, there were no practical alternatives to locating some project construction features in these wetlands. Adverse impacts to wetlands are discussed in Section 5 of this report. The preferred plan is responsive to the planning objectives established for the study and is also consistent with the requirements of Executive Order 11990. It minimizes direct construction impacts along channel enlargement reaches by avoiding high-quality areas and reducing the width of the channel. In addition, it recommends mitigating direct losses to wetland habitats as part of the reforesting of 9,557 acres of frequently flooded agricultural land.

Backwater inundation on wet croplands and bottomland hardwood forests within the project area would be reduced with the closure of the New Madrid Floodway, and placement of drainage pumps in the New Madrid Floodway and the St. Johns Bayou Basin. Also, channel modifications in the St. Johns Bayou Basin would result in reductions in the frequency and duration of overbank flooding. Reduced inundation relating to wetland determinations is addressed in Appendix J. The Corps' jurisdictional status of non-cropland (forested, herbaceous, etc.) wetlands in both basins would not change, however, there would be a reduction in lands eligible for NRCS designation as farmed wetlands (FW) on up to 7,263 acres.

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Wetlands, including farmed wetlands, will continue to exhibit wetland characteristics because the existing topography, rain water supply, surface and sub-soil characteristics, and water table will not change and will produce a median continuous inundation or saturation for at least five percent of the growing season. The Mississippi River will continue to influence the water table, and inundation or saturation will continue to occur during the spring and early summer when the river is at high stage and rainfall is plentiful. This determination was based on evaluations performed by Corps hydraulic and geotechnical engineers and regulatory functions biologists. It is supported by the fact that there are jurisdictional wetlands above the limits of backwater inundation in both basins (see plates 3, 4 and 5). This is explained in more detail in Appendix D of the SEIS.

Mitigation for the impacts incurred due to project implementation were evaluated using Habitat Evaluation Procedures (HEP) for terrestrial analysis, shorebird analysis, and fishery analysis, and the Waterfowl Assessment Methodology for the waterfowl analysis. Fishery reproduction is a wetland function that can be reasonably quantified since the life history of fishes that occur in the project area is relatively well documented. Other wetland functions (e.g., nutrient cycling, maintenance of water quality, organic export) are more difficult to quantify, but high fish diversity generally indicates that wetlands are of high quality. Therefore, mitigation of fishery habitat losses would compensate for impacts to other wetland functions.

Floodplain fishery impacts associated with the project include shallow, infrequently flooded areas in cleared fields (i.e., agricultural and fallow land) that may not be used extensively by larval fish, but may provide other important wetland functions that are difficult to quantify. These impacts would be mitigated by reforesting 9,557 acres (1,318 acres to mitigate impacts for the St. Johns Bayou Basin and 8,239 acres for the New Madrid Floodway impacts) of frequently flooded agricultural land. The proposed mitigation plan would double the forested acres presently within both basins.

S.3-7 Wetland Impact Analysis Summary

The Corps prepared general wetlands maps of the St. Johns Bayou Basin and New Madrid Floodway for environmental impact analyses, environmental planning, and resource inventory purposes. The wetlands maps were developed from satellite imagery, hydrologic data, and soils data using the general criteria for Corps jurisdictional wetland delineations, percent dominance of hydrophytic vegetation, frequency and duration of flooding during the growing season, and the presence of hydric soils. Because the project area is so large, it was not possible to map wetlands to the degree of detail provided in evaluations of Section 404 permits for small areas. The project area was found to contain approximately 67,396 acres of wetlands comprised of 75 percent croplands, 15 percent bottomland hardwood forests, and 10 percent marsh, open water, and pastureland.

Impact analyses indicate that the preferred plan would reduce inundation on an estimated 36,056 acres of wetland, of which 76 percent is cropland. Most (21,792 acres) of the affected wet croplands are in the New Madrid Floodway. The St. Johns Bayou area contains about 5,663 acres of affected wet cropland. Most of the total 27,425 acres of cropland are primarily in

soybean fields that require frequent summer irrigation every year. Most of these cropland areas are not classified by the NRCS as farmed wetlands, and do not meet requisite inundation criteria for FW based on the FSA. However, they were considered wetlands for the purposes of project planning and impact analyses, based on satellite imagery, hydrologic data, soils data, and field verification by Corps regulatory functions biologists. All aspects of wetland delineation and verification were coordinated with the USFWS and the MDC.

The 1987 Wetlands Delineation Manual requires that wetlands must have continuous inundation or saturation for five percent of the growing season. This level of inundation occurs at the 289.4 feet NGVD elevation in the St. Johns Bayou Basin and at the 290 feet NGVD elevation in the New Madrid Floodway. The Food Security Act (FSA) criteria for farmed wetlands are lands inundated for 15 consecutive days or 10 percent of the growing season (whichever is less). In a letter dated May 29, 1998, the NRCS designated the vast majority of the wet croplands in the project area (85.3 percent in the St. Johns Bayou Basin and 90.9 percent in the New Madrid Floodway) to be prior converted cropland (PC) and not subject to regulation under Section 404 of the Clean Water Act. NRCS classified 0.4 percent of the wetlands in the St. Johns Bayou Basin and 0.4 percent of the wetlands in the New Madrid Floodway as farmed wetlands (FW).

To ensure that all wetland impacts were evaluated, the Corps considered a worst-case scenario when determining potential wetland impacts. The affected acres are illustrated in Table S-2.

Table S-2. Wetland Acres Evaluated and Mitigated by the Corps in St. Johns Bayou Basin and New Madrid Floodway

Total Wetland Area in Both Basins From the Wetland Scene	67,396
Total Wetlands with Reduced Inundation (below 300 ft. NGVD)	36,056
Forested Wetlands	5,703
Wet Cropland (PC & FW)	27,425
Herbaceous Fields	1,846
Pasture, Marsh, and Open Water	1,082

Although the NRCS has overriding authority regarding PC and FW classifications, for the purposes of this project, and to account for all potential wetland impacts, the Corps evaluated impacts of reduced inundation and construction on all areas that met the Corps and NRCS hydrology classification for wetlands or farmed wetlands. The evaluation covered effects on fisheries, waterfowl, and shorebirds. This resulted in more mitigation land than what would have been required by using the NRCS classification to determine wetland impacts.

The jurisdictional status of non-cropland (forested, herbaceous, etc.) wetlands would not change in either basin. Of the croplands within this area, 7,263 acres are wet croplands that may no longer be eligible for classification as farmed wetlands based on the FSA criterion of 15 consecutive days of inundation.

The NRCS has stated in correspondence that application of the most recent mapping conventions would result in additional farmed wetland designations in the area. However, by considering all lands meeting wetland hydrology, based on the 1987 Wetlands Delineation Manual as being wetlands, the aforementioned "additional farmland" was automatically included within the Corps' evaluation. In the same correspondence, the NRCS also stated that the information the Corps had developed on agricultural wetlands in the project is good for project planning and impact analysis. No existing forested wetlands would be converted to cropland or other uses as a result of the project, and all existing wetlands not required for direct construction will remain as wetlands. Thus, the existing jurisdictional status of all wetlands (based on the 1987 Wetlands Delineation Manual) would remain unchanged with or without the project.

There was concern that some wetland functions may be difficult to quantify and mitigate. Since life history of fishes is relatively well documented in the project area, fishery reproduction is a wetland function that can be reasonably quantified. High fish diversity generally represents high quality of the wetland environment. Therefore, mitigation of fishery habitat impacts would compensate for impacts to other wetland functions. The Corps originally proposed mitigating all spawning habitat, and rearing losses associated with reduced BLH flooding, by reforesting 6,396 acres. Even though fishery losses would have been fully mitigated according to the HEP based on minimum depth and duration criteria, the USFWS requested mitigation for all lands (including cleared cropland) that flood within the two-year floodplain, regardless of depth and duration. The proposed 9,557 acres to be reforested as mitigation would compensate fishery habitat losses (both spawning and rearing) and other wildlife functions. In conjunction with the proposed mitigation, flood easements for shorebird mitigation would be purchased on 765 acres of herbaceous lands. With these lands, all proposed direct and indirect impacts related to fish and wildlife would be fully mitigated. As a result, the environmental design and resulting compensation features to fish and wildlife for the project, as determined by the USFWS HEP, would result in net gains by the following amounts:

Terrestrial	115%
Waterfowl	1,073%
Shorebird	100%
Fishery Rearing	100%
Fishery Spawning	285%

Wetlands and related fishery impacts, as well as mitigation features, are discussed in greater detail in Appendix D, Section 5, and Appendix C of this report.

S.3-8 Cultural Resources Findings

An intensive cultural resources survey was performed for the originally authorized project, and a report was prepared that is included in the Technical Appendices, Revised December 1981, of the GDM. Another survey documented a number of prehistoric and historic sites within the project area (Klinger *et al.* 1988). All surveys were coordinated with the Missouri State Historic Preservation Officer (see Appendix H of this report). Several of the sites were determined to be significant and eligible for inclusion in the National Register of Historic Places. However, the project was designed to avoid all of the significant and potentially significant cultural resources sites.

In the First Phase of the overall project, a portion of the work on St. James Ditch would be switched from the east (left-descending) bank to the west (right-descending) bank. A cultural resources survey was originally conducted on the east bank only along this stretch of the project ROW. Thus, switching work to the west bank would require a new cultural resources survey. If cultural resources are found within the new ROW, they would be tested, or the ROW designed to avoid them. Cultural resources that are found to be significant and unavoidable would undergo mitigation under provisions of the National Historic Preservation Act. All cultural resources investigations and survey results will be coordinated with the Missouri State Historic Preservation Officer and other appropriate parties. Any inadvertent discoveries of cultural resources sites will be fully addressed under provisions of the National Historic Preservation Act and other applicable laws.

In response to the State Historic Preservation Officer's letter dated April 21, 1999, concerning the St. Johns bayou and new Madrid Floodway DSEIS, the district agreed to conduct a cultural history of the entire project area. A Memorandum of Agreement (MOA) has been developed and signed by all parties, in which the Memphis District agrees to conduct a historic cultural history of the area. At this point, a scope of work is being written. The signing of a contractor(s) and beginning the fieldwork will occur near the end of the summer (2000).

S.3-9 ER 1165-2-132; Hazardous, Toxic, and Radioactive Waste Findings

Engineering Regulation 1165-2-132, Water Resources Policies and Authorities for Hazardous, Toxic, and Radioactive Waste for Civil Works Projects, requires the performance of a hazardous, toxic, and radioactive waste (HTRW) assessment to determine the potential for encountering any HTRW at or near Corps civil works projects.

A Phase 1 Assessment was conducted to determine the potential for HTRW occurring within the area that would be affected by the project. Site inspections, aerial photography review, document research, and coordination with appropriate agencies were performed. These investigations indicated that there are no HTRW or potential HTRW within the area that would be affected by the project, and it is unlikely that any known or potential HTRW will be impacted by project construction or operation. No additional HTRW investigations are required unless new information is forthcoming. The complete HTRW Phase 1 Assessment is contained in Appendix I of this report.

S.4 AREAS OF CONTROVERSY

The environmental and economic concerns raised during this study were largely related to the potential impacts of closing the 1,500-foot gap in the Mississippi River levee at the lower end of the New Madrid Floodway. These concerns are:

- National Environmental Policy Act (NEPA). The USFWS and the Environmental Defense Fund (EDF) expressed concerns that completing this First Phase of the overall St. Johns Bayou and New Madrid Floodway Project would piecemeal the NEPA process, and the environmental impacts associated with the project would not be fully assessed. Except for the specific project described and evaluated in this FSEIS, any other feature of the larger overall project that was approved as the General Memorandum 101 would not be constructed at this time. Therefore, the present document fulfills NEPA requirements. The USFWS and EDF also stated that previous environmental documents inadequately evaluated the impacts of closing the 1,500-foot levee gap on the New Madrid Floodway. The USFWS expressed further concern that the NEPA evaluation on the remaining project components (after completion of the clearing and snagging portion) be open and objective and that the decision on how to proceed with the overall project not be predetermined by the scope of the earlier Project Cooperation Agreement (PCA) of May 6, 1997. It was jointly determined that previous environmental documents were inadequate and a new SEIS was needed to evaluate the impacts. Therefore, one of the primary objectives of this FSEIS was to bring NEPA-related issues to resolution.

- Bottomland Hardwoods. The USFWS, MDC, and EDF are concerned that elimination of spring floodwaters on the BLH wetlands would induce significant clearing on privately owned tracts. The USFWS conducted an independent hydraulic review and determined that it is extremely difficult to predict post-project surface water patterns. They also state that based on existing land practices, reasonably foreseeable modifications to the project area's drainage patterns, and the purpose of the proposed project, most of the privately owned forested wetlands that would be subject to reduced backwater and overland flooding will face greater development pressure and likely be converted to agricultural use.

  Corps hydraulic and geotechnical engineers and regulatory functions biologists reached different conclusions from the USFWS based on soil surveys, existing wetlands determinations, and 40 years of rainfall and hydraulic data. The Corps concludes that existing wetlands would remain jurisdictional wetlands due to the influence of the high ground water table in the sandy aquifer underlying both basins during high Mississippi River stages. An interagency team reviewed and validated the methodologies used to conduct the wetland analysis.

  Most existing wetlands in the project area, particularly BLH, lie in depressional areas around major drainage features. These lower areas include Edward's Woods in the St. Johns Bayou Basin and Bogle Woods, Hubbard Lake, Tenmile Pond, and Eagles Nest in the New Madrid Floodway. Such areas tend to retain surface water due to

their low topography and underlying clay soils. They will continue to experience inundation from high river stages and interior rainfall even under with-project conditions. Based on the above information, the existing bottomland hardwood forests that meet wetland hydrology and soil criteria would remain subject to Clean Water Act Section 404(b)(1) jurisdiction.

Recent surveys indicate that forest loss has slowed within the Mississippi Alluvial Valley. Several factors account for this trend, including government incentives such as the Wetland Reserve Program (WRP), which encourages private landowners to plant or retain forests. MDC forest surveys show no change in the percentage of forested acres in six Missouri Bootheel counties from 1972 to 1989 (Lynn Barnicol, pers. comm.). The clearing of forested areas in Missouri appears to have been reduced and is now minimal.

- Wet Cropland. The USFWS, MDC, and EDF expressed concern that reduction of backwater flooding on project area lands would change the hydrology and thus change the existing quality of the wetlands. They also believe cropping patterns on thousands of acres may change because of a reduction in backwater flooding and lowered water tables around the enlarged channels, which would result in significant wetland losses within the project area. The wet croplands at issue are almost all soybean fields that are periodically inundated in late winter and early spring when the land cover is soybean stubble. Economic analyses by the Corps and recent water quality analyses (U.S. Army Corps of Engineers, 2000) indicated that there might be a five percent increase in corn planting and a slight change to a higher yield/longer season variety of soybeans. There should be no significant change in overall cropping patterns in the project area. The changes that could occur would be similar to those that already occur yearly with changing crop prices. (Note, this study is referred to as the WES study in the remainder of the text.) Within the 456,770 acres of the entire project area, only 19.7 miles of previously constructed channels will be modified, and this will only be in the St. Johns Bayou Basin. No channel work will occur in the New Madrid Floodway.

  Corps hydrologic, geotechnical, and regulatory functions investigations were expanded to include qualitative reviews of groundwater levels and patterns relative to identified wetland areas. It was determined that internal rainfall events and the high water table resulting from Mississippi River stages would continue to produce ponded, flooded, or saturated soil conditions. The lands will retain their wetland functions and hydrology, but periodic inundation by the Mississippi River will be reduced. This review was coordinated in November 1998 with NRCS, which concurred with the findings.

  The Corps, MDC, and USFWS conducted terrestrial, shorebird, waterfowl, and fishery analyses using the USFWS HEP to determine changes to the project area wetlands. The HEP team jointly selected evaluation species and models to assess a broad range of cropland and other wetland habitats. The various habitats used by the modeled species are also used by other types of animals, fish and birds. The habitat

impacts to reptiles and amphibians were automatically taken into account with the modeled species, evaluated, and then compensated. Separate HEP models to specifically evaluate the impacts to these and other species are unnecessary. This is explained in greater detail in the USFWS Coordination Act Report (Appendix C) and in Wetland Appendix D.

EPA expressed concern about water quality, nutrient cycling, detrital import/export, and floodwater storage resulting from reduced Mississippi River inundation on wet cropland. Recent analyses revealed that water quality in the area reflects conditions typical for basins where agriculture is the dominant land use. With the Avoid and Minimize Alternative, water quality should be similar to present conditions during periods of no flooding. Material processing (detrital import/export) with the project should also be similar to existing conditions. Sediment retention during inundation was estimated to be low (10 percent) in the study area. This is supported by the observation that during the 1993 flood, nearly all sediment settled out upstream of St. Louis, Missouri. There is little evidence of sediment deposition following flooding in the study area. Also, with floodwater slowly moving through the levee gap and then ponding on the land, there appears to be little detrital movement over the bare earth and soybean fields. Reducing inundation is not expected to result in significant adverse impacts to nutrient cycling, detrital import/export and flood water storage. Hydrologic analyses revealed very minimal changes in high Mississippi River stages and durations with the Avoid and Minimize Alternative. Therefore, there would be little change over existing conditions with respect to water quality.

- Fisheries. The USFWS, MDC, and EDF stated that the impacts of closing the levee gap and the reduction in the duration and frequency of Mississippi River backwater flooding through the levee gap on thousands of acres of the New Madrid Floodway would be a major loss to the spawning and rearing habitats in the local streams and to the Mississippi River fisheries. To evaluate the impacts, summer, fall, and spring adult fish surveys were conducted. The survey data revealed that the majority of the collected species were common and ubiquitous fish found throughout the entire Lower Mississippi River Valley. The survey data were used by the HEP team to identify and check the representative species in the study area. The HEP team chose species models based on the floodplain species that occur in the project area. WES conducted the aquatic HEP using these models and analyzed project impacts on fisheries. The HEP is contained in the USFWS Coordination Act Report.

- Mussels. The USFWS and MDC stated that a diverse mussel community unique to southeast Missouri would be severely impacted. A mussel survey was conducted to locate colonized sites and determine species compositions. The Corps worked with the USFWS and the MDC to design avoid and minimize measures, in addition to mitigation required to offset adverse mussel impacts. All measures recommended by the resource agencies were incorporated into the Avoid and Minimize Alternative. The resource agencies and the Corps agreed that prior to construction, portions of the mussel populations that are of State and Federal importance would be moved to adjacent areas. A nine-foot wide strip at the toe of the opposite work bank would be

avoided to provide a seed source for recolonization. A 10-year monitoring plan will be implemented to study the speed and diversity of mussel recolonization of the enlarged channels. The Corps will follow the recommendations of the USFWS regarding mussels within the project area that will partially mitigate project impacts.

- Endangered Species. The USFWS and the MDC expressed concern about project impacts to two Federally endangered species and one Federally threatened species in the project area. These species included the Federally endangered pallid sturgeon, the interior least tern, and the Federally threatened bald eagle. Concern about the pallid sturgeon pertained to potential losses of some forage fish and possible spawning areas. The concern regarding the bald eagle pertained to losses of foraging, roosting, and nesting habitat and increased disturbance with earlier tillage during nesting, in addition to wintering, dispersing, and colonizing bald eagles. The concern over the interior least tern pertained to the loss of forage fish entering the river during spring migration and early nesting periods. Hydrologic, geotechnical, and fishery data were reviewed and used to prepare the Biological Assessment (BA) for these species. On December 3, 1999, the BA was submitted to the USFWS with a request to initiate formal consultation under Section 7 of the Endangered Species Act. The USFWS concurred with the BA's finding that the project is not likely to adversely affect the pallid sturgeon.

  The USFWS biological opinion (BO) stated that the St. Johns Bayou and New Madrid Floodway Project, as proposed, is not likely to jeopardize the continued existence of the bald eagle or the interior least tern and that since no critical habitat has been designated for those species, none would be affected. The USFWS does believe, however, that an incidental take of bald eagles and least terns could occur as a result of the project. According to USFWS, an incidental take of two bald eagles is expected through disturbance from harassment from earlier tillage and reduced foraging area for adult eagles because of reduced Mississippi River flooding in and around the nest during the breeding season.

  The BO also stated that incidental take in the form of harassment of interior least terns will be very difficult to determine because least terns are wide-ranging, may change nesting colonies from year to year, and reduced reproductive success may be masked by annual variability in tern numbers. However, an unquantifiable level of take of this species can be anticipated by loss of fisheries habitat in the New Madrid Floodway. The level of take is based on the permanent loss of a significant portion of the forage base for the tern colonies in and around the project area.

  Under the terms and condition of Section 7(b)(4) and Section 7(o)(2) of the Endangered Species Act, taking that is incidental to and not intended as part of an agency's actions is not prohibited under the Act provided that such taking is in compliance with the terms and conditions of the incidental take statement in the BO. To ensure compliance, the USFWS listed several nondiscretionary measures that must be undertaken by the Corps so that they become binding conditions of the project. These are presented and discussed along with the BA in Appendix F of this

report.

- Executive Orders. The USFWS, MDC, and EDF maintain that the project is not consistent with Executive Order 11988 (Floodplain Management) and Executive Order 11990 (Protection of Wetlands). The contention is that increased private drainage projects that would be built once backwater flooding is eliminated do not comply with proper floodplain management. They requested the Corps to fully evaluate the effects on human life, health, and property regarding infrastructure that would be built because of reduced flooding. The USFWS stated that the project does not incorporate features to protect the quality and integrity of forested and non-forested wetlands once periodic backwater inundation is eliminated. The USFWS believes that the extent of project impacts, even with the proposed mitigation plan, is at odds with the goals of these executive orders.

  Regarding fishery and wetland impact analysis, the USFWS and the MDC were involved in early project planning to establish the types of analyses needed to adequately measure impacts. All the various conservation design features, which were developed jointly, were incorporated to avoid, minimize, or mitigate adverse impacts.

- New Madrid Floodway Operation. The USFWS, MDC, and EDF state that the levee closure and enhanced drainage and flood control would result in increased infrastructure and investment in the floodway. Such project-induced development would place additional human life, health, and property at risk in the event that Floodway operation became necessary during a major flood event. They further state that the SEIS should disclose whether this increased risk would affect future use of the Floodway or the costs of using the Floodway. In response to their concern, the Corps evaluated this aspect of the New Madrid Floodway operation throughout the SEIS preparation process and determined that no change in the operation of the Floodway is anticipated subsequent to closing the gap at the lower end of the Floodway. Additional information on this analysis is contained in Section 5.

- East Prairie Project Only. The USFWS and EDF recommended that some form of flood protection be provided around the town of East Prairie, Missouri, in lieu of any major basinwide improvements. The USFWS maintains that this alternative is more consistent with the executive orders described previously than either the Authorized Project Alternative or the Avoid and Minimize Alternative. Additional engineering design and hydraulic analyses of a ring levee around the town were conducted. The investigations revealed that in addition to a ring levee, channel work to resolve interior drainage problems would be required within the town. Economic analysis indicated that the costs to East Prairie outweigh the benefits that would accrue. Moreover, limiting construction and benefits to East Prairie would not provide flood protection to the overall area.

- Limit Work to St. Johns Bayou Basin. The USFWS and the MDC recommended that the project be limited only to the St. Johns Bayou Basin, which would avoid nearly all

the adverse fish and wildlife impacts of the project, especially those in the New Madrid Floodway. Throughout the SEIS, impacts to both basins were evaluated separately. A discussion of St. Johns Bayou Basin only option is presented as Alternative 5. The recommended approach would leave the most economically sound portion of the overall project unbuilt. In addition, the recommended approach does not completely address the economic development goals of the East Prairie Enterprise Community and the overall area. All items of work in both basins are economically justified.

- Non-Structural Alternatives. The USFWS and MDC recommended that non-structural measures, such as flooding easements, be evaluated to address agricultural flood damages in the New Madrid Floodway to minimize environmental impacts. In keeping with the recommendation of the USFWS, an array of non-structural and smaller structural alternatives was investigated to address the stated project purpose of flood control. These are included as Alternative 9. The non-structural and smaller structural alternatives were found to be infeasible from a benefit-to-cost standpoint, with the exception of Alternative 5 (St. Johns Bayou Basin Only). Alternatives found to be economically infeasible were not recommended for construction since they would have a net negative effect on the nation's economy. Although Alternative 5 is economically feasible, it does not maximize the net positive effect to the nation's economy and is not the best investment from a national perspective. Therefore, it was not chosen as the preferred plan. In addition, none of the non-structural or smaller structural alternatives address the goals and intentions of the East Prairie Enterprise Community.

- New Levee Closure Location. The MDC proposed locating the levee closure farther inside the New Madrid Floodway, starting from Tenmile Pond and extending along St. James Bayou to tie into the Mississippi River levee northeast of Big Oak Tree State Park. This alignment and a range of pumping station sizes was studied in detail in the St. Johns Bayou and New Madrid Floodway, Missouri, Phase I GDM dated July 1980. This alignment was found to create new flood problems. It would frequently impound significant amounts of interior rainfall behind the levee on lands that formerly experienced only infrequent backwater flooding. Though a range of pump sizes was analyzed, none was large enough to compensate for and evacuate the impounded rainfall. In addition, a new levee in the middle portion of the Floodway could affect Floodway operations. Although this approach would not provide economic benefits and would induce new flood problems, it would avoid significant adverse impacts to fish and wildlife resources.

S.5 UNRESOLVED ISSUES

- Big Oak Tree State Park. The MDNR, USFWS, and MDC expressed concern that reduction in the duration and frequency of periodic Mississippi River backwater flooding through the levee gap would promote drainage projects adjacent to Big Oak Tree State Park and accelerate drying of the park's swamps and unique old growth BLH forests. These agencies also stressed that Big Oak Tree State Park is a National Natural Landmark and, as such, cannot be adversely impacted by the project. A

hydrologic and geotechnical evaluation revealed that saturated soil conditions would continue because of the proximity of the Mississippi River, soil types within the park, and rainfall. To maintain the periodic inundation necessary for a healthy forest community, several relief wells and a well pump will be installed within the park to capture groundwater flows at high river stages.

There was concern over well water quality and its effect on the forest. Recent water quality analyses revealed very little differences between well and river water other than sediment loads. In addition, some of the nutrient levels would be higher in the well water than in the backwater. To maintain natural sediment influx to the park, a second pump would be included to convey sediment-laden runoff water to the forest. The MDNR would manage the wells and regulate the flows of water to mimic historic flooding cycles. The Corps also proposed to construct MDNR's hydrology restoration project for capturing surface water around the park. The Corps is continuing to coordinate with MDNR to develop acceptable engineering solutions and designs for maintenance of the park. The USFWS, however, believes there are still unresolved issues pertaining to the artificial backwater flooding regime that would be produced by relief wells and groundwater and also to changes in water chemistry that will not compensate for the ecological functions lost with reduced Mississippi River flooding.

S.6 ACRONYMS

A&M	Avoid and Minimize
AAHUs	Average Annual Habitat Units
BA	Biological Assessment
BLH	Bottomland Hardwood
BO	Biological Opinion
CA	Conservation Area
CAR	Coordination Act Report (U.S. Fish and Wildlife Service)
CEQ	Council on Environmental Quality
cfs	cubic feet per second
DSEIS	Draft Supplemental Environmental Impact Statement
DUDs	duck-use-days
EA	Environmental Assessment
EC	Enterprise Community
EDF	Environmental Defense Fund
EIS	Environmental Impact Statement
EL	Environmental Laboratory
EO	Executive Orders
EPA	Environmental Protection Agency
ERDC	Engineer Research and Development Center
ESEI	Environmental Science and Engineering, Inc.
FSA	Food Security Act
FSEIS	Final Supplemental Environmental Impact Statement

FW	Farmed Wetlands
GDM	General Design Memorandum
GEC	Gulf Engineers and Consultants, Inc.
GIS	Geographic Information System
HEP	Habitat Evaluation Procedures
HES	Habitat Evaluation System
HSI	Habitat Suitability Index
HTRW	Hazardous, Toxic, and Radioactive Waste
HU	Habitat Unit
LRR	Limited Reevaluation Report
MAV	Mississippi Alluvial Valley
MDC	Missouri Department of Conservation
MDNR	Missouri Department of Natural Resources
MR&T	Mississippi River and Tributaries
MRL	Mississippi River Levee
NED	National Economic Development
NRC	National Response Center
NRCS	National Resource Conservation Service
PC	Prior Converted
PCA	Project Cooperation Agreement
PDF	Project Design Flood
PED	Pre-construction, Engineering, and Design
ROW	Rights-of-Way

SHPO	State Historic Preservation Officer
TM	Thematic Mapper
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WAM	Waterfowl Assessment Methodology
WES	Waterways Experiment Station
WRDA	Water Resources Development Act
WRP	Wetland Reserve Program
YOY	young-of-the-year

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1.0 PURPOSE AND NEED

1.1 PUBLIC CONCERNS

The lower part of the New Madrid Floodway has traditionally flooded from Mississippi River backwaters. The St. Johns Bayou Basin has undergone coincidental flooding whenever the St. Johns Bayou control gates are closed at high river stages. While other areas along the Mississippi River Valley secured flood control benefits from the levees, this area has continued to experience difficulties because the levee gap has never been closed. From 1993 to 1997, heavy rains and high Mississippi River stages increased the urgency for some form of flood control in the project area. Agriculture has been severely impacted as a result of frequent flooding in the area. Planting has sometimes been delayed until July. Net farm income is substantially lower than optimum because of crop yield decreases and production cost increases caused by inefficiencies resulting from flooding. Floodwaters regularly damage public electric, water, and sewer utilities and disrupt businesses, schools, and residences. Flooded roads prevent the normal traffic flow of goods and services within the project area. This results in economic losses, disruption, and adverse quality of life impacts. There is widespread public support for a project that would provide flood control and benefit environmental resources within the project area.

East Prairie, Missouri, is a concern of this project, but is only one segment of the overall project for the three-county area. The community has identified flooding as the primary impediment to its future prosperity. The town was designated an Enterprise Community (EC) by the Administration in December 1994, one of a handful of such communities across the nation. East Prairie was selected because it met eligibility criteria regarding size, poverty, unemployment, and general distress. The town chose the St. Johns Bayou and New Madrid Floodway Project to improve the quality of life and living conditions for its many underprivileged residents. In addition to East Prairie, several other small communities such as Pinhook would benefit socially and economically from the protection that would be provided by the project.

There is widespread public support for a project that would provide flood protection and benefit environmental resources within the project area. The project need has been identified by local interests and confirmed by Congress. This project could provide both flood control and flood protection to the St. Johns Bayou Basin and the New Madrid Floodway. Plates 1 and 2 show the project location. Plate 3 shows the extent of the 25-year flood that occurred in 1997.

1.2 PROJECT AUTHORITY

The St. Johns Bayou and New Madrid Floodway Project was originally authorized for construction by the Water Resources Development Act of 1986 (PL 99-662), Section 401(a). The originally authorized project is based on the Report of the Chief of Engineers, dated January 4, 1983, which is part of the Phase I General Design Memorandum (GDM) documents prepared in response to Section 101(a) of the Water Resources Development Act of 1976 (PL 94-587). The Phase II GDM is based on the Phase I GDM project recommendations and was prepared under the Office of the Chief of Engineers authority for continuing planning and

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engineering studies on a viable project while awaiting project authorization. Revisions were made in the Phase II GDM to indicate the non-Federal cost-sharing requirements reflected in the authorizing Act, PL 99-662. The original project was not constructed because the local sponsor could not meet cost-sharing requirements. The designation of East Prairie, Missouri, as an Enterprise Community by the Administration provided momentum toward implementation of the First Phase of the overall project. The Water Resources Development Act (WRDA) of 1996 contained provisions regarding Federal cost-sharing exceptions for East Prairie and allowed USDA to provide funds to East Prairie (as an Enterprise Community) to offset the cost of the project to the local sponsors. This reduced the non-Federal cost to five percent. In late FY 96, funds were reprogrammed to the project to initiate Pre-construction, Engineering and Design (PED) activities associated with this phase. In FY 97, Congress urged completion of pre-construction activities within six months and provided new-start construction funds.

The authority for closing the gap in the Mississippi River levee was granted under the Flood Control Act of 1954, as part of the Mississippi River Levee feature of the Mississippi River and Tributaries (MR&T) Project. This would have provided flood protection to part of the project area; however, construction of this component of the mainline levee system was suspended because of difficulties in obtaining rights-of-way (ROW) plus lack of local support.

1.3 NATIONAL OBJECTIVE

The Water Resources Council's *Economic and Environmental Principles for Water and Related Land Resources Implementation Studies* states that "The Federal objective of water and related land resources project planning is to contribute to national economic development consistent with protecting the Nation's environment, pursuant to national environmental statutes, applicable executive orders, and other Federal planning requirements." Contributions to the national economic development (NED) objective are achieved by increasing the net value (expressed in monetary units) of the nation's output of goods and services. Water and related land resource management plans must develop long-range goals and priorities for the study area that are consistent with the NED objective.

1.4 PROJECT NEED

Flooding on the Mississippi River usually occurs in the winter and spring months, resulting in backwater flooding on almost a yearly basis in the New Madrid Floodway. The flood of record at the New Madrid gage occurred in 1937. The most significant recent flood event occurred in 1973, which inundated over 56,500 acres of agricultural land in the Floodway. Other significant backwater flooding occurred in 1961, 1962, 1964, 1972, 1974, 1975, 1979, 1983, 1984, 1993, 1994, 1995, 1996, 1997, and 1998. During the last three of those years, floodwaters remained through late June, resulting in major agricultural losses. According to recent hydrologic and Geographical Information System (GIS) data, the two-year backwater flood occurrence in the New Madrid Floodway inundates 17,293 acres, of which 11,837 acres are agricultural land and 3,841 acres are wooded. At high Mississippi River stages, the St. Johns Bayou Basin control gates are closed, thereby preventing interior drainage. The two-year headwater flood event under these circumstances inundates approximately 13,185 acres, of which 8,764 acres are agricultural land and 3,335 are wooded (Plate 6).

1.5 PROJECT PURPOSE

The purpose of this project is to provide flood protection in the St. Johns Bayou Basin and New Madrid Floodway. Flood protection provides for a reduction in flood damages incurred by the region and the nation. One of the benefits of flood protection that would be provided by the project is a reduction in the physical and economic impediments created by frequent flooding in East Prairie, Missouri, several small communities such as Pinhook, Missouri, and the surrounding area. The project planning objectives that would be met through flood protection are:

1. Reduce the duration and frequency of backwater flooding events in the New Madrid Floodway and ponded water from St. Johns Bayou Basin whenever the existing gravity outlet structure gates are closed at high Mississippi River stages.

2. Alleviate headwater flood problems associated with the drainage outlet for East Prairie, Missouri.

3. Minimize adverse impacts to the wildlife and fisheries of the project area and Mississippi River and mitigate, to the maximum practicable extent possible, significant wildlife and fishery impacts.

4. Minimize cost and maximize outputs.

The purpose of this study is to evaluate the impacts of various project alternatives and recommend the most environmentally and economically justified alternative that would provide flood protection. Agriculture is the primary economic resource within the project area. Land use in the area is approximately 86 percent agricultural in both basins, with urban and built-up areas accounting for less than one percent. Damaging floods in the St. Johns Bayou Basin result from impounded runoff in the lower reaches of St. Johns Bayou and headwater flooding in the upper reaches of St. Johns Bayou and tributaries that results from inadequate channel capacities. Flood damages to agricultural lands and to urban property in East Prairie, Pinhook, and other small communities are major problems.

2.0 PLAN FORMULATION

This section briefly describes the project alternatives retained for further analysis, the project alternatives examined and eliminated during the screening process, the comparative impacts of the alternatives, and the preferred plan.

2.1 ALTERNATIVE 1: WITHOUT-PROJECT

The existing gravity outlet structure at the lower end of St. Johns Bayou prevents Mississippi River backwater flooding in the St. Johns Bayou Basin. Under the Without-Project Alternative, this condition would continue. The floodgates in the six 10-foot by 10-foot concrete box culverts remain open to permit water passage through the levee to the Mississippi River

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when river stages are lower than interior water and are capable of passing 10,000 cfs of water. During high river stages, the gates of the gravity outlet are manually closed when Mississippi River stages are higher than interior water elevations. They remain closed until the Mississippi River recedes to an elevation lower than the impounded landside water. Then the gates are opened and gravity drainage through the structure is permitted. The gates remain open at all times when the Mississippi River water elevation is lower then the impounded water. Headwater flooding will continue to be influenced by local rainfall events. Runoff water would continue to pond at the lower end of the St. Johns Bayou Basin whenever the control structure gates are closed, inundating many acres of farmland in the lower end of the St. Johns Bayou Basin.

Without any project, the gap at the lower end of the New Madrid Floodway would remain open. Headwater flooding would continue to be influenced by local rainfall events. During high Mississippi River stages water would continue to pass through the gap and flood thousands of mostly agricultural acres in the New Madrid Floodway. Big Oak Tree State Park would continue to receive periodic flooding that is essential to the health of the old growth forest. However, the MDNR stated that the park is experiencing regeneration problems from too much drying during the growing season, which has allowed species from drier water regimes to displace wet forest/swamp features on adjacent cropland. They are initiating a $1.2 million Hydrology Restoration Project to compensate for the progressive drying of the park's swamp and the altered flooding species in the understory and midstory tree layers. Currently, the park appears to be undergoing a change in the water regime. If this trend continues, the wet BLH swamp ecosystem could be replaced with a less water tolerant community. The MDNR believes the drying is caused by increased drainage regimes. A Corps review of MDNR's design indicated that the design does not provide sufficient levee top width, levee freeboard, or spillway capacity to provide a maintainable structure.

Agricultural production in both basins would continue to be impacted as the lands are flooded. Additionally, without channel modifications in the St. Johns Bayou Basin to improve drainage, the community of East Prairie, Missouri, and many structures within that basin would continue to experience flooding during significant rainfall events.

The USFWS and the MDC state that the New Madrid Floodway is the only portion of the Mississippi River floodplain in Missouri still largely connected to the river. This does not take into account any of the batture lands outside the Floodway. Many fish species collected in the St. Johns Bayou Basin and the New Madrid Floodway are characteristic of the Mississippi lowlands or occur only occasionally elsewhere in the state (Pflieger 1997). In all, 114 species representing 22 families have been collected from project-area drainages and the Mississippi River. Of these species, 93 have been collected from ditches and bayous in the project-area drainage (Sheehan *et al.* 1998, MDC 1997a). The remaining 21 species have been collected from the Mississippi River proper (USGS 1991-1996, MDC 1997a). Of the 93 species collected from the project area, 10 are considered as State-endangered, rare, or on the watch list in the State of Missouri. One species, the golden topminnow, which was once believed to be extirpated from Missouri, was collected recently from the St. James Ditch (Sheehan *et al.* 1998). The diversity and abundance of the fish fauna reflect the diverse aquatic habitats in the project area. The floodplain would continue to remain available and provide habitat essential for spawning,

foraging, and refuge to numerous aquatic species. The project area would also continue to support a diverse fishery.

In addition, under this alternative, wetlands and permanent waterbodies in the St. Johns Bayou Basin would continue to provide substantial wildlife habitat. The Without-Project Alternative would not alter the flooding regime on thousands of acres in the New Madrid Floodway that are used as migratory habitat by waterfowl and shorebirds.

2.2 ALTERNATIVE 2: AUTHORIZED PROJECT

The St. Johns Bayou and New Madrid Floodway Project consists of channel enlargement and improvement in St. Johns Bayou Basin along the lower 4.5 miles of St. Johns Bayou, beginning at New Madrid, Missouri, then continuing 8.1 miles along the Birds Point New Madrid Setback Levee Ditch, and ending with 10.8 miles along St. James Ditch (see Plate 1). The lower 4.5 to 5.0 miles of St. James Ditch were referred to in previous project documents as Lee Rowe Ditch. The first item of work, consisting of selective clearing and snagging, has already been completed along a 4.3-mile reach of the Setback Levee Ditch beginning at the confluence with St. James Ditch. The impacts of that work were evaluated in the Limited Reevaluation Report (LRR) and supporting Environmental Assessment (EA) for the First Phase of the project (U.S. Army Corps of Engineers 1997). There would also be a 1,000 cfs pumping station located a few hundred feet east of the existing gravity outlet at the lower end of St. Johns Bayou. The channel improvements for the overall Authorized Project were of two-year design. This First Phase of the project would provide the same design level of flood protection as the overall project, but over a smaller project area. A 25-year level of urban protection would be provided in portions of East Prairie, Missouri. No channel modifications would occur in the New Madrid Floodway.

Two-sided clearing and enlargement would take place along St. Johns Bayou. The channel would be enlarged from an existing bottom width of approximately 80 feet to a new bottom width of 200 feet. Approximately 2,485,000 cubic yards of excavated material would be deposited along both top banks. The embankments would be about 220 feet wide on each side of the enlarged channel. All cleared vegetation within the embankment ROW would be burned or buried following standard construction procedures and would adhere to EPA guidelines. This area would be allowed to vegetate naturally as part of a conservation easement.

The lower 8.1 miles of the Birds Point New Madrid Setback Levee Ditch would be enlarged from about 40 feet to 50 feet. This work would take place from the left-descending (south) bank to the confluence of St. James Ditch. Approximately 675,000 cubic yards of excavated material would be placed in about a 120-foot-wide embankment along the left-descending bank. Any cleared vegetation would be disposed of as described in the previous paragraph. This area would be allowed to vegetate naturally as part of a conservation easement.

St. James Ditch would be enlarged from the east (left-descending) bank. Approximately 630,000 cubic yards of earth would be removed. The lower 3.5 miles would be enlarged from a bottom width of 35 feet to 45 feet. For the remaining 7.8 miles, the bottom width would remain approximately 25 feet. However, the left-descending bank would be widened for an average top

width of approximately 80 feet. The new embankment would be approximately 100 feet wide. Cleared vegetation within the ROW would be disposed of as previously described. The ROW would be allowed to vegetate naturally as part of a conservation easement.

A 1,000 cfs pumping station would be constructed several hundred feet to the east of the existing gravity outlet structure on St. Johns Bayou. The station would discharge ponded interior water over the levee during high Mississippi River stages. The pumps would be manually started when water in the sump reaches 279.0 feet NGVD. Pumping would continue as long as Mississippi River stages are higher than those in the sump and would automatically stop when the water elevation in the sump drops to 277.0 feet NGVD. Whenever the river level drops below the elevation of the impounded water (even if the elevation is above 279.0 feet NGVD), any pumping operations would cease and the floodgates would be opened and gravity flow permitted through the 10,000 cfs culverts in the outlet structure.

The 1,500-foot gap in the Mississippi River levee at the lower end of the New Madrid Floodway would be closed. A 1,500 cfs pumping station and gravity outlet structure would be built in the levee closure at the lower end of the New Madrid Floodway. The pumps would be manually started when water in the sump reaches 278.0 feet NGVD and would automatically stop when the water elevation in the sump drops to 275.0 feet NGVD. As with the St. Johns Bayou pump station, gravity flow would prevail whenever river stages drop below the elevation of impounded water. Since no channel excavation is proposed, headwater flooding will not change.

Closing the levee gap at the lower end of the New Madrid Floodway would constrict the opening that floodwaters would be able pass through to drain the Floodway when it is operated. Because the volume of water passing through the levee closure would be less than what could pass through the 1,500 foot gap, it would back up inside the Floodway and pond at a higher elevation on the levee. At very high stages, there is a possibility of inducing damages if the levee is overtopped. This requires raising the Birds Point New Madrid Setback Levee from 0.1 foot to three feet (average 1.28 feet) for a distance of 14.1 miles to prevent flooding the St. Johns Bayou Basin. Soil for this levee raise would be obtained from the excavated channel material. The excavated material would be placed on the existing grass-covered berm and the levee crown.

Mitigation for the originally authorized project, as presented in the Phase II GDM, included the purchase in fee title of 2,500 acres in the Tenmile Pond area. This area is recognized as one of the most significant environmental resources in the region. When the original project was formulated, habitat losses outside the ROW were to be mitigated by purchasing a portion of the originally designated 2,500 acres. Cropland and woodland were to be developed into high-quality wildlife habitat, with proper management by the MDC. A review of the original EIS revealed that previous analyses of the levee closure did not adequately evaluate the impacts on the New Madrid Floodway. Therefore, the USFWS requested discarding the original mitigation package and the Habitat Evaluation System (HES) used to evaluate the impacts and develop the mitigation. The USFWS requested that a new habitat evaluation be done for the entire project area and that it be used as the basis in developing new mitigation.

The Corps subsequently agreed that the Habitat Evaluation Procedures (HEP) (U.S. Fish and Wildlife Service 1980) would be completed for this First Phase of the project and used to determine the amount of mitigation land required. Based on the terrestrial HEP conducted in both basins, approximately 2,118 acres would be required to mitigate direct losses to terrestrial habitat (forested wetlands), based on planting acorns. The exact quantities of cropland and wooded land to be purchased would be determined at a later date by consultations with the resource agencies and the project sponsor. The USFWS recommended that protective easements be placed on forested wetland areas, which would no longer be seasonally inundated by backwater flooding. If easements cannot be obtained, the USFWS recommends purchasing an additional 6,998 acres of mitigation lands to compensate for project-induced conversion of forested wetlands.

The Authorized Project Alternative would also reduce the available habitat for spring shorebird migration. The USFWS and the Corps recommend managing approximately 796 acres of fallow land or 1,583 acres of agricultural land for shorebirds during April and May to mitigate these impacts. This land should be secured through fee title or easements and flooded for shorebird habitat. Structures within the existing drainage network could possibly be used to seasonally trap rainwater. Certain areas could also be engineered to control water levels.

With project operation, lands that normally flood in late winter and early spring from impounded water in the St. Johns Bayou Basin and from backwater in the New Madrid Floodway would no longer be available for waterfowl. The overall project, as originally authorized, included purchasing seasonal flooding easements on a total of 4,900 acres at the lower ends of both basins to offset this loss. Although it was determined in the LRR that the total 4,900 acres of ponding would be required to mitigate First Phase construction impacts, there was no compelling reason to limit the ponding area to less than that originally designed. Impounded water could rise to elevation 286.0 feet NGVD in the St. Johns Bayou Basin and 285.4 feet NGVD in the New Madrid Floodway before the pumps are started. Once started, the pumps would pull the water down and then maintain water elevations up to 285.0 feet NGVD in the St. Johns Bayou Basin and up to 284.4 feet NGVD in the New Madrid Floodway through February 1. Several days would be needed after this date to draw the water down.

Revised estimates now indicate that up to 6,460 acres of mixed farmland and wooded acres could potentially be flooded during the waterfowl season. However, only the area with less than two feet of water provides significant waterfowl foraging habitat. By holding a steady depth, a maximum of 1,039 acres in the St. Johns Bayou Basin and 849 acres in the New Madrid Floodway would actually be available and useful to waterfowl as feeding areas at any one time. This results in a potential net increase in waterfowl habitat during December and January, but a decrease during the remainder of the waterfowl season, particularly during the critical spring migration. During spring migration, flooded moist soil and BLH acreage would be reduced, thus reducing habitat that provides necessary protein sources particularly important to waterfowl migrating to their breeding grounds.

Under the Authorized Project Alternative, the levee closure and pumping operations would reduce Mississippi River backwater flooding in the Floodway and reduce interior flooding in the St. Johns Bayou Basin. In the St. Johns Bayou Basin, inundation from backwater events

would be reduced on approximately 6,710 acres of wetlands (5,633 acres of croplands) and on approximately 29,770 acres in the New Madrid Floodway (21,901 acres of croplands). Direct construction would impact only 121 acres of wetlands in the St. Johns Bayou Basin and approximately 12 acres in the New Madrid Floodway. In addition, fishery access through the drainage structure to the floodplain would be reduced. The 1,500-foot gap in the levee that currently provides fish access to floodplain habitats during the spawning season will be restricted to four 10-foot by 10-foot box culverts. Killgore and Hoover (1998) used HEP to quantify project-related reductions in flooding on fish spawning and rearing habitat in both basins. Mitigation would require the purchase in fee-title and reforestation of approximately 10,312 acres of frequently flooded agricultural land. The areas reforested for fishery mitigation would also fully mitigate losses to terrestrial and waterfowl habitats as described earlier.

Nearly 584.5 acres of new embankments would be seeded in grass and permitted to naturally vegetate as conservation easements to provide wildlife habitat to help offset direct construction habitat losses. All exposed earth for the Setback Levee raise would be immediately seeded in a wildlife grass cover. The temporary loss of grass habitat would quickly return as the grass establishes. All bridges and culverts would be replaced or upgraded to accommodate enlarged channels.

2.3 ALTERNATIVE 3: AVOID AND MINIMIZE

The ROW, channel improvement features, and levee raise discussed in Alternative 2 would remain basically the same for the Avoid and Minimize Alternative. However, several environmental features are incorporated in the engineering design of the Authorized Project Alternative to avoid or minimize adverse construction impacts. St. Johns Bayou would be excavated only from the right bank (instead of both banks), and the bottom width would be decreased from 200 feet to 120 feet. Excavated material from St. Johns Bayou that is to be used for the levee closure and levee raise would be temporarily stored within the ROW until it is needed for construction. The majority of the storage area is cropland that abuts the top bank of the ditch. However, approximately 65 acres of the storage area are wetlands within the project ROW. Approximately 376,065 cubic yards of excess material would remain as an embankment in the ROW, allowed to vegetate naturally, and then remain as part of a conservation easement. Channel enlargement would be divided into several work items, beginning with the lower 4.5 miles of St. Johns Bayou. Work will be completed on each item before starting the next item. There will be a short time interval between each construction phase when no work would be done. This would lessen the impacts to fish and wildlife and permit time for resources to adjust to construction impacts.

Along St. James Ditch, construction on about 2.6 miles of the work bank between Missouri Rt. 80 and Missouri Rt. 00 would be changed to the right-descending (west) bank to preserve the large oak, baldcypress, pecan and sugarberry trees and other high-quality woodland that has developed along the left-descending bank. The golden topminnow was believed extirpated from the Bootheel region since about 1946, but fall 1997 fishery surveys collected several specimens in the upper reach of St. James Ditch (see the Fishery Impact Analysis section of the Fish and Wildlife Coordination Act Report in Appendix C). Therefore, to avoid adverse

impacts to the golden topminnow, the upper 3.7 miles of St. James Ditch would be removed from construction.

To maintain bank stability at the confluence of St. James Ditch with Setback Levee Ditch, and also at the confluence of Setback Levee Ditch with St. Johns Bayou, bank stability structures would be provided. The rock contained in these structures would also serve as fishery and mussel habitat. Channel gradient control would not be necessary at these locations, because the bottom elevation of the ditches would be the same. Also, gradient control would not be necessary at the upper end of channel construction, since the grade differential is minimal. At the upper limit of channel construction, lateral transitions to the existing channel dimensions would be constructed to minimize potential bank caving. Nine transverse rock dikes would be constructed in St. Johns Bayou to maintain a thalweg at low-flow conditions and provide structure for benthic invertebrates and fish.

The recent terrestrial HEP revealed that approximately 1,546 acres of cropland would be required to offset direct construction impacts, based on planting acorns (other mitigation options are presented in Appendix B). The land would be planted with a mixture of bottomland hardwood (BLH) seeds and trees. The seeding and planting rates would be determined later by the MDC, USFWS, and Corps biologists. This mitigation land would be managed by the USFWS and the MDC through agreements with the local sponsor. The Corps mitigation recommendations are presented in detail in Appendix B.

As presented in Alternative 2, the USFWS also recommends placing conservation easements on bottomland hardwood areas that would no longer be seasonally inundated by backwater flooding to protect these areas from conversion to other uses such as agriculture. If easements are not obtained, the USFWS recommends the purchase and reforestation of an additional 6,789 acres of flooded agricultural land.

After a review of the hydrologic, geotechnical, and regulatory data, the Corps determined that although these lands would experience a reduction in the degree and duration of inundation, these areas would continue to exhibit wetland hydrology characteristics (as currently defined by the Corps) and therefore would be protected under Section 404 of the Clean Water Act. The proposed mitigation plan would fully compensate for the terrestrial direct and indirect habitat value losses.

Spring shorebird migration habitat would be reduced under this alternative. Mitigation of this resource would require flooding on approximately 765 acres of fallow land or 1,523 acres of agricultural land to be managed for shorebirds during April and May. The same mitigation scenarios described under Alternative 2 would fully compensate this resource.

The Avoid and Minimize Alternative would provide for higher start and stop pump elevations than those in the Authorized Project Alternative. Both basins would have a start pump elevation of 282.5 feet NGVD and a stop pump elevation of 280 feet NGVD. This would provide an additional 4.5 feet of spring inundation in the New Madrid Floodway and 3.5 feet in the St. Johns Bayou Basin over the Authorized Project Alternative. The USFWS and the MDC would manage the control gates to fluctuate water durations and depths from November through

March to permit water interchange with the Mississippi River. Fluctuating water levels on nearly 6,400 acres would maximize waterfowl benefits.

As with Alternative 2, inundation from all backwater events would be reduced due to project implementation. In the St. Johns Bayou Basin, inundation would be reduced on approximately 6,680 acres of wetlands (5,633 acres of cropland), and on approximately 29,376 acres in the New Madrid Floodway (21,792 acres of which are croplands). These are acres below the 300 ft. NGVD elevation. Direct construction would impact only 155 acres of wetlands in the St. Johns Bayou Basin and approximately 12 acres in the New Madrid Floodway.

Fisheries mitigation under this alternative is slightly reduced due to a higher start/stop pump elevation. Based on the HEP analysis, the USFWS and Corps agree that 9,557 acres of flooded, reforested, agricultural lands would be required to mitigate all the rearing and spawning habitat value losses (U.S. Army Corps of Engineers 1999). In addition, restoring 9,557 acres of agricultural land with BLH species would increase wetland functional value losses and increase the amount of detritus available for import/export.

All fishery spawning and significant rearing losses associated with reduced inundation of cropland and BLH habitat would be mitigated by reforesting 6,396 acres of agricultural lands. Because the USFWS still expressed concerns related to other less measurable and uncertain wetland functions, it was decided to also mitigate rearing losses associated with agricultural lands that were flooded infrequently, to shallow depths, and short duration. The rationale for doing this is the same as previously discussed in Alternative 2, only the acre figures have changed. Although it was again difficult to justify this added mitigation, now totaling 9,557 acres, from a purely fishery mitigation standpoint, the Corps agreed to this acreage to ensure full mitigation of all wetland functions.

To maximize spring fish passage into both basins, the operation of the gravity gates at both structures would be altered to remain open until the Mississippi River stage at the New Madrid gage reaches 27, which corresponds to 282.5 feet NGVD in both basins. Based on the period of record, the average number of days that the gage is less than or equal to 27 is 14.3 days in March and 12.9 days in April. Therefore, the gates would be open periodically during the spawning season and allow fish passage between the river and the two basins.

Approximately 406 acres of ROW would be seeded with grasses and then permitted to naturally vegetate to BLH and remain as a conservation easement. Fewer ROW acres would be required with this alternative than the Authorized Project Alternative due to the reductions in channel dimensions and the elimination of the upper 3.7 miles of St. James Ditch to avoid golden topminnow habitat.

Big Oak Tree State Park is a National Natural Landmark. The MDNR has stated that agricultural drainage projects adjacent to the park are altering the area's hydrology and causing it to dry out. They believe that reductions in the duration and frequency of periodic Mississippi River backwater flooding associated with the proposed project would cause further alteration of the park's swamps and unique old growth bottomland hardwood forests. To maintain the periodic inundation necessary for a healthy forest community, the Corps recommends taking on

and constructing (with slight modifications to ensure engineering stability) MDNR's hydrology restoration project for the park. The Corps would also install several relief wells and a well pump within the park to capture groundwater flows at high river stages. Features would also be designed to provide sediment and nutrient-laden surface runoff water to the park that would maintain these important elements for the forest. The Corps and the MDNR would work together to develop a memorandum of agreement on all engineering features to minimize adverse impacts to the park. Recent water quality analyses revealed that well water would not contain chemicals that would adversely impact the park's forest. The analyses also revealed that certain phosphorus and nitrogen nutrients are greater in the well water and may actually benefit the park. This is discussed in greater detail in the Environmental Consequences section and in Appendix J, Hydraulics and Hydrology and Water Quality of this report.

The Corps recommends incorporating several additional mitigation options. These options include, but are not limited to: avoiding a nine-foot strip along the right-descending bank of the Setback Levee Ditch to leave enough mussel breeding stock to repopulate dredged reaches, relocate mussels out of the construction area, establish a 10-year mussel monitoring plan, and avoid approximately 66 acres of BLH trees within the project rights-of-way. The Corps mitigation plan is contained in Appendix B.

2.4 ALTERNATIVES CONSIDERED BUT ELIMINATED FROM DETAILED STUDY

Six other alternatives were considered but were eliminated from further detailed study. They are briefly discussed as follows:

2.4.1 Alternative 4: Ring Levee Around East Prairie

Under Alternative 4, a ring levee would be constructed around East Prairie in lieu of any major basinwide improvements. The levee would protect the city from headwater flooding in the eastern and western parts of the town associated with water draining through culverts to St. James Ditch and Lateral Number 2. These culverts can handle rainfall events up to approximately the 10-year flood. Events in excess of the 10-year flood event exceed the culverts' capacities and spill out into the town and the industrial park. Hydraulic analysis revealed a ring levee around East Prairie and additional channel work within the town would solve interior drainage problems (refer to Plate 7 for improvements at East Prairie). Note that interior East Prairie drainage improvements are not part of this Phase I project.

Since no BLH or wetlands are within the proposed levee footprint, no impacts to these or associated wildlife would occur. All affected land would either be urban areas or cropland that are not regularly inundated by Mississippi River backwater and therefore are not important waterfowl, shorebirds or fishery habitat. Based on the relatively small amount of land required for this alternative and the absence of frequent backwater flooding on the levee ROW, it can reasonably be concluded there would be no measurable impacts to waterfowl, shorebirds, or fish. All other impacts of this plan on both basins would be similar to Alternative 1.

This alternative was analyzed both with and without interior drainage improvements. The project improvements on St. James Ditch will prevent the frequent flooding of the industrial park that has caused abandonment of the park's buildings, by providing a 100-year level of protection. Many other areas of town will also receive a 100-year level of protection. Virtually all the area, though, would be provided a 25-year level of protection.

Even though this alternative would provide flood protection, economic analysis revealed the costs to East Prairie, in any combination of improvements, outweigh the benefits that would accrue. This alternative has a benefit-to-cost ratio of less than 0.5 to 1 and thus is not economically feasible. Flood protection for the agricultural areas is a major portion of the original authorization and justification of the project. Limiting construction and its associated benefits to East Prairie would not provide flood protection for the agricultural areas. Further, this alternative did not address any of the city's access problems. During large flood events, the city would still become an island, isolated from necessary services until the floodwaters recede. As a result, it was not recommended for construction due to lack of economic justification. See Appendix E for a more detailed assessment of this alternative.

2.4.2 Alternative 5: St. Johns Bayou Basin Only

This alternative consists of only the channel work and the pumping station features in the St. Johns Bayou Basin. It excludes the levee closure and the pumping station in the New Madrid Floodway. This alternative is economically viable and may be more acceptable to the environmental community. However, it was not recommended for detailed analysis. It leaves the most economically sound portion of the overall project unbuilt. It is not the economic optimum alternative. Because of this, it is also not the NED plan, which maximizes positive gains to the nation's economy. Deviation from the NED plan forgoes significant economic development opportunities in the nation's production of goods and services. In addition, this alternative does not completely address the goals of the East Prairie Enterprise Community to increase the area's quality of life by producing new economic development opportunities and reducing the misery of the area's residents caused by frequent flooding.

Even though this alternative was not carried through to detailed analysis, every aspect of the recommended alternative was evaluated by individual basin as it would be if Alternative 5 was presented separately. The results are discussed and presented as separate St. Johns Bayou Basin and New Madrid Floodway elements throughout the entire document for the express purpose of providing separate documentation, should it be required.

2.4.3 Alternative 6: Wildlife Refuge

The lower portions of the St. Johns Bayou Basin and the New Madrid Floodway would be purchased for a wildlife refuge. Under this alternative, the lands would continue to receive periodic backwater flooding, yet be developed into high-quality wildlife and fishery habitat through reforestation. This alternative was studied in detail in a 1993 USFWS report (EIS) and determined to be technically feasible (U.S. Fish and Wildlife Service 1993). However, the local community would not support the proposal and provide the necessary lands even at a fair market

value. Consequently, the proposal was considered unimplementable by the USFWS and was eliminated from further consideration in this study.

2.4.4 Alternative 7: New Floodway Levee Location

The MDC proposed locating the levee closure farther north in the New Madrid Floodway, starting from Tenmile Pond and extending along St. James Bayou to tie into the Mississippi River levee northeast of Big Oak Tree State Park. This alignment with a range of pumping station sizes was studied in detail in the St. Johns Bayou and New Madrid Floodway, Missouri, Phase I GDM dated July 1980. This alignment was found to create new flood problems. It would frequently impound significant amounts of interior rainfall behind the levee on lands that formerly experienced only infrequent backwater flooding. Though a range of pump sizes was analyzed, none were large enough to compensate for the impounded rainfall. Moving the levee farther north into the Floodway would cut benefits while increasing costs. The benefits would be cut by reducing the area protected from floods, and the costs would increase with the longer length of the levee closure.

Although this alternative would provide no economic benefit and actually induce new flood problems, it would avoid significant adverse impacts to fish and wildlife resources. According to the USFWS, this alternative is more consistent with Executive Orders 11988 and 11990. Because of the extremely high costs and the absence of any tangible economic benefit, this alternative was not considered further. Additionally, a new levee in the middle portion of the Floodway could affect Floodway operation. Appendix E of this report contains a more detailed discussion of the economics of this alternative.

2.4.5 Alternative 8: Convert Agricultural Land To Silviculture

This alternative would convert frequently flooded agricultural land in both basins to silviculture. It proposes changing the land use on several thousand acres of cropland to forest through the Wetland Reserve Program (WRP) or a similar mechanism. It would reduce flood damages by changing the existing land use but would not provide any flood protection. After serious consideration, it was determined that this alternative would not be implementable. WRP has been available to landowners for many years. They have the option of participating in it now, but few choose to do so. It is reasonable to assume that landowners will continue in this mode. This alternative is very similar to purchasing the land for a wildlife refuge in Alternative 6. Although it would not provide any flood protection, it would reduce flood damages while providing recreational and economic benefits.

2.4.6 Alternative 9: Non-Structural

This alternative is a combination of non-structural measures. These include floodplain evacuation and relocation of residents, flood proofing, restrictions on future development, flood easements, conservation easements, and conversion of agricultural lands subject to frequent flooding to uses not significantly damaged by repeated flooding. Two broad categories of non-structural measures were evaluated. These were Urban (East Prairie Proper) and Rural (East Prairie Vicinity).

- Urban (East Prairie Proper) - Floodplain Evacuation: This alternative was investigated during the Phase I GDM and was not found to be economically feasible. It was investigated again for the DSEIS and found to be impractical or unimplementable from a physical location standpoint. East Prairie is already located on some of the highest ground in the area. When large floods occur, East Prairie becomes an island. For this alternative to be practical, a higher or less flood-prone location would have to be found for the citizens of East Prairie and citizens from all the other communities throughout both basins. Since no other locations are available in the immediate vicinity, this alternative was not recommended.

- Flood Proofing of Residences and Businesses: This alternative does not provide overall flood protection per se, but it can potentially reduce flood damages by making the structures more resistant to the effects of flooding. Since it does not alleviate any of the City's access problems, provide flood protection to its industrial park, protect its municipal water and sewer system, or remove any of the negative image associated with flooding, this alternative was not recommended for stand-alone construction. This alternative does offer potential as a remedy for the residual flooding that will occur after construction of the recommended alternative (Alternative 3).

- Restrictions on Future Development: Such restrictions do not help existing flood problems, but they can greatly assist in keeping situations in current problem areas from worsening and in avoiding any future problem areas. East Prairie already places significant restrictions on future development. It complies with FEMA guidelines and requires future development to be at or above the 100-year flood level. Because of this, it was determined that little could be gained from additional restrictions on future development.

- Rural (East Prairie Vicinity): Flood Easements: Flood easements were investigated as an alternative to a structural solution. They were proposed to compensate local landowners for the effects of frequent flooding. Although flood easements compensate landowners for damage, they provide no quantifiable economic benefit unless landowners change the activities that cause the flood damage. Since no flood damage would actually be reduced, no economic benefit or contribution to the national economy would occur. It was determined that flood easements are not economically feasible since they produce no economic benefit.

- Restrictive Easements: A restrictive easement could possibly produce benefits to the national economy by causing a shift to crops less susceptible to flood damage or by changing crops to shorter maturing crops, which could possibly avoid the spring or fall flood seasons. Soybeans is the major field crop that is least subject to flood damage since it is the cheapest to grow, requiring the least amount of inputs, and has the shortest growing season of any of the area's crops. The area's farmers are presently growing soybeans in the most flood-prone areas. Since no better alternative crops are available, this was not considered to be a viable option.

- Change in Land Use: This alternative was an extension of Alternative 8: Convert Agricultural Land to Silviculture. Forest practices are more tolerant to flooding than most agricultural crops. It is conceivable that conservation easements requiring the conversion of agricultural lands to woodlands could possibly reduce flood damages. This alternative used incentives other than those similar to WRP payments. Instead, the frequently flooded lands would be purchased and reforested. However, programs that provide landowners annual payments to convert wetlands from cropland to woodlands have been offered for many years. The area's landowners have not adopted these programs, indicating that agricultural production is more profitable than forest practices. If agricultural production is truly more profitable, there is no potential benefit associated with this type of restrictive easement. The DSEIS used a traditional land valuation approach to assess the benefits of this alternative and found that it was not economically justified. Also, it could require significant expenditures equivalent to, or greater than, any of the structural alternatives previously considered. Economic consideration coupled with the resistance of landowners to participate in the WRP and in the USFWS-proposed wildlife refuge led to the conclusion that this was not a viable option.

- Non-Structural Alternatives under Sections 214 and 222 of WRDA 1999: Since the DSEIS was issued, the Water Resources Development Act of 1999 (WRDA99) was passed. WRDA99 contains two sections (214 and 222) that potentially affect this non-structural alternative. Section 214 is the Flood Mitigation and Riverine Restoration Pilot Program, whereby flood damages can be reduced by restoring the natural functions and values of a river. These projects can be built provided:

  1. They will significantly reduce potential flood damages.
  2. They will improve the quality of the environment.
  3. They are economically justified considering all costs and beneficial outputs of the project.

  Also, Section 222 allows the estimation of non-structural flood control benefits similar to structural projects. Traditionally, the benefits of a non-structural alternative are estimated using a land valuation methodology. Under Section 222, the benefits can be comprised of the flood losses or flood damages avoided. In light of this recent development, the Land Use Change component of Alternative 9 was investigated further. The cost of purchasing the three-year floodplain in the New Madrid Floodway was analyzed under this proposed methodology to see if results would differ from the traditional analysis. The three-year floodplain was chosen because this is the area where most of a project's benefits typically accrue. The results of this analysis are presented in Table E-II-27 of the Economics and Social Analysis Appendix.

  This alternative was analyzed under two scenarios. The first treated the benefits and costs of woodlands (i.e., hunting and timber production from the annual benefits and woodland costs from the annual costs) as financial costs and benefits and excluded them from the economic analysis. Under this scenario, Alternative 9 was not

justified. It yields annual economic benefits and costs of $735,000 and $1,993,000, respectively, with a benefit-to-cost ratio of 0.37 to 1. The second treated the woodland benefits and costs as economic benefits and costs and included them in the economic analysis. Alternative 9 was not justified under this scenario either. It yielded annual economic benefits of $1,190,000 and annual costs of $3,085,000, with a benefit-to-cost ratio of 0.39 to 1. The estimated financial cost of the project ($41,833,000) is the same under both scenarios. Under both scenarios, the reforestation component of Alternative 9 was not economically feasible and was not recommended for implementation.

2.5 COMPARATIVE IMPACTS OF ALTERNATIVES

Table 2-1 compares the without-project conditions and lists the impacts of each detailed plan on the significant resources of the project-affected area. Economic characteristics of the plan are also compared. The significant resources are individually described in Section 4 of this SEIS, and the impacts of each alternative plan on each significant resource are discussed in detail in Section 5.

2.6 PREFERRED PLAN

Alternative 3, the Avoid and Minimize Alternative, is the preferred plan because it provides a net economic benefit to the area and causes less adverse environmental impacts than the Authorized Plan. Separate economic analyses were conducted for the levee closure feature and all other project features because they would be funded under different project authorities. The estimated cost of Alternative 3, including mitigation, is $65,133,000 ($22,914,000 for the levee closure and $42,219,000 for all other project features). This alternative provides annual net benefits of $930,000 for the levee closure and $981,000 for all other project features. The benefit-to-cost ratio is 2.6 to 1 for the levee closure and 1.2 to 1 for all other project features.

The alternative meets the study objective of flood control by reducing flooding problems in both basins. This alternative increases agricultural productivity and satisfies the needs of East Prairie, Missouri, and the overall project area. The alternative includes wetland and fish and wildlife conservation measures and mitigates unavoidable adverse impacts by restoration of 9,557 acres of primarily soybean fields to bottomland hardwood forests. This alternative and the associated mitigation would also improve the water quality of both basins as well as the Mississippi River, although relative changes in water quality are not expected to be discernable.

Table 2-2 presents the compliance status of the preferred recommended plan with Federal environmental protection statutes and appropriate executive orders and memoranda.

Table 2-1. Comparative Impacts of Alternatives

Significant Resource	Without-Project	Authorized	Avoid and Minimize
Agriculture Land	Continued risk of flooding of agriculture land and loss of crops in both basins.	Approximately 232 acres in SJBB impacted due to channel work and reforestation of easements. Two-year flood damage reduced by 31% in SJBB and 86% in NMFW. Levee construction would require 3 acres.	Approximately 219 acres in SJBB impacted due to channel work and reforestation of easements. Two-year flood damage reduced by 31% in SJBB and 86% in NMFW. Levee construction would require 3 acres.
Woodlands	Existing conditions would continue- 20,096 ac in SJBB and 10,369 ac in NMFW.	Clearing of 747 ac and reforestation of 585 ac of easements in SJBB. 14.5 ac converted to project feature in NMFW. HEP determined 2,118 mitigation acres would be reforested. About 10,312 cropland acres would be reforested in BLH with the fishery mitigation.	Clearing of 470 ac and reforesting 406 ac in SJBB. 14.5 ac converted to project feature in NMFW. HEP determined 1,546 ac to be reforested for mitigation. Reforesting 9,557 ac for fishery mitigation would fully mitigate all impacts woodland.
Wetlands	Existing conditions would continue.	107 ac of woodlands, 7 ac cropland, and 5 ac of herbaceous would be impacted by direct construction in SJBB. In NMFW, 7 ac of woodlands, 3 ac of cropland, and 2 ac of herbaceous would be impacted.	In SJBB, 78 ac of woodlands, 7 ac of cropland, and 5 ac of herbaceous land would be impacted by direct construction. About 65 wetland ac along SJ Bayou would be used to place excavated material. Loss of 7 ac of woodlands, 3 ac of cropland, and 2 ac of herbaceous in the NMFW due to direct construction. No induced losses due to hydrology and soils. Reduced Miss. River backwater and flooding on 6,680 St. Johns and 29,376 New Madrid Floodway acres (total 36,056 acres) for a 30 year flood event. About 76% are primarily soybean fields. The recommended mitigation plan compensates all habitat value losses.

Table 2-1. (cont'd). Comparative Impacts of Alternatives

Significant Resource	Without-Project	Authorized	Avoid and Minimize
Wildlife	Existing conditions would continue.	Terrestrial HEP indicated a net loss of 2,754 AAHUs in SJBB and 66 AAHUs in NMFW due to direct construction impacts. Losses would be mitigated as described under woodlands. Shorebirds result in a net loss of 119 AAHUs in SJBB and 672 AAHUs in NMFW, which would be mitigated by obtaining flood easements on 120 ac of herbaceous land for SJBB and 676 acres in the NMFW.	Terrestrial HEP indicated a net loss of 2,754 AAHUs in SJBB and 66 AAHUs in NMF due to direct construction impacts. Losses would be mitigated as described under woodlands. Shorebirds result in a net loss of 104 AAHUs in SJBB and 657 AAHUs in NMFW, which would be mitigated by obtaining flood easements on 104 ac of herbaceous land in SJBB and 660 acres in the NMFW.
Waterfowl	Existing conditions would continue.	Total DUDs would increase by 464,906 (SJBB) and 50,140 (NMFW), but decrease in February and March by 74,390 DUDs (SJBB) and 225,822 (NMFW). Acres reforested for fishery mitigation would fully compensate these impacts.	Total DUDs would increase by 545,856 (SJBB) and 53,374 (NMFW), but decrease in February and March by 6,180 DUDs (SJBB) and 222,588 (NMFW). Acres reforested for fishery mitigation would fully compensate these impacts. Additionally, water levels on up to 6,400 ponding acres would be manipulated to maximize benefits.
Fisheries	Existing conditions would continue.	Net loss of 145 HUs of in-stream habitat in SJBB. Average loss over all seasons of 1,719 HUs of rearing habitat and 988 HUs of spawning habitat in SJBB. In NMFW, average loss of 3,064 HUs of rearing habitat and 1,704 HUs of spawning habitat.	Net loss of 58 HUs of in-stream habitat in SJBB. Nine dikes would be installed in SJ Bayou as part of the mitigation. Average floodplain loss over all seasons of 1,557 HUs of rearing habitat and 905 HUs of spawning habitat in SJBB. In NMFW, average

Table 2-1 (cont'd). Comparative Impacts of Alternatives

Significant Resource	Without-Project	Authorized	Avoid and Minimize
Fisheries		Approximately 10,312 ac. of frequently flooded agriculture land would be reforested to fully mitigate this loss.	floodplain loss of 2,879 HUs of rearing habitat and 1,603 HUs of spawning habitat. The recommended mitigation plan includes the reforestation of 9,557 ac of frequently flooded agriculture land to compensate these impacts.
Mussels	Existing conditions would continue.	Channel enlargement may adversely impact mussels. No avoidance or mitigation features are included.	Channel enlargement may negatively impact mussel population. Mitigation includes avoiding a 9 ft strip along the opposite bank, relocating mussels out of the work reaches, and a 10-year monitoring plan to study re-colonization of excavated channels.
Endangered Species	Existing conditions would continue.	BA concluded the project may slightly affect the species. BA was coordinated with the USFWS as described under Avoid and Minimize.	The Corps has completed formal Section 7 consultation under the Endangered Species Act with the USFWS on the interior least tern and bald eagle. The USFWS stated the project is not likely to jeopardize the continued existence of these species or critical habitats provided certain conditions are met. The USFWS concurred that the project is unlikely to adversely impact the pallid sturgeon. The upper 3.7 miles of St. James Ditch will be eliminated to protect the state endangered golden topminnow.

Table 2-1 (cont'd). Comparative Impacts of Alternatives

Significant Resource	Without-Project	Authorized	Avoid and Minimize
Big Oak Tree State Park and Conserv. Areas	Existing conditions would continue. The park would continue to dry out.	Existing hydrology of Floodway streams would not change. These areas would continue to receive groundwater at high Mississippi River stages. Yearly rainfall would continue to supply water needs at the Tenmile Pond Conservation Area. Periodic inundation from Mississippi backwater would be eliminated from parks within the NMFW, which may adversely impact BOTSP.	Existing hydrology of floodway streams would not change. These areas would continue to receive groundwater at high Mississippi River stages. Yearly rainfall would continue to supply water needs at the Tenmile Pond Conservation Area. Periodic inundation from Mississippi backwater would be eliminated from parks within the NMFW. Relief wells and a pump in BOTSP would supply water to mimic backwater flooding. The Corps will construct the MDNR's water retention project as part of the mitigation package.
Water Quality	Existing conditions would continue.	Initial adverse turbidity and suspended solids impacts are expected to the channels immediately after construction, but existing conditions are expected to return soon after completion of construction. There would be some water quality improvements with reduced Mississippi River inundation no longer taking agrichemicals out of the basins.	Initial adverse impacts are expected to the channels immediately after construction, but current conditions are expected to return soon after completion of construction. Water quality is expected to improve inside the basins, the Miss. River, and the Gulf of Mexico with reduced flooding. Reforesting 9,557 acres would further reduce chemical transport and increase wetland filtration area.
Recreation	Existing conditions would continue.	Reduced flooding is expected to decrease recreational fishing in both basins. Waterfowl hunting may increase if the waterfowl ponding plan occurs. Reforesting 10,312 acres	Reduced flooding is expected to decrease recreational fishing in both basins. Duck hunting may increase if the waterfowl ponding plan occurs. Reforesting 9,557 acres

Table 2-1 (cont'd). Comparative Impacts of Alternatives

Significant Resource	Without-Project	Authorized	Avoid and Minimize
Recreation		Of agriculture land may increase turkey, swamp rabbit, squirrel, waterfowl, and deer hunting.	of agriculture land may increase turkey, swamp rabbit, squirrel, waterfowl, and deer hunting.
Cultural Resources	Existing conditions would continue.	No impacts expected. All sites eligible for or listed on National Register of Historic Places (NRHP) would be avoided.	No impacts expected. New ROW along St. James Ditch would be surveyed, and all sites eligible for or listed on NRHP would be avoided.
Section 122 Items	Existing conditions would continue.	No adverse impacts expected.	No adverse impacts expected.
Socio-economic	Existing conditions would continue.	Flood reduction benefits to agriculture.	Flood reduction benefits to agriculture.
Hazardous, Toxic, and Radioactive Wastes	Existing conditions would continue.	No adverse impacts expected.	No adverse impacts expected.

Table 2-1 (cont'd). Comparative Impacts of Alternatives

Significant Resource	Without-Project	Authorized	Avoid and Minimize
Total First Cost	Not applicable	MRL : $22,914,000 LRR : $41,004,000	MRL : $22,914,000 LRR : $42,219,000
Net Annual Benefits	Not applicable	MRL : $ 1,510,000 LRR : $ 4,981,000	MRL : $ 1,510,000 LRR : $ 4,688,000
Benefit/Cost Ratio	Not applicable	MRL : 2.6 LRR : 1.3	MRL : 2.6 LRR : 1.2

Notes: SJBB: St. Johns Bayou Basin
NMFW: New Madrid Floodway
HEP: Habitat Evaluation Procedure
HUs: Habitat Units
AAHUs: Average Annual Habitat Units
DUDs: Duck Use Days
NRHP: National register of Historic Places
BOTSP: Big Oak Tree State Park
MRL: Mississippi River Levee Feature (levee gap closure)
LRR: All other project design features

Table 2-2. Relationship of the Preferred Plan to Environmental Protection Statutes or Other Environmental Requirements

Item	Compliance*
Federal Statutes	
Archaeological and Historic Preservation Act	Partial Compliance*
Clean Air Act, as amended	Full Compliance
Clean Water Act, as amended	Partial Compliance*
Coastal Zone Management Act, as amended	Not Applicable
Comprehensive Environmental Response, Compensation, and Liability Act of 1980	Not Applicable
Endangered Species Act of 1973, as Amended	Full Compliance
Farmland Protection Act	Full Compliance
Federal Water Project Recreation Act, as amended	Full Compliance
Fish and Wildlife Coordination Act	Full Compliance
Land and Water Conservation Fund Act	Partial Compliance*
National Historic Preservation Act, as amended	Full Compliance
National Environmental Policy Act, as amended	Full Compliance
Native American Graves Protection and Repatriation Act	Not Applicable
Rivers and Harbors Act	Full Compliance
Watershed Protection and Flood Prevention Act	Not Applicable
Wild and Scenic Rivers Act, as amended	Not Applicable
Executive Orders, Memoranda, etc.	
Floodplain Management (E.O. 11988)	Full Compliance
Protection of Wetlands (E.O. 11990)	Full Compliance
Environmental Effects Abroad of Major Actions (E.O. 12114)	Partial Compliance*
Environmental Justice in Minority Populations and Low-income Populations (E.O. 12898)	Partial Compliance*
State and Local Policies	
State Water Quality Standards	Partial Compliance*
State Air Quality Standards	Full Compliance
Land Use Plans	
No known land use plans would be affected by any of the alternatives	

*Full compliance will be achieved after coordination of the final SEIS.

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3.0 AFFECTED ENVIRONMENT

3.1 LOCATION

The St. Johns Bayou Basin and New Madrid Floodway Project area is located in southeastern Missouri on the west bank floodplain of the Mississippi River delta. The project area encompasses parts of two drainage basins separated by a common levee.

The St. Johns Bayou Basin drains approximately 450 square miles. The area that would be directly affected by the proposed action lies immediately west of the New Madrid Floodway. Project channels begin just north of East Prairie, Missouri, and proceed south, then southwest, terminating at New Madrid, Missouri. The area is approximately 40 miles from north to south, with a maximum width of 25 miles. The immediate project area covers 324,173 acres. This First Phase of the overall project lies within New Madrid and Mississippi counties. In addition to St. Johns Bayou, Birds Point New Madrid Levee Ditch, and St. James Ditch, the other major ditches in the St. Johns Bayou Basin are St. Johns Ditch, Lee Rowe Ditch, and Maple Slough Ditch. All ditches flow south or southwest and drain into St. Johns Bayou, which empties into the Mississippi River about one-half mile upstream of New Madrid through the St. Johns Bayou outlet structure. This structure provides the only outlet for the St. Johns Bayou Basin (see plates 1 and 2).

The New Madrid Floodway covers about 183 square miles. It begins just south of Cairo, Illinois, and extends southward to New Madrid, Missouri. The eastern boundary is the frontline levee along the Mississippi River. The Birds Point - New Madrid Setback Levee separates the Floodway from the St. Johns Bayou Basin on the west. The Floodway is approximately 33 miles long, with a maximum width of 10 miles. The project area covers 132,605 acres. Major drainage in the New Madrid Floodway is provided by Mud Ditch, Wilkerson Ditch, St. Johns Diversion Ditch, Tenmile Pond, and St. James Bayou. All Floodway drainage flows into Mud Ditch, which converges with St. Johns Bayou just before emptying into the Mississippi River (see Plate 1). Except for the batture lands outside the levee, the New Madrid Floodway is the only portion of the historic Mississippi River floodplain in Missouri still largely connected to the river.

3.2 CLIMATE

The climatic conditions range from comparatively mild winters to warm summers. The average monthly temperatures range from 30 degrees Fahrenheit in January to 81 degrees Fahrenheit in July. Summer temperatures occasionally climb into the mid-90s. The average relative humidity in mid-afternoon is about 60 percent. Humidity occasionally reaches 90 percent during summer months. Annual precipitation varies from 27 to 80 inches, with a normal over the area of about 50 inches. Average precipitation is greater from late fall through early spring than throughout the rest of the year. Due to the large amount of precipitation in fall and winter, ditches are necessary to maintain extensive surface drainage. Summer precipitation is usually not sufficient for agricultural crops and irrigation is necessary. Thunderstorms occur on about 50 days each year, with most occurring in the summer. Average snowfall is between

six and 11 inches annually, but varies greatly from year to year. The prevailing winds are from the southwest, with the highest wind speeds occurring from mid-February through March.

3.3 LAND USE

Land use in the study area is predominantly (86 percent) agricultural. The major commercial crops, in order of value, are soybeans, corn, grain sorghum, double crop of wheat/soybeans, cotton, pasture and rice. Livestock production has not been emphasized. Optimum production from field crops has not been realized because of wet soil conditions. In 1970, over 13 percent of total regional employment was in agriculture. At that time, this was more than two and one-half times the average for the State of Missouri and three and one-half times that of the United States.

Of the estimated pre-settlement 2.5 million acres of bottomland hardwood forest in southeast Missouri, approximately 50,000 acres remain (L.H. Fredrickson, cited in MDC 1989). Wooded lands account for approximately six percent (20,096 acres) of the total landcover in the St. Johns Bayou Basin and approximately eight percent (10,386 acres) of the total landcover in the New Madrid Floodway.

Table 3-1 lists the total acres of each landcover type in each basin, the acres below 300 feet NGVD, and the percent distribution of each cover type as determined by recent satellite imagery, aerial photography, ground surveys, and GIS delineation. The acres below 300 feet NGVD are shown because this is the maximum practical limit of backwater flooding. A GIS map of cover types is shown in Plate 8.

3.4 TOPOGRAPHY

Since the retreat of the last glacier over 10,000 years ago, the Mississippi and Ohio River channels traversed back and forth across the area, gradually silting in the original valleys and low rolling hills within the alluvial valley. The project is situated in the braided-relict alluvium deposited by the Mississippi - Ohio River complex. The low-lying delta land on the east side of the project area gradually changes on the west to a series of low sandy ridges with swampy sloughs between the ridges. These low ridges are tongues of sand that were not removed by previous river meanders. The topography is characteristic of a large river delta. The area is relatively flat, with elevations ranging from 280 to 325 feet NGVD.

3.5 HYDROLOGY

The drainage basins of both St. Johns Bayou and New Madrid Floodway are situated on a landscape of ridges and troughs created by the meanderings of the Mississippi and Ohio rivers. In recent geological time, the two basins have been subjected to two vastly different hydrologic processes: local runoff events and flooding by the Mississippi River.

Table 3-1. Landcover Types in St. Johns Bayou Basin and New Madrid Floodway

St. Johns Bayou Basin Total Landcover		
Land Use	Total Acres	% Landcover
Forested	20,096	6%
Scrub-shrub/Marsh	269.6	0.1%
Cropland	280,289.8	86.5%
Pasture	1,277.4	0.3%
Herbaceous	21,121.0	6.5%
Open Water	944.2	0.3%
Sandbar	166.5	0.1%
Urban	8.1	0%
Total	**324,172.8**	**100%**

New Madrid Floodway Total Landcover		
Land Use	Total Acres	% Landcover
Forested	10,368.7	7.8
Scrub-shrub/Marsh	878.2	0.7%
Cropland	113,007.3	85.2%
Pasture	922.2	0.7%
Herbaceous	6,624.7	5%
Open Water	797.3	0.6%
Sandbar	6.6	0%
Urban	0	0%
Total	**132,605.1**	**100%**

St. Johns Bayou Basin Landcover 300 feet and Below		
Land Use	Total Acres	% Land cover
Forested	6,164.3	11.2%
Scrub-shrub/Marsh	83.0	0.2%
Cropland	44,545.8	81%
Pasture	176.2	0.3%
Herbaceous	3,742.0	6.8%
Open Water	287.0	0.5%
Sandbar	0	0%
Urban	0	0%
Total	**54,998.2**	**100%**

New Madrid Floodway Landcover 300 feet and Below		
Land Use	Total Acres	% Land cover
Forested	7,913.8	10.5%
Scrub-shrub/Marsh	451.5	0.6%
Cropland	61,799.1	82.3%
Pasture	340.7	0.5%
Herbaceous	3,881.1	5.2%
Open Water	691.4	0.9%
Sandbar	0.2	0%
Urban	0	0%
Total	**75,077.7**	**100%**

Over a period of several decades, structures were installed to permit cultivation in the two basins. Ditch systems now provide an increased surface water removal rate; but due to the very small slope of the landscape, existing condition runoff hydrographs are still characterized by slow rises, low peaks, and prolonged recession. In the case of the St. Johns Bayou Basin, the installation of levees and gates has reduced the impacts from hydrologic effects of the Mississippi River.

Data available for hydrologic analysis included records of local rainfall and Mississippi River stages. Rainfall records were available for Cairo, Illinois, New Madrid, Missouri, and Sikeston, Missouri. New Madrid gage data for the Mississippi River provided daily river elevations at the outlets of both basins. Only limited gage data were available to describe local runoff events for St. Johns Bayou, and no gage data were available for the New Madrid Floodway. Therefore, the two basins were modeled to provide discharge estimates for single events of selected probability and also continuous daily discharges over a 1943-1974 simulation period.

More detailed information on basin hydrology and hydraulics is presented in GDM 101, St. Johns Bayou and New Madrid Floodway, Missouri, dated August 1986, and also in the hydraulic analysis contained in Appendix J of this report.

3.6 FLOODPLAIN ECOLOGY

The St. Johns Bayou Basin and the New Madrid Floodway are part of the Mississippi River floodplain, and although highly altered, still perform floodplain functions required by regional fish and wildlife resources. The total two-year floodplain from Cairo, Illinois, to Caruthersville, Missouri, contains approximately 177,571 acres, of which about 17,284 acres are in the New Madrid Floodway. The Floodway represents less than 10 percent of the total Mississippi River floodplain within the identified 113-mile reach. Bottomland hardwoods located within the New Madrid Floodway comprise about 5.6 percent of the land cover within this reach. The Floodway is still largely connected to the Mississippi River, which annually inundates much of the lower study area, providing an important exchange between terrestrial habitats and the aquatic system.

Such flood pulses have been called the principal driving force for the existence, productivity, and interactions of the major biota in river-floodplain systems (Junk *et al.* 1989). Not only do floodwaters rejuvenate aquatic habitats (e.g., bayous, oxbows, sloughs, ditches, ponds, and wetlands) on the floodplain, they also provide access to the floodplain's productivity, which is far greater than that of the river main stem (Junk *et al.* 1989, Guillory 1979). Much of that productivity is organic detritus (leaves, grasses, etc.); however, invertebrate levels are also significant. Eckblad *et al.* (1984) found that the number of macroinvertebrates drifting from an upper Mississippi River backwater was three to eight times higher than in the main channel upstream of the backwater. Hrabik (1994) notes that floodplain production is high relative to the other macrohabitats based on estimated zooplankton densities and biological oxygen demand rates. In 1993, zooplankton density was 500 times greater in the wide versus the moderately wide floodplain near Cape Girardeau (Hrabik 1994). That productivity in turn supports the fisheries and other aquatic resources of the river proper (Junk *et al.* 1989, Amoros 1991, Lambou 1990, and Welcomme 1979).

The floodplain also provides habitat essential for spawning, foraging, and refuge to numerous aquatic species. Fishes that seasonally use the floodplain dominate the fisheries, biomass, and production in river-floodplain systems (Junk *et al.* 1989). Approximately half of the fish species of the lower Mississippi River use the floodplain as a nursery (Gallagher 1979). In most years, rising river levels inundate the floodplain in the spring, while rising temperatures and increased photoperiod trigger spawning in numerous fish species. Turner *et al.* (1994) collected more larval and juvenile fish from the floodplain than from the adjacent river, consistent with several other studies. Unlike the main stem of the river, the floodplain is characterized by slackwaters, and organically rich substrates (Guillory 1979, Rissoto and Turner *et al.* 1994), important habitat for fish spawning and rearing. Those areas often have aquatic vegetation, snags, and logs that also provide refuge from predators (Killgore and Hoover 1998).

High spring river stages may be positively correlated to forage fish production. Junk *et al.* (1989) and Tibbs (1995) stated that regular flood pulses that inundate the floodplains of big rivers are crucial to nutrient cycling, biodiversity, and fish production. Dugger (1997) agreed with Tibbs (1995) that the lack of connection between the floodplain and the river likely results in decreased fish populations during years when the spring flood-pulse does not exceed bank full. Many years of river stage data indicate that rarely is there a total lack of spring flooding over the entire lower Mississippi River floodplain (U.S. Army Corps of Engineers 1930-1997). Relatively low inundation still provides thousands of acres of fish spawning habitat to complement that found in the tributary stream floodplains throughout the Lower Mississippi River Valley.

The pulse of floodwater inundating BLH and other habitat types within a floodplain is important in maintaining diverse fish populations. Evaluation has focused on springtime reproductive and recruitment biology of fishes. During low flows, a restricted floodplain concentrates fish into the river channel. A study by Killgore and Hoover (1996, unpublished data) in the Big Sunflower River system in Mississippi, indicated that extremely shallow water (less than one foot) is not extensively used by larval fish. Their data suggest that larval fish preferentially exploit depths of three to four feet. Use of shallow water by larvae generally coincides with the presence of vegetation, shade, submerged branches, or other forms of structure (Wallus *et al.* 1990; Killgore and Baker 1996). The majority of the inundated land within the New Madrid Floodway during spring is bare soil and soybean stubble. Killgore and Hoover (1998) further state that absence of cover, particularly in shallow water, makes fish more vulnerable to predation and possible stranding during receding water levels. Without predators, numbers of small fish remain high in shallow water, food and space become limited, and competition is likely. Therefore, fish productivity in rivers is largely regulated by water elevation, but also structural complexity of inundated areas. In this regard, forested floodplain will have a greater habitat value than cleared floodplain.

Spring floods also benefit other wildlife. Many species of amphibians throughout the project area require shallow waters to successfully reproduce. In addition to permanent ponds, sloughs, and ditches, spring flooding can cover up to 75,000 acres in the New Madrid Floodway alone during rare flood events. As those waters recede, they create thousands of ephemeral ponds critical to maintaining a healthy and diverse amphibian population. Even though periodic

inundation helps create ephemeral ponds, most of these ponds are made when increased late winter and early spring rainfall fills the low-lying areas located on clay soils. In addition, flooding increases invertebrate biomass, which then becomes an important protein source for waterfowl and shorebirds on their migration to northern breeding grounds (Helmers 1992, Reinecke *et al.* 1989).

Mississippi and New Madrid counties, which includes the project area, support more diverse habitats and natural communities than elsewhere in the Bootheel region of Missouri. That increased diversity is reflected in the number of State-listed plant, mussel, fish, amphibian, reptile, bird, and mammal species reported for the two-county area (Table 3-2). This diversity is due in part to the influence of the river's annual hydrologic regime on the lower St. Johns Bayou Basin and New Madrid Floodway ecosystems. The area provides important breeding, migration, and overwintering habitat for numerous species. The forested wetlands in the project area, a small remnant of a once extensive forest complex, are scarce. These wetlands are critical as refugia to numerous species that once flourished on the floodplain. In spite of numerous modifications, the varied habitats within the project area contribute significantly to Missouri's biodiversity. Although greatly altered, the project area still functions as an integral part of the ecology of the lower Mississippi River.

3.7 GEOLOGY

The deep underlying basement rock consists of Cretaceous marine deposits and sediments from surrounding uplands that filled in a continental rift that created the Gulf of Mexico Basin in Late Triassic or Early Jurassic times (Buffler 1991). Since that time, sedimentation has progressed and formed the present-day Mississippi River delta. The New Madrid Fault is the most notable geologic structure associated with the study area. It is an ancient rift fault that did not fully separate. It is generally believed that the fault extends from about Cairo, Illinois, to the vicinity of Helena, Arkansas. The most violent earth tremors ever on the North American continent occurred along this fault in December of 1811 and early 1812, with the epicenter near New Madrid, Missouri.

3.8 MINERALS

The area's mineral resources are limited to sand and gravel deposits excavated on the uplands of nearby Crowley's Ridge and the in-channel and floodplain deposits of the Mississippi River. No other commercially valuable minerals have been found in the area.

3.9 SOILS

The St. Johns Bayou Basin is covered by nearly 200 feet of recent alluvial deposits of sandy loams, clays, sands, and gravels underlain by Tertiary sediments. All soils were formed in alluvium that was sorted by the Mississippi River or ancient Ohio River as they overflowed the

Table 3-2. State-Listed Rare and Endangered Species in New Madrid and Mississippi Counties

Plants	Mississippi*	New Madrid*
Gourd (*Cayaponia grandifolia*)	E	
Juniper leaf (*Polypremum procumbens*)	R	R
Lake cress (*Armoracia lacustris*)	SU	
Trepocarpus (*Trepocarpus aethusae*)	SU	
Primrose willow (*Ludwigia leptocarpa*)	E	
Yellow false mallow (*Malvastrum hispidum*)	WL	
Arrow arum (*Peltandra virginica*)	R	
American frogbit (*Limnobium spongia*)	E	
American cupsale (*Sacciolepis striata*)	E	
Swamp loosestrife (*Decondon verticillatus*)	E	
Bristly sedge (*Carex comosa*)	R	
Sedge (*Carex socialis*)	SU	
Swan sedge (*Carex swanii*)		WL
Corydalis(*Corydalis micrantha*)		E
Leatherflower (*Clematis viorna*)		E
Finger dog-shade (*Cynosciadium digitatum*)		R
Weak nettle (*Urtica chamaedryoides*)	E	E
Narrow-leaved wild crabapple (*Malus augustifolia*)		E
Eastern blue-eyed grass (*Sisyrinchium atlanticum*)	R	R
An umbrella sedge (*Cyperus retroflexus*)	E	
An umbrella sedge (*Cyperus grayoidies*)		E
Many-spiked cyperus (*Cyperus polystachos*)		E
Baldwin's cyperus (*Cyperus croceus*)		E
Mussels		
Rock pocketbook (*Aricidens confragosus*)	R	R
Wartyback (*Quadrula nodulata*)	R	R
Flatfloater (*Anodenta suberbiculata*)	R	R
Texas lilliput (*Toxolasma texasensis*)	R	R
Fish		
Harlequin darter (*Etheostoma histrio*)	E	
Pugnose minnow (*Opsopoeodus emiliae*)	WL	WL
Flier (*Centrarchus macropterus*)	WL	
Ironcolor shiner (*Notropis chalybaeus*)	WL	WL
Mississippi silvery minnow (*Hybognathus nuchalis*)	WL	
Pallid sturgeon (*Scaphirynchus albus*)	E	
River darter (*Percina shumardi*)	WL	
Blue sucker (*Cycleptus elongatus*)		WL
Lake chubsucker (*Erimyzon sucetta*)	R	R
Brown bullhead (*Ameiurus nebulosus*)		R

Table 3-2. State-Listed Rare and Endangered Species in New Madrid and Mississippi Counties (cont'd)

	Mississippi*	New Madrid*
Fish		
Mooneye (*Hiodon tergisus*)	R	R
Striped mullet (*Mugil cephalus*)		R
Paddlefish (*Polyodon spathula*)	WL	
Sicklefin chub (*Macrhybopsis meeki*)	E	
Golden topminnow (*Fundulus chrysotus*)	E	
Reptiles and Amphibians		
Illinois chorus frog (*Pseudacris streckeri illinoensis*)	R	R
Western chicken turtle (*Deirochelys recticularia miaria*)	E	
Eastern spadefoot *(Scaphiopus holbrookii*)	R	
Alligator snapping turtle (*Macroclemys temminckii*)		R
Birds		
Bald eagle nest (*Haliaeetus leucocephalus*)	E	E
Heron (Ardeidae) rookery	R	
Mississippi kite nest (*Ictinia mississippiensis*)	R	R
Pied-billed grebe (*Podilymbus podiceps*)	R	R
Interior least tern (*Sterna antillarum athalassos*)	E	E
Barn owl (*Tyto alba*)	R	R
Swainson's warbler (*Limnothlypis swainsonii*)		E
Mammals		
Swamp rabbit (*Sylvilagus aquaticus*)	R	R
Cotton mouse (*Peromyscus gossypinus*)		R
Communities		
Wet Bottomland Forest	R	R
Swamp	E	E
Shrub swamp	R	

Contained in the USFWS CAR (Appendix C); Source: MDC (1997a and b), Carter and Bryson (1991)

* Status Codes: E: Endangered; R: Rare; WL: Missouri Watch List; EXT: Extirpated from Missouri; SU: Species Undetermined

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main channel or entered the deltaic plain. Gravels were deposited first, next sand, then finer clayey sediments on top as floodwater continued. Numerous deep clay plugs penetrate the underlying sands and gravels, marking the paths of ancient oxbows and river channels. There are two basic surface soil associations deposited in broad basins and former channels of the Mississippi and Ohio rivers. One association (Sharkey - Alligator) originated along the floodplain from clayey sediments deposited by still water in backwater swamp areas. When wet, these soils are sticky and plastic; when dry, they become hard and crack. The other major association (Dundee - Forestdale) originated along natural levees and adjacent lowlands from a former Ohio River alluvial fan. These soils are somewhat poorly drained and are found in higher areas of the St. Johns Bayou Basin. They are also somewhat acidic and require lime for optimum crop yields. Runoff is slow due to the low ground elevations, high water table immediately below the ground surface, and very low soil permeability. Both associations are poorly drained and are subject to wind and surface water erosion.

3.10 WATER QUALITY

A water quality study of the total St. Johns Bayou and New Madrid Floodway Project area was performed by the Corps of Engineers in 1978. Water quality limits were derived from studies conducted by MDNR. Sediment analyses were also performed in December 1978, February 1979, and August 1979. These studies are discussed in the Water Quality section of the September 1980 Technical Appendix of the GDM (U.S. Army Corps of Engineers 1980). Additional water quality data for the same general area are available from a study conducted by Environmental Science and Engineering, Inc. (ESEI) in 1977 and 1978 (ESEI 1978). See Appendix J for additional information.

Studies of dredging operations have revealed that toxic substances in the sediment will not necessarily be released into the water during dredging and that most of the materials released rapidly settle out or are reabsorbed by the particulate matter (Fulk *et al.* 1975). A total of 46 separate water quality parameters were examined. At the time these tests were done (for the 1981 GDM), the results of all parameters, except mercury, fell below or within the lower limits established by the EPA and the State of Missouri. Only at one site was the mercury concentration slightly elevated. No parameter moved from an acceptable level to an unacceptable level.

In October 1977, ESEI tested for pesticide levels in fish flesh and found all to be below the maximum limits set by the EPA. However, a few samples contained mercury concentrations in excess of the maximum safe level for human consumption. Because of its persistence and bioaccumulative property in the flesh of aquatic organisms, mercury is considered harmful to humans. Thus, EPA expressed concern and requested further sampling and testing on fish flesh. Analyses of these samples revealed mercury levels within the EPA limits, which satisfied EPA concerns.

All of the earlier water quality analyses are contained in the St. Johns Bayou and New Madrid Floodway, Missouri, Phase I GDM, Volume II, EIS and Technical Appendices, Revised December 1981, on file with the Memphis District Corps of Engineers. Test results at that time indicated no serious release or accumulation of toxic materials during or after dredging. When

the GDM was submitted, and subsequently approved by all reviewing agencies, the long-term effects of the overall project were estimated to be negligible. Land use and cropping practices have not changed significantly from 1981 when the water quality tests were performed. Because of more stringent controls on pesticide use and other chemicals since the time of the GDM, it was reasonable to assume that project impacts related to toxic materials would be no worse than in 1981.

However, since the early GDM, different agrichemicals have come into use. Because of this, and the potential changes in crops, new water quality analyses were completed (U.S. Army Corps of Engineers 2000). Methods used in the supplemental water quality analyses were developed by the U.S. Army Engineer Research and Development Center (ERDC) Environmental Laboratory (EL) and presented to the Memphis District, EPA, USFWS, and MDNR prior to implementation. All agencies agreed the approach and methodology were acceptable to meet the requirements of NEPA, and the analyses were conducted. An additional review of the input data and rationale was requested from the above agencies. Memphis District personnel verified land use and hydrology data, and USFWS personnel provided comments on material processing that were incorporated into the mass balance analyses.

The results of the recently conducted water quality analyses are contained in Appendix J. These revealed no substantive changes in crops and cropping patterns and agrichemical use and very minimal changes in water quality both inside the basins and in the Mississippi River. Since no wetlands will be lost other than 167 acres required for construction, there will be minimal net changes to wetland functions in the basins pertaining to water quality. The addition of 9,557 acres of restored wetlands acquired by reclaiming cropland will provide a positive impact through a reduction in available material associated with agricultural land and a positive, long-term impact with the establishment of additional forested wetland acres. Thus, the same conclusion can be made now as was made for the previous analyses: water quality is expected to return to the existing levels soon after construction is completed.

3.11 SOCIOECONOMIC PROFILE

When the 1986 Phase II GDM was published, urban and built-up areas accounted for only 1.9 percent of the land area. In the Revised December 1981 GDM, it was estimated that manufacturing output would increase in excess of 500 percent over the next 50 years (1979-2039). Manufacturing is limited to relatively small plants, which produce and export such items as furniture, apparel, electrical devices, and metal tubing. The anticipated increase in manufacturing output is considered important to the economy and continued growth of employment opportunities in the area.

Mississippi County has the largest percent urban population, with 69.1 percent of its population residing in Charleston and East Prairie. New Madrid County has only 32.3 percent of its population residing in the two communities of Portageville and New Madrid. All have populations over 2,500. Approximately 45.9 percent of the area's total population resides in these four communities. The study area does not contain any major metropolitan areas. The closest major population center is Sikeston, Missouri, in nearby Scott County, which had a 1990 population of 17,641. The population of the study area has declined from 40,067 in 1970 to

33,226 in 1990, a 17.1 percent decrease. This trend is typical of most rural, agricultural based economies. Many of the study area residents have moved to more urbanized areas that offer better job opportunities. This is reflected in the greater percentages of preschool and school age children and elderly in the study area than in the State of Missouri. Following the national trend, the number of persons per household has also decreased over the last decade. From 1970 to 1990, the labor force of the study area lagged behind the statewide increase. This is also reflective of a rural and agrarian area.

Manufacturing is the largest employer, followed by wholesale and retail trade. Agriculture is the third largest employer, with employment rates ranging from a high of 11.6 percent in Mississippi County to 11.9 percent in New Madrid County. Overall industry employment figures indicate that the study area has a greater percentage of its population dependent on agriculture than the average for the State of Missouri. The study area is less dependent on employment in public administration, health, finance, insurance and real estate than the rest of the State. Consequently, agricultural flooding can have a greater effect on employment in the study area than it would elsewhere. Impacts to agriculture have significant spin-off effects on wholesale and retail trade.

Total personal income is the principal component of gross national product. Personal income statistics from the 1990 census show personal income to be up approximately 70 percent over 1979 levels. Per capita income in the study area in 1989 was approximately 70 percent of the State average. This is reflective of the rural nature of both counties. Rural per capita incomes are historically lower than those of more urbanized areas. As a measure of relative wellbeing, these numbers can be compared to housing statistics. Housing prices in the study area are approximately 54 percent of the State average, which indicates that housing may be relatively more affordable in the study area than other areas.

Massive restructuring of farm financial markets that took place in the mid-1970s significantly changed the economic structure of agriculture. The value of farm products sold decreased by 21.9 percent in Mississippi County and 17.4 percent in New Madrid County. As a result, the number of farms declined while the size of the remaining farms increased between 40.5 percent and 51.5 percent as smaller farms were incorporated by the large agribusinesses. With the decline in agricultural activity in the project area, there has also been a decrease in some other sectors of the economy. From 1977 to 1992, the number of wholesale business establishments decreased with dramatic declines in sales. Retail business also showed decreases in the number of firms and sales volumes. This is contrary to the State of Missouri trend.

The balance sheet for local governments, depending on mandated expenditures, can reflect the health of the local economy. Growing revenues generally mean a thriving economy, while growing expenditures coupled with declining revenues can mean an economy in distress. Unlike many parts of the country, the growth in local government revenues in the project area has exceeded the growth in expenditures. In 1977, both counties in the project area spent significantly more than their revenues. By 1992, this trend was reversed, with both counties having revenues exceeding expenditures. Over this period, Mississippi County's revenues grew 19.3 percent while its expenditures fell 3.7 percent. New Madrid County experienced similar trends, with revenues increasing 14.4 percent and expenditures falling 18.3 percent.

Unfortunately for the project area, this trend does not reflect a thriving local economy. Instead, it signifies the fiscal accountability of local government officials as they balance their budgets to prevent continued deficit spending and its resulting problems. To put this trend in perspective, these figures can be compared to the State of Missouri figures, which show increases in revenues and expenditures of 153.7 percent and 164.1 percent, respectively, over this period. For further information, see the detailed socioeconomic analysis for this project contained in Appendix E of this report.

4.0 SIGNIFICANT RESOURCES

4.1 AGRICULTURAL LAND

Most of the project area is in agricultural production. Crop distribution acres used for this discussion were obtained from GIS survey data. The GIS, however, was unable to distinguish between corn and milo. It also did not account for winter wheat, since the satellite imagery was obtained after wheat fields had been planted in soybeans.

The St. Johns Bayou Basin has approximately 280,290 acres of cropland. Soybeans, which comprise approximately 175,793 acres, or approximately 63 percent of the total planted acres, is the major crop within the floodplain and is expected to remain so. Corn, at 64,226 acres, or approximately 23 percent, is the second crop. Milo is planted on approximately 32,194 acres, amounting to 11 percent of the cropland. Cotton is planted on approximately 7,960 acres, or three percent of the cropland. Approximately 51,394 acres of winter wheat are double cropped on land that is later planted in soybeans. Winter wheat is planted on 18 percent of the farmland. Less than one percent of the land (1,277 acres) is kept in pasture.

When the St. Johns Bayou floodgates are closed, impounded runoff water is trapped inside the basin. Headwater flooding occurs with severe thunderstorms or prolonged rain events. Agricultural damages from headwater flooding are usually limited to acres along the channels and streams once carrying capacity is exceeded and waters flow out of top banks. Backwater flooding inundates a percentage of farmland that is subject to headwater flooding when the water cannot drain into the Mississippi River. Over the period of record, these events ranged from approximately 30 percent of the time along St. Johns Bayou to as little as three percent of the time along the upper reaches of St. James Ditch near East Prairie, as can be seen in Table C-30 in Vol. 3 of the 1986 Phase II GDM (U.S. Army Corps of Engineers 1986).

Cropland is the most significant resource to the economy of the project area. As such, the impacts to prime and unique farmlands must be addressed. It should be noted that the NRCS classified prime and unique areas by reviewing soil types in each county that were considered prime and unique (and thus placing them all in one category) and not by a specific on-site survey. These classification were based on published soil survey manuals dated 1977 (New Madrid County) and 1981 (Mississippi County). Several of the acres listed as prime and unique are currently located in and along ditches and may actually be berm areas formed from deposition from ditch cleanouts or the ditch itself, and therefore are not farmed. In addition, acres located in the lower parts of St. Johns Bayou Basin and New Madrid Floodway are frequently flooded and therefore do not meet the definition of prime and unique farmlands.

Based on this information and discussions with NRCS personnel, it is unlikely that any prime and unique farmlands (or a very small quantity) are actually located within the project area or will be impacted by this project.

Agriculture is also the major resource in the New Madrid Floodway, with 113,007 acres of cropland. As in the St. Johns Bayou Basin, soybeans are the major crop, comprising approximately 88,398 acres, or 78 percent of the total planted acres. Corn, at approximately 14 percent and 15,508 acres, is the second crop. Milo is planted on 7,769 acres, or seven percent of the farmland. Winter wheat is also double cropped with soybeans. Approximately 25,844 acres of winter wheat are planted prior to soybeans, comprising 23 percent of the farmland. Less than one percent of the land is in pasture (922 acres).

Mississippi River backwater passing through the levee gap annually inundates thousands of farmland acres in the spring. This backwater flooding can cover up to 57,468 acres of agricultural land during a 25-year flood event.

4.2 WOODLANDS

The southeastern lowlands of Missouri were originally extensively forested with a climax lowlands - swamp hardwood forest that was removed, for the most part, in the early 20th century. Over 96 percent of the originally forested areas have been cleared for agriculture and municipal uses. Approximately 20,096 acres of bottomland hardwood (BLH) forest remain in the St. Johns Bayou Basin, with approximately 6,164 acres (30 percent of the total woodland in the basin) below the 300 feet NGVD elevation. There are approximately 10,369 acres of forested land in the New Madrid Floodway, with approximately 7,913 acres (76 percent of the total woodland in the basin) below the 300 feet NGVD elevation. With few exceptions, the remaining smaller woodland stands are found on poorly drained sites unsuitable for agriculture due to their topographic position and the degree and duration of inundation or soil saturation. Many of these stands are too small to be harvested efficiently (Yorder 1976). Other small wooded plots were left as shade for cattle when the land was originally cleared. A few embankments along several of the larger ditches were never reused as deposition sites following earlier channel enlargement or maintenance. Stretches of these old embankments now contain a diverse assemblage of large, mature trees that provide a semi-upland forest habitat type.

Within the project area, there are approximately 10,207 acres of forested wetlands, which comprise approximately 34 percent of the total forested acreage. These are described in more detail in the next section on wetlands. Bottomland hardwood forests are productive in terms of fish, wildlife, and commercial forest products. When flooded, these forests provide aquatic habitat for fish, waterfowl, and other wetland wildlife. White-tailed deer, swamp rabbit, gray and fox squirrels, wood ducks, and mallards are common game species found throughout this habitat type. These forests also support an abundance of songbirds, small mammals, reptiles, and amphibians. Commercial forest products that could be derived from these wooded lands include lumber, veneer, wood pulp, and firewood.

Three large tracts of woods remain in the New Madrid Floodway. Big Oak Tree State Park (approximately 1,007 acres) and Bogle Woods (approximately 1,200 acres) and the

privately owned wooded tract north of Tenmile Pond Conservation Area are situated in clay-type soils located on silted-in ancient oxbow lake beds. A third tract located at the lower end of the New Madrid Floodway is owned by the Westvaco Timber Company. In the lower end of the St. Johns Bayou Basin, three larger wooded tracts have not been cleared due to the low ground elevation and persistent saturated soil conditions. Overall, the large forested tracts have retained their wooded cover because they are in public or timber company ownership, because of owner preference, or because it is infeasible under existing hydrologic conditions to clear the land for agricultural use.

Three main woodland types in the study area are: (1) riparian cottonwood - willow, (2) subclimax of sugarberry - American elm - green ash, and (3) woodland swamp of swamp chestnut oak - cherrybark oak (Yorder 1976). Other species include overcup oak, willow oak, red oak, bur oak, bitter pecan, persimmon, red maple, silver maple, baldcypress, pond cypress, hickory, boxelder, sweetgum, honey locust and river birch. Tree species composition of the forest varies according to the extent and duration of flooding in any particular area.

4.3 WETLANDS

Wetlands are defined by Title 33, Part 323 CFR, dated 22 January 1977, Regulatory Program of the Corps of Engineers: "Wetlands means those areas that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and that, under normal circumstances, do support a prevalence of vegetation typically adapted for life in saturated soil conditions."

The Corps prepared general wetlands maps of the project area for environmental impact analyses, environmental planning, and resource inventory purposes. The wetlands maps were developed from satellite imagery, hydrologic data, and county soil survey maps using the general criteria specified in the 1987 Wetland Delineation Manual for jurisdictional wetland delineation: percent dominance of hydrophytic vegetation, frequency and duration of flooding during the growing season, and the presence of hydric soils. Because of the large drainage basins (456,778 acres), costs and time constraints prohibited mapping of wetlands to the same degree of detail and accuracy as would be routinely done for evaluation of individual Section 404 permits for small areas. Based on the analysis performed, the project area was found to contain approximately 67,396 acres of wetlands, of all types, comprised of 75 percent cropland and 15 percent BLH forests. The remaining 10 percent included open water, herbaceous, and pasture (See tables 2 and 4 in the Wetland Appendix D).

4.3.1 Wetlands Delineation

The methodology chosen for this project and agreed to by the interagency team was an offsite determination with limited groundtruthing using the five percent duration elevation as a wetland hydrology indicator. Land located at elevation 300 feet NGVD and below within both the St. Johns Bayou Basin and New Madrid Floodway was considered to be the area that would be potentially impacted by the proposed project through reduction in the degree and duration of flooding. This area constitutes the maximum practical extent of flooding in both basins due to backwater events. The 300 feet NGVD contour is in excess of a 70-year flood event in the St. Johns Bayou Basin and in excess of a 30-year flood event in the New Madrid Floodway.

Because of the extensive area covered by the jurisdictional determination, certain assumptions were made about vegetation, soils, and hydrology based upon preliminary field investigations. These assumptions were then applied to the entire project reach. The following is a description of the key assumptions.

1. Vegetation: An existing geographic information system (GIS) database characterizing vegetation cover and land use over a large portion of the project area was used as a preliminary tool for assessing wetland vegetation. Based on hydrologic data, landscape position, soil survey data, and best professional judgment, it was assumed that those areas with dominant facultative plants primarily occupied nonwetland areas, whereas facultative wetland and obligate plants were assumed to occupy wetland areas. This assumption was supported by individuals familiar with the distribution of species in the basin and by guidance in the 1987 Wetland Delineation Manual (Environmental Laboratory 1987) that cautions users that facultative-dominated plant communities may not meet wetland hydrology criteria.

2. Soils: Mapped areas that contained soils that were found on the local hydric soils list were assumed to meet hydric soils criteria. Areas with nonhydric soils and those with hydric inclusions were generally considered to be nonwetlands following the 1987 manual criteria.

3. Hydrology: According to the Wetland Delineation Manual, the upper limits of jurisdictional wetlands meeting wetland hydrology are those areas that are flooded, ponded, or saturated for at least five percent of the growing season in most years. An inundation analysis based on the methodology in the 1987 manual was selected as an appropriate tool to identify wetland hydrology in the project area.

Determination of wetland hydrology was the first activity in the delineation of the project area's wetlands. This was accomplished in a two-step approach: 1) calculation of wetland profiles from an inundation analysis; and 2) aerial identification of wetlands based on satellite imagery and field inspection. Calculations of sump elevations meeting the requisite wetland hydrology in the St. Johns Bayou Basin and the Mew Madrid Floodway were determined based on the five percent continuous inundation criterion. These elevations were based on the combined effects of Mississippi River stages, local runoff events, and project operations such as gate closure and pumping, if applicable. The elevations do not account for wetland areas such as shallow depressions that hold water under existing and project conditions for extended periods of time after inundation occurs. Following completion of the inundation analysis, a satellite image dated April 22, 1993, was selected that approximated the five percent growing season water surface elevation calculated for the project area. The Mississippi River elevation at New Madrid was 290.5 feet NGVD at the time of the image. This compares with the calculated five percent duration elevations of 289.4 feet NGVD in the St. Johns Bayou Basin and 290.0 feet NGVD in the New Madrid Floodway. In addition, the image was taken after a period of plentiful rainfall and so identified additional wet areas. The wetland scene developed from the image identified all areas with wetland hydrology potentially impacted by project implementation.

The areas meeting wetland hydrology from the satellite image were classified. Eight classes of land cover were delineated: forested, scrub/shrub marsh, herbaceous vegetation, cropland, pasture, sandbars, urban, and open water. The landcover maps were entered into the GIS database for analysis. The project area was further classified into wetland and nonwetland areas. Available offsite information was entered into the GIS database and used to assess the wetland characteristics of vegetation, soils, and hydrology using the assumptions previously listed.

After preliminary classification of wetlands, the wetlands map was sent to all team members prior to groundtruthing. The Corps requested the interagency group to participate in field identification and verification for this project. Other Federal and State agencies opted not to participate due to time, cost, and staffing constraints. The wetland types to be mapped and all subsequent wetland information for the project were forwarded to the entire study team for review and comment as soon as they became available. Since they were accepted by all the study team agencies for their use, the Corps proceeded with the wetlands delineation and impact analyses presented in this report, with the understanding between the Corps and the interagency team that wetlands identified and mapped in this analysis were not intended for regulatory use.

The Corps' delineation indicated 30,622 acres of wetlands in the St. John Bayou Basin, with 13,553 at or below 300 feet NGVD. Within the 300 feet elevation 9,303 wet cropland acres are subject to inundation (Table 4-1).

Table 4-1. St. Johns Bayou Basin Wetland Acres

Land Use	Total Wetland Acres	Wetland Acres 300 and below (Subject to Inundation from backwater flooding)	Authorized Impacts				Avoid & Minimize Impact			
			Acres	% Total Directly Impacted	Acres Indundation reduced	% Total Inundation Reduced	Acres	Percent total acres	Acres Indundation reduced	% Total Inundation Reduced
Forested	4,473	3,164	107	2.4%	592	13%	78	1.8%	565	13%
Scrub/Shrub/Marsh	13	4	0	0.0%	1	9%	0	0.0%	1	9%
Cropland	22,999	9,303	6	0.0%	5,633	24%	6	0.0%	5,633	24%
Pasture	135	76	0	0.3%	19	14%	1	0.4%	19	14%
Herbaceous	2,045	719	5	0.3%	295	14%	5	0.2%	295	14%
Open Water	944	287	3	0.3%	169	18%	0	0.0%	166	18%
Sandbar	11	-	-	0.0%	-	0%	-	0.0%	-	0%
Urban	2	-	-	0.0%	-	0%	-	0.0%	-	0%
Total	30,622	13,553	121	0.4%	6,710	22%	90	0.3%	6,680	22%

The Corps' delineation indicated 36,774 acres of wetlands in the New Madrid Floodway with 29,875 acres or below 300 feet NGVD. Within the 300 feet elevation, 21,923 wet cropland acres are subject to inundation (Table 4-2).

Table 4-2. New Madrid Floodway Wetland Acres

Land Use	Total Wetland Acres in Entire NM Floodway	Wetland Acres 300 and below (Subject to inundation from backwater flooding)	Authorized				Avoid & Minimize			
			Acres Directly Impacted	% Total Directly Impacted	Acres Indundation reduced	% Total Inundation Reduced	Acres Directly Impacted	Percent total wetland acres	Acres Indundation reduced	% Total Inundation Reduced
Forested	5,734	5,403	6.8	0.12%	5,330	93%	6.8	0.12%	5,138	90%
Scrub/Shrub/Marsh	194	139	-	0.00%	139	72%	-	0.00%	138	71%
Cropland	27,904	21,923	3.0	0.01%	21,901	78%	3.0	0.01%	21,792	78%
Pasture	206	141	-	0.00%	140	68%	-	0.00%	136	66%
Herbaceous	1,939	1,579	2.2	0.12%	1,572	81%	2.2	0.12%	1,551	80%
Open Water	797	691	0.1	0.02%	689	86%	0.1	0.02%	622	78%
Sandbar	0	-	-	0.00%	-	0%	-	0.00%	-	0%
Urban	-	-	-	0.00%	-	0%	-	0.00%	-	0%
Total	36,774	29,875	12.2	0.03%	29,770	81%	12.2	0.03%	29,376	80%

Table 4-3 compares the total wetland acres in both drainage basins for all landcover types below 300 feet NGVD with the wetland acres conforming to the five percent jurisdictional elevation due to backwater flooding. In the St. Johns Bayou Basin, there are about 7,282 wetland acres of all types that would fall within the Corps' regulatory five percent flooding criterion.

In the New Madrid Floodway, the five percent flooding elevation contains 16,526 wetland acres of all types. The five percent flooding elevation wetland acres represent the full extent of wetlands that meet the five percent inundation criterion due to backwater flooding in the basins. Plate 5 shows the wetland acres below the 300 feet NGVD elevation. Plate 6 shows the wetlands at the five percent criterion.

Table 4-3. Total Existing Wetland Acres by Corps Criteria in Both Basins

	St. Johns Bayou Basin			New Madrid Floodway		
Land Use	Acres Below 300.0 ft. NGVD	Acres 5% Flooding 289.4 ft. NGVD	Acres Difference	Acres Below 300.0 ft. NGVD	Acres 5% Flooding 290.0 ft. NGVD	Acres Difference
Forested	3,164	2,210	954	5,403	3,689	1,714
Scrub/Shrub/ Marsh	4	0	4	139	62	77
Cropland	9,304	4,334	4,970	21,923	11,337	10,586
Pasture	76	60	16	141	77	64
Herbaceous	719	551	168	1,579	768	811
Open Water	287	126	161	691	593	98
Sandbar	--	--	--	--	--	--
Urban	--	--	--	--	--	--
Total	13,553	7,282	6,271	29,875	16,526	13,349

Within the project area, there are approximately 10,207 acres of forested wetlands. Most of those acres are considered BLH forests and are found along the lower reaches of St. Johns Ditch in the St. Johns Bayou Basin, within Big Oak Tree State Park, and adjacent to the Tenmile

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Pond Conservation Area in the Floodway. BLH forests are subject to regular periodic seasonal flooding most years. The MDC has identified several significant examples of this rare community that occur in the project area (MDC 1997b). The extent and duration of flooding determines the vegetation structure in any particular area, resulting in an extremely diverse plant community. Tree species typically found in those forests are overcup oak, Nuttall oak, pin oak, willow oak, swamp chestnut oak, cherrybark oak, baldcypress, tupelo gum, sweetgum, sugarberry, green ash, pumpkin ash, American elm, black willow, black gum, cottonwood, water hickory, and red maple. Many of the forests in the project area also contain understory composed of swamp privet, buttonbush, possumhaw, sweet greenbriar, poison ivy, trumpet creeper, Virginia creeper, blackberry, and various herbaceous species (See the USFWS CAR in Appendix C).

The remaining forested wetlands in the project area include riparian forest and swamp. Riparian forests have vegetation similar to BLH and are found along the St. Johns Bayou, St. Johns Ditch, Mud Ditch, and most of the large drainage ditches. Swamps are found along old oxbows and permanently flooded lakes and ponds. They are often flooded a significant portion of the growing season, and in some cases all year. While swamps may contain tree species found in drier forests, the majority of vegetation consists of baldcypress, tupelo gum, red swamp maple, black willow, box elder, buttonbush, swamp privet, duckweed, lizard's tail, and numerous other herbaceous species. MDC has identified several significant examples of this increasingly rare community that occur in the project area, including Big Oak Tree State Park and Tenmile Pond (MDC 1997b) (USFWS CAR).

Scrub/shrub marsh and freshwater marsh are found in much smaller quantities in both basins, most of which is located on public land (e.g., Tenmile Pond Conservation Area and Big Oak Tree State Park) and along perennial streams and lakes. Common shrub species in those habitats include young black willow, box elder, red maple, buttonbush, and swamp privet. Herbaceous species include sedges, rushes, cattail, giant cane, lizard's tail, smartweeds, and aquatic plants such as water lotus, coontail, duckweeds, Elodea and water primrose (USFWS CAR).

The remaining wetlands are largely composed of 4,000 acres of wet herbaceous vegetation, much of which is adjacent to croplands and levees. Although such habitats have been highly altered, they can provide valuable wintering, migration, and breeding habitat for numerous species of fish and wildlife depending on the period and depth of inundation.

Permanent open water in the project area consists of natural streams, oxbows, ponds, ditches, and borrow pits. The sand and gravel alluvium underlying much of the lowlands acts as a vast reservoir for storing precipitation. This water reserve is released slowly into the ditches, creating well-sustained base flows (Pflieger 1997). The riparian corridor along the ditches, streams, and borrow pits provides shade needed to sustain aquatic life by maintaining moderate summer water temperatures. These waterways vary greatly in size, current velocity, water clarity, and amount of aquatic vegetation. The ditches also contain deeper pools, woody debris, and a variety of emergent and submergent vegetation (Pflieger 1997). Lentic habitat (i.e., borrow pits, oxbow lakes, and ponds) also contributes to habitat diversity in the project area, which in turn supports an extremely diverse fauna (USFWS CAR).

4.3.2 NRCS Wetland Classifications

The Bootheel of Missouri was one of the first areas in Missouri to be mapped in accordance with the 1985 Food Security Act (Farm Bill). The NRCS wetland determinations were done according to mapping conventions developed by a multi-agency team of the USFWS, MDC, and NRCS, which utilized Food Security Act (FSA) crop photography. According to Pat Graham (NRCS, November 1998), all determinations were made off-site using four years of slides (1984-1989). Two sets of slides (spring and summer) were available, but NRCS chose to use the summer set. Drought conditions occurred during these years, but that was not a factor in making the determinations.

The NRCS used topographic maps, photographs, and their own National Wetland Inventory maps to classify wetlands and determine the various wetland and cover type acres. The NRCS methodology is different from the Corps methodology for delineating wetlands. Thus, acres for each land use will differ between methodologies. The NRCS information covers about the same area as the 300 feet NGVD elevation used by the Corps. Even though the land use acres are not identical, they are similar enough that comparisons can be made and discussed.

The NRCS classified only 0.4 percent of the wetlands in each basin's project area as farmed wetlands (Natural Resources Conservation Service 1998). Farmed wetlands (FW) are lands where an agricultural commodity production is possible; or where an agricultural commodity was produced at least once prior to December 23, 1985; that are not abandoned; and that have a 50 percent chance of being seasonally ponded or flooded for at least 15 consecutive days during the growing season, or 10 percent of the growing season. This applies to both the Corps and the NRCS. The NRCS has noted that if wetland determinations were done today for the same area using current delineation procedures, there would be considerably more FW and fewer Prior Converted (PC) cropland determinations. In 1995, the Secretary of Agriculture placed a moratorium on any new wetland determinations unless requested by the landowner. Therefore, NRCS has no alternative but to use the 1989 determinations. In addition, NRCS probably identified too many forested areas as wetlands to safeguard the landowner in questionable areas. The NRCS has noted that most requests for wetland determinations done in the past year were for forested areas, many of which were nonwetland. The NRCS has indicated that they will revisit existing determinations only on a request basis from the landowner and that county or project-wide wetland determinations are no longer performed by NRCS. NRCS stated that the information presented by the Corps on agricultural wetlands in the project area is good for project planning and impact analysis.

The Corps performed an analysis to determine the acres that met the FSA criterion of 15 continuous days of inundation during the growing season. A minimum of 9,526 cropland acres may be eligible for farmed wetland classification, of which 3,514 acres are in the St. Johns Bayou Basin below 289.0 feet NGVD and 6,012 acres are in the New Madrid Floodway below 288.3 feet NGVD.

The Corps recognized that if the NRCS classification is strictly adhered to when evaluating project impacts, the results might underestimate actual impacts. The Corps did not want to underestimate wetland impacts by only analyzing impacts to a small portion of the

wetlands (0.4 percent) that is currently classified as FW. Therefore, following the 1987 Wetland Delineation Manual, the Corps classified *all* cropland as wetland if it was inundated by backwater flooding five percent of the growing season (12 consecutive days) rather than the 15 consecutive days required by the NRCS. This five percent jurisdiction only goes up to the 289.4 feet NGVD elevation in the St. Johns Bayou Basin and the 290 feet NGVD elevation in the New Madrid Floodway. However, to account for all wetland impacts from both inundation as well as saturation from other hydrologic events, the Corps evaluated impacts of reduced inundation and construction on all wetlands that were mapped, regardless of their jurisdictional classification (PC or FW) or cover type. This included effects on fisheries (up to the 2-year floodplain elevation), plus waterfowl, shorebirds, and wetland functional values up to the 300 feet NGVD elevation in both basins.

4.4 WILDLIFE

In southeastern Missouri, the past conversion of woodlands and swamps to cropland has eliminated, or severely reduced, the abundance of those wildlife species dependent upon extensive forest or swamp ecosystems. Intense farming in the project area makes forestland or other permanent vegetative cover important to wildlife. Although large predators are no longer found in the project area, the diversity and abundance of the remaining wildlife species in the remaining woodlands, swamps, and riparian habitats throughout the basin remains high. Important game mammals that occur in the project area include white-tailed deer, eastern gray and fox squirrels, swamp rabbit (State-listed rare), and eastern cottontail rabbit. Other mammals found in the project area are mink, beaver, raccoon, muskrat, flying squirrel, river otter, opossum, striped skunk, coyote, red fox, various rodents, and the big and little brown bats.

The diverse habitat in the project area supports hundreds of water-dependent and terrestrial bird species during both breeding and migration. Although there are no known heronries in the project area, wading birds such as the great blue heron, little blue heron, great egret, snowy egret, and yellow-crowned night heron depend on project area wetlands as foraging habitat. During migration, various shorebirds, such as greater yellowlegs, killdeer, dunlin, short-billed dowitcher, lesser golden-plover, semipalmated plover, and solitary sandpiper, rely on shallow-water overflow areas to forage, replenishing critical energy supplies for the flight to northern breeding grounds. Forested wetlands have been found to support significantly higher abundance and diversity of bird species compared to upland forests (Brinson *et al.* 1981). In the project area, raptors, woodpeckers, warblers, thrushes, and flycatchers use BLH forests as migration and breeding habitat. The State-listed Mississippi Kite (rare) has been known to nest in BLH forests within the project area. Recent research has pointed to sharp population declines in several neotropical migratory species (e.g., white-eyed vireo, northern parula, cerulean warbler), particularly those that require large, mature forested tracts to successfully reproduce (Robbins *et al.* 1989, Askins *et al.* 1990). In the Lower Mississippi Valley, the Partners in Flight Program is focusing on forested wetlands conservation because 13 of the 14 priority species require BLH forests for breeding (USFWS CAR).

Johnson (1997) notes that the native swamplands of southeast Missouri provide unmatched habitat for many species of amphibians and reptiles. Amphibians expected to occur on stream and lake edges, ponds, and in the forested wetlands in the project area include: the western lesser siren, marbled and small mouth salamanders, Fowler's toad, eastern narrow-

mouthed toad, spring peeper, green treefrog, and bronze frog. Wetlands in the project area also support a number of State-listed species, including the three-toed amphiuma (rare), Illinois chorus frog (rare), and the eastern spadefoot toad (rare). Reptiles found in sloughs, swamps, ditches, oxbows, and ponds in the project area include Mississippi mud turtle, stinkpot, southern painted turtle, western chicken turtle (State-listed rare), red-eared slider, eastern spiny softshell, broadhead skink, black rat snake, dusky hognose snake (State-listed rare), speckled king snake, water snakes, western ribbon snake, eastern garter snake, and rough green snake (USFWS CAR).

It should be noted that an animal may be abundant in other parts of the country but considered rare in Missouri because the animal is at the limit of its normal range. Thus, even though a specific animal may be considered as a State-listed rare animal within the project area, it may actually be very abundant in many other parts of the country.

4.5 WATERFOWL

Waterfowl are present throughout the year in the project area. Wood duck and, to a lesser extent, mallard, hooded merganser and blue-wing teal, breed in the project area. During migrations and overwintering, the St. Johns Bayou Basin and the New Madrid Floodway are important areas for hundreds of thousands of dabbling ducks (i.e., mallard, gadwall, green and blue-winged teal, pintail, widgeon, shoveler, and black duck), coots, and geese. A large part of the waterfowl use occurs in the Tenmile Pond Wildlife Management Area. Diving ducks such as lesser scaup, ring-neck, and canvasback use the deeper waters of the project area. Migration is a slow, drawn-out process during which waterfowl require feeding and resting habitat. Earliest fall migrations of waterfowl occur in mid-August when the first flocks of blue-wing teal arrive. Fall migration continues through late December and even early January as more winter-hardy species continue south. Fall/winter migration has barely concluded before early migrants fly north. Wintering may occur at various latitudes and is dictated by habitat availability and freezeup. Spring migration through the project area generally concludes by mid-March as the last of the shovelers and blue-wing teal depart. Because of their importance to waterfowl, wetlands in the project area are a key component in the Lower Mississippi Valley Joint Venture, a feature of the North American Waterfowl Management Plan (MDC 1989).

The waterfowl season in the project area (as analyzed in the Waterfowl Assessment Model) extends for 151 days from November 1 to March 31. In most years, lands at the lower ends of both basins are not normally flooded during the winter months. This land has the potential to provide additional resting and feeding habitat for waterfowl that may winter in the area. During spring migration from February through mid-March, high Mississippi River backwater in the lower basin often inundates the area of the proposed sump. This not only provides resting habitat, but the less than 24-inch deep water-field interface provides feeding areas that supply important invertebrate protein food sources required for proper pre-egg laying conditioning.

In addition, sustainable waterfowl populations depend on a variety of habitat types to fulfill their reproductive needs. The remaining wetlands in the project area, particularly the bottomland hardwoods, are very important to wintering waterfowl. Forested wetlands fulfill special waterfowl habitat requirements not found in open land. Wooded habitats produce

nutritious food for waterfowl and provide secure roosting areas, cover during inclement weather, loafing sites, protection from predators, and isolation for pair formation. Coupled with nearby State and Federal wildlife refuges/conservation areas, project-area wetlands provide wintering and migration habitat to hundreds of thousands of waterfowl annually.

Periodically flooded cropland and forests are important to migrating waterfowl within the seasons that these birds require these lands for food and cover. However, there are many times when Mississippi River elevations are high and the St. Johns Bayou floodgates are closed and ponded interior water cannot drain into the river. Backwaters, several feet deep, also extend far into the New Madrid Floodway. When this happens, flooded croplands and bottomland hardwoods located mostly on the lower-lying elevations of ancient oxbows become too deep to be used as feeding areas for the dabbling ducks. It is water less than 24 inches deep that receives the most use and is most important to waterfowl. Shallower water levels, which can be controlled and manipulated, would provide higher-quality waterfowl habitat for longer periods of time. However, the areas flooded to depths greater than two feet do provide some waterfowl benefits, especially to diving ducks such as ringneck and scaup. In addition, these areas also serve as resting areas, with the wooded lands providing secure roosting areas, cover during inclement weather, loafing sites, protection from predators, and isolation for pair formation as discussed earlier.

4.6 FISHERIES

Southeastern Missouri lowlands were originally covered with climax bottomland hardwood forests through which many meandering streams provided diverse aquatic habitat. Approximately 1,200 miles of ditches have now been dug that drain the land, making the land one of the most productive agricultural areas in the nation. Approximately 86 percent of the total land in both basins is now farmland. Almost all the streams have been previously channelized or modified in some way for efficient agriculture. The major ditches, such as St. Johns Bayou, Birds Point - New Madrid Setback Levee Ditch, Mud Ditch, and Wilkerson Ditch, have current and woody streambank vegetation. Some smaller ditches have no perceptible current, while others are fairly swift, depending on the season and local rainfall events. The estimated velocities for streams in the study area range from less than one to about eight feet per second.

The network of drainage ditches in southeast Missouri was largely constructed at the turn of the century when the region was converted to agricultural land. This development replaced most of the natural landscape, leaving the ditches as the principal habitat for aquatic resources (Pflieger 1997). Changes in the aquatic fauna were undocumented, but this large-scale disturbance undoubtedly altered the original assemblage of species. Many species characteristic of lowland habitats have managed to persist in the area, but not necessarily in their former abundance. Other species that were able to exploit ditch environments may have benefited from the altered conditions (USFWS CAR).

The project area supports a remarkably rich and distinctive fishery. In all, 114 species representing 22 families have been collected from the project area-drainages and the Mississippi River (USFWS Coordination Act Report, Appendix C). Of these species, 93 have been collected from ditches and bayous in the project area drainage (Sheehan *et al.*, 1998, MDC 1997a). The

remaining 21 species have been collected from the Mississippi River proper (U.S.G.S. 1991-1996, MDC 1997a). Of the 93 species collected from the project area, 10 are considered endangered, rare, or on the watch list in the State of Missouri. One species, the golden topminnow, once believed to be extirpated from Missouri, was collected recently from the St. James Ditch (Sheehan *et al.*, 1998). Many fish species collected in the St. Johns Bayou Basin and the New Madrid Floodway are either confined to the Mississippi lowlands or occur only occasionally elsewhere in the state (Pflieger 1997). The diversity and abundance of the fish fauna reflect the regionally rare and diverse aquatic habitats in the project area (USFWS CAR).

The New Madrid Floodway is the only portion of the historic Mississippi River floodplain in Missouri still connected to the river. Annual flooding in the Floodway plays an important role in the natural cycle of the Mississippi River. Backwater flooding from the river provides spawning, nursery and foraging habitat for river fish. This event enhances fish stocks and plays an important role in maintaining fish diversity in the Mississippi River and its floodplain. Most of the species that have been collected in the project area use the floodplain for rearing and spawning or depend on free access to small tributaries such as Mud Ditch during their reproductive season in the spring (Sheehan *et al.*1998). Baker *et al.* (1991) noted that floodplain ponds support some of the most unusual fish communities in river systems. Uncommon species characteristic of that habitat include chain pickerel, golden topminnow, flier, banded pygmy sunfish, and the cypress, mud, bluntnose and slough darters, all of which have been documented from the project area (MDC 1997a, Sheehan *et al.* 1998, USGS 1991-1996) (USFWS CAR).

Recent sampling in the project area has documented high numbers of fish. Sampling of Mud Ditch and St. Johns Bayou below the outlet structure in 1993 and 1994 (mid-May to early July) collected large numbers of young-of-the-year (YOY). Those collections were made as backwaters drained to the Mississippi River (John Tibbs, Texas Wildlife and Parks, pers. comm.). The YOY specimens represented 27 and 17 species in 1993 and 1994, respectively. Similar results were reported by Sheehan *et al.* (1998) after collecting fishes from inundated floodplain and channel habitats during a time period that coincided with a rise and fall of floodwaters in the project area. Adult fish and YOY were collected that represented 24 species from the New Madrid Floodway and 11 from sites within the St. Johns Bayou Basin. Many adults showed a reduction in the presence of gametes starting from the beginning of the flood pulse, suggesting that spawning occurred during the flood event. The majority of fish reported by Tibbs (1995) and Sheehan *et al.* (1998) are river species that require quiet, off-channel habitat for spawning and rearing of young (e.g., black, bigmouth, and smallmouth buffalo, channel catfish, gar and carp). These collections also contained extremely large numbers of YOY shad, which are a principal prey species for other fishes (e.g., largemouth bass, white bass, catfishes, sauger, crappie, and gar).

Although more shad were collected in the St. Johns Bayou Basin, the New Madrid Floodway yielded twice as many YOY fish species other than shad, including white bass and buffalo. In the New Madrid Floodway, sampling data suggested that white bass have a single, protracted spawning period, or make multiple runs into the Floodway. High numbers of white bass are probably related to the connectivity (i.e., fish access) between the Mississippi River and the Floodway during the spring spawning season.

Project area waters also support diverse sport fish communities in both the St. Johns and the New Madrid basins that provide significant angling opportunities to the public. The recreational fisheries provided by Mud Ditch, St. Johns Bayou, and the Mississippi River are important to this area of the State because of the lack of other fishable waters in the Bootheel. In the spring, white bass from the Mississippi River enter Mud Ditch in large numbers to spawn. During spring flooding, carp and several species of buffalo also enter the Floodway from the Mississippi River to spawn. Anglers take these fish by gigging in shallow floodplain waters. In spring, Mud Ditch also provides significant angling opportunities for crappie, channel catfish, and flathead catfish as far as the Tenmile Pond Conservation Area (Dave Wissehr, MDC, pers. comm.).

Sports fishes found in the project area include channel catfish, flathead catfish, largemouth bass, bluegill, white crappie, freshwater drum, and common carp. Other sports fishes include spotted bass, blue catfish, white bass, yellow bass, sauger, rock bass, black crappie, longear sunfish, warmouth, black bullhead, yellow bullhead, chain pickerel, grass pickerel, bowfin, quillback, river carpsucker, northern hogsucker, river redhorse, shorthead redhorse, golden redhorse, and spotted sucker (USFWS CAR).

The larger channels and the downstream sections of major ditches have relatively high species diversity. This can be attributed, at least in part, to the length of time since previous maintenance and the regrowth of vegetation along the banks. Diversity along the smaller channels is low because of the lack of instream habitat, shallow water depth, wide temperature fluctuations, sedimentation, and homogeneity of the unstable streambed substrate. Submerged aquatic vegetation, primarily coontail, watermilfoil, and pondweeds, are often abundant in the shallow ditches with little current. Water primrose and elodea are found in standing water of the slower-flowing ditches. Sand and small gravel are the main bottom types in areas with current; while silt, mud, and organic debris predominate in low-flow areas (Pflieger 1997). The upstream sections of ditches in the St. Johns Bayou Basin contain a fairly diverse assemblage of minnows, shiners, and other smaller species (Christoff 1997). This is evident in the upper reach of St. James Ditch, which has vegetated banks, clear flowing water, and sandy substrate.

The fish fauna of southeastern Missouri lowlands have been greatly altered by drainage of the original swamps and backwater areas. Wetland species characteristic of standing waters have decreased in abundance, while habitat generalists and fish species adapted to flowing water have become more widespread. The species that predominate are adapted to poor water quality and lack of cover. Environmental Science and Engineering, Inc. (ESEI 1978) collected fish in Tenmile Pond and St. James Bayou. In Tenmile Pond, 12 fish species and 442 individuals were collected. The sample was dominated by commercial and non-sport fish, primarily carp (39 percent), gizzard shad (36 percent), gar (5 percent), and buffalo (3 percent). In St. James Bayou, nine species and 70 individuals occurred, with carp (29 percent), gizzard shad (40 percent), and gar (21 percent) being the dominant fish. These samples indicate a depauperate fishery due to degraded habitat conditions and poor water quality. Later surveys by MDC from the St. Johns Bayou Basin revealed a more diverse community compared to the 1978 ESEI collection in the New Madrid Floodway (Christoff 1997). The dominant species included gizzard shad (23 percent), carp (19 percent), longear sunfish (15 percent), spotted bass

(12 percent), bluegill (6 percent), freshwater drum (5 percent), shortnose gar (3 percent), channel catfish (3 percent), and smallmouth buffalo (2 percent).

Sampling 1997 and 1998 indicated a diverse assemblage in both. Gizzard shad, buffalo, shortnose gar, freshwater drum, and carp were recorded in both basins, with gizzard shad dominating. Sheehan (1998) noted over twice as many fish species were collected in the New Madrid Floodway (both adults and juveniles). White bass were collected in the New Madrid Floodway during their spring spawning run and were the fourth most abundant species (probably due to sampling during the spawning run). Electrofishing and seining during high water levels in St. Johns Bayou Basin ditches revealed a dominant adult composition of unidentified minnows (42 percent), gizzard shad (12 percent), mosquitofish (18 percent), and smallmouth buffalo (eight percent). The YOY were comprised of gizzard shad (99 percent), freshwater drum (0.2 percent), unidentified buffalo (0.6 percent), and crappie (0.2 percent). In the New Madrid Floodway ditches, the dominant adult composition was comprised of gizzard shad (38 percent), mosquitofish (24 percent), shortnose gar (10 percent), carp (7 percent), white bass (5 percent), bigmouth buffalo (3 percent), freshwater drum (3 percent), threadfin shad (2 percent), and smallmouth buffalo (2 percent). The YOY were comprised of gizzard shad (76 percent), carp (6 percent), temperate bass (6 percent), inland silverside (6 percent), and freshwater drum (1 percent). Nearly all the fish species were fairly characteristic of drainage ditches in the southeastern Missouri lowlands (Pflieger 1997). Dominant species in all the collections cited above are commonly found in the Mississippi River channel and throughout the entire river floodplain. The complete survey is contained in Appendix C of this report.

In addition to fisheries data, ESEI (1978) collected benthic macroinvertebrates at Tenmile Pond and St. James Bayou in May and October, 1977. The dominant macroinvertebrate groups (98 percent) at both stations were burrowing forms, including oligochaetes (81 percent), chironomid larvae (11 percent), and biting midges (six percent). Oligochaetes (aquatic earthworms) are adapted to a burrowing life in the soft silt and clay sediment layers most common in the study area. This substrate type, although suitable to burrowing organisms, is unstable and abrasive to non-burrowing benthic organisms. Chironomid (midge fly) larvae are tolerant of the poor water quality characteristic of many ditches in the area. Biting midge larvae also are burrowers and tolerate a wide range of environmental and water quality conditions.

Additional data on the benthic larval insect fauna from the project area are limited to a small number of collections made by a consulting firm on St. Johns Ditch in 1995 and 1996 (Samuel McCord, QST Environmental, pers. comm.). These samples revealed a surprisingly diverse non-dipteran (not belonging to the fly family) insect community. Several "intolerant" taxa were found, including the stonefly *Perlesta* and the caddis flies *Brachyucentrus* and *Ploycentropus*. The presence of these species indicates good water quality and favorable conditions. Dominance of dipteran (flies) taxa usually indicates polluted waters.

As noted in the USFWS Coordination Act Report (Appendix C), crayfish are one of the dominant groups of invertebrates occurring in a variety of flowing and standing-water habitats (Pflieger 1997). They are an important food source for many fish (Momot *et al.* 1978) and are a major food item in the diet of bullfrogs in ponds, lakes, and streams (Korschgen and Moyle 1963, Korschgen and Moyle 1955). A wide variety of other wildlife species, including snapping

turtle, raccoon, mink, great blue heron, and kingfisher, also prey heavily on crayfish (Pflieger 1997).

The USFWS Coordination Act Report also states although crayfish surveys specific to the project area have not been conducted, the Lowland Region in Missouri's Bootheel supports a small but distinctive crayfish fauna. A State-wide crayfish survey conducted by the MDC found 10 species representing six genera in southeast Missouri (Pflieger 1997). These species include the shrimp crayfish (*Orconectes lancifer*), grey-speckled crayfish (*O. palmeri*), devil crayfish (*Cambarus diogenes*), White River crayfish, (*Procambarus acutus*), red swamp crayfish (*P. clarkii*), vernal crayfish (*P. viaeveridus*), Cajun dwarf crayfish (*Cambarellus puer*), Shufeldt's dwarf crayfish (*C. shufeldtii*), digger crayfish (*Fallicambarus fodiens*), and shield crayfish (*Faxonella clypeata*). While most of these species have large distributions nationwide, the occurrence of several of those species in Missouri is limited to the Bootheel. The State-listed species are the shrimp crayfish (endangered), the shield and digger crayfish (rare), and the Cajun and Shufeldt's crayfish (watch list). Swamp and seasonally flooded roadside ditches and sloughs are important habitat for these macroinvertebrates (Pflieger 1997). The varieties of ditch habitats are also important for crayfish.

4.7 MUSSELS

Most of the over 300 North American species of Unionid mussels have declined greatly in recent decades, and many species are in danger of extinction (Williams *et al.* 1992). The manmade waterways that drain the agricultural lands in southeastern Missouri and northeastern Arkansas are significant Unionid habitat. The combination of moderate depth and current speed, stable flows, sandy substrates, substantial groundwater flow, and presumably abundant fish hosts found in these ditches provide good conditions for certain Unionid species. Compared to natural rivers of similar size, mussel populations in these ditches appear to be relatively diverse, abundant, and rather uniformly distributed.

At least 24 species were collected in the project area, which represents 1/3 of the species known to occur in Missouri. The highest species diversity and greatest abundance of individuals were found in the lower portions of Lee Rowe Ditch and the Setback Levee Ditch. Species composition differed between the Floodway and St. Johns Bayou Basin. Thirteen species were found in the St. Johns Bayou Basin that were not found in the Floodway. Only one species, *Obliquaria reflexa*, was found in the New Madrid Floodway ditches and not in the St. Johns Bayou Basin ditches.

The presence of mature woody vegetation on banks in the Setback Levee Ditch appeared to correlate with the presence of relatively abundant and diverse Unionids. Older individuals and greater diversity were found along the wooded bank at sites where only one side was cleared at the time of a previous dredging, which was estimated to have occurred approximately nine years preceding the survey. The numbers of younger individuals of some species indicated recruitment might have been rapid following dredging. Areas of obviously loose, silty and unstable substrate in the lower St. Johns Bayou were depauperate of mussels, as was the upper end of the surveyed reach of the St. James Ditch.

Four Missouri State-rare species were found in this survey (Barnhart 1998). They were the rock pocketbook (*Arcidens confragosus*), flat floater (*Anodonta suborbiculata*), wartyback (*Quadrula nodulata*), and Texas lilliput (*Toxolasma texasensis*). Missouri is well within the historic range of the rock pocketbook, flat floater, and wartyback, whereas the Texas lilliput is probably on the edge of its range in the study area. Of these species, the rock pocketbook and flat floater are among the most rare Unionids in the State (Oesch 1995). The ditches of the Bootheel lowlands appear to provide the most important habitat for all of these four species within Missouri. No Federally listed endangered mussels are recorded within the project area, and none were found in the survey. Additional information and potential impacts of this project on the mussel community are contained in Appendix C of this report.

4.8 ENDANGERED SPECIES

Two Federally listed endangered species, the interior least tern (*Sterna antillarum athalassos*) and pallid sturgeon (*Scaphirhynchus albus*), and one Federally listed threatened species, bald eagle (*Haliaeetus leucocephalus*), are found in or near the project area.

The interior least tern is a small gray and white bird with a black cap, white forehead, and forked tail that nests on large, bare, isolated sandbars in the Mississippi River. The recovery plan (Sidle and Harrison 1990) listed the 1986-1988 average least tern population for the entire country at 4,580 adults. This includes an average of 2,360 terns in the lower Mississippi River. At that time, the lower river was estimated to contain 51 percent of the total least tern population. Recent surveys by the Corps have recorded over 6,000 adult least terns from Cape Girardeau, Missouri, to Natchez, Mississippi (Rumancik 1995; Jones 1999). This recent number is 2.7 times the average 1990 nationwide population size outside of the Lower Mississippi River Valley. Two large sandbars, each five miles upstream and downstream of New Madrid, Missouri, and one sand bar directly across from New Madrid contain least tern nesting colonies yearly. There is no least tern nesting habitat within the immediate project area.

The pallid sturgeon is an ancient species of fish that requires large, turbid, free-flowing riverine habitat with rocky or sand substrate. They are usually found on the bottoms of the rivers on sand flats or gravel bars and apparently prefer areas with strong currents in or near the main channel. It is one of the largest and rarest fish in the Mississippi and Missouri River basins. Pallid sturgeon are opportunistic feeders that eat insects, crustaceans, mollusks, annelids, fish, and eggs of other fish. Scant information exists on the range and habitat preferences of pallid sturgeon for this part of the Mississippi River. Most data are from populations in upper Missouri and other Midwest rivers and also from the Atchafalaya River in Louisiana. In 1994 and 1997, several thousand young pallid sturgeon were stocked in the Mississippi River upstream from the project area. Over 150 were recaptured through monitoring efforts, but only two individuals were found in tributary streams (Salveter 1998). No pallid sturgeon were captured in the project area during recent fishery surveys by Sheehan *et al.* (1998), but a pallid sturgeon was found in a quiet backwater of the Mississippi River just downstream of the project area.

The bald eagle was listed as endangered throughout most of the conterminous United States in 1978. Since then the population has made a remarkable comeback and is now listed as threatened. The eagle is opportunistic, feeding on fish and carrion, with fish comprising the

major portion of its diet. Waterfowl and turtles are also occasionally taken by bald eagles. Nesting may begin in January with nests built near water (less than two miles) in large living cypress or cottonwood trees. Young eagles were released from sites at Mingo National Wildlife Refuge in southeast Missouri and Schell-Osage Conservation Area north of El Dorado Springs from 1981 to 1990. Three nests are reported within the project area near the lower part of the New Madrid Floodway, in the Hubbard Lake area. One of these is active. Eagles have also nested south of the project area, on Donaldson Point Conservation Area, and across the river at Reelfoot Lake National Wildlife Refuge in Tennessee. The New Madrid Floodway also serves as a wintering area for a moderate number of bald eagles.

Another species of note is the Federally endangered fat pocketbook mussel (*Potamilus capax*). The project area is within the range of the fat pocketbook mussel. This species was historically widespread and ranged from the Mississippi River in Minnesota, southeast to the Wabash and Ohio Rivers and west to the St. Francis River drainage of Arkansas. Currently, fat pocketbook mussels are limited to the St. Francis River drainage in Arkansas, the lower Wabash and Ohio Rivers in Illinois, Indiana, and Kentucky, and possibly in stretches of the upper Mississippi River adjacent to Missouri (U.S. Fish and Wildlife Service 1989, Cummings *et al.* 1990). An environmental survey reported the species in the project area from Fish Lake Ditch at Hwy 80, just northeast of the Tenmile Pond Conservation Area (Environmental Science and Engineering, Inc., (ESEI) 1978); however, no voucher specimens were provided. A 1980 survey of Fish Lake Ditch by Alan Buchanan, MDC, failed to find this species. He believed the mussel reported by ESEI to be *P. capax* was actually mistaken for *L. ventricosa* (=*cardium*), a similar species. The most comprehensive mussel survey of the St. Johns and New Madrid basins did not find any evidence of this species (Barnhart 1998). Thus, the conclusion can be made that this project will not adversely impact *P. capax*. However, many of the ditches in the project area may be suitable habitat (Brian Obermeyer, Kansas Wildlife and Parks, pers. comm.) (USFWS CAR).

Two Federal candidate species, the sicklefin chub and sturgeon chub, occur in the main channel of the Mississippi River in the project area. The chubs (fish) are small, native river cyprinids that are currently being considered for Federal listing as threatened or endangered. Both those fish occur along and over sandbars in main channel border areas and chutes between the mainland and sandbar islands. The proposed project will not affect habitat for these species.

4.9 BIG OAK TREE STATE PARK AND OTHER STATE CONSERVATION AREAS

Big Oak Tree State Park is managed by the MDNR. It is the only known sizeable tract of essentially uncut wet-mesic BLH forest remaining in the northern portion of the Missouri Alluvial Plain section of the Gulf Coast Plain natural region. It contains over 100 trees greater than four feet in diameter and represents a substantial portion of the "one percent remaining" commonly referenced for BLH forests in Missouri's portion of the Mississippi River floodplain. This part of the park is designated a National Natural Landmark by the U.S. Department of Interior, which means that Federal agencies are asked to consider the unique properties of the landmark during NEPA compliance.

Besides being a National Natural Landmark, Big Oak Tree State Park is a unique and significant natural heritage site for citizens of Missouri, and it represents one of the State's most threatened natural history features. Virtually the entire 1,008-acre park is native wetland and a Missouri Natural Area designated by the interagency Missouri Natural Area Committee. The park protects substantial examples of mesic BLH forests and swamps; nine state and national champion trees; 200 native plant, 150 bird, 25 mammal, 44 fish, and 31 reptile species; and 11 rare or endangered species for Missouri. Bald Eagles have been reported wintering in the park.

The MDNR is concerned that the park is drying due to the surrounding agricultural drainage features. They state that the vegetative character of the park is slowly changing from wetter BLH to a drier forest type. Several large oaks have fallen due to old age, with little or no oak regeneration taking place. To help alleviate this and preserve the park, the MDNR is planning to construct a $1.2 million water retention project around the park to capture rainfall and maintain an optimal hydrologic regime. They believe the water will eliminate the invading, competing understory species and promote regeneration of the existing dominant forest species.

The MDC manages two conservation areas in the project area. The Tenmile Pond Conservation Area covers 3,793 acres of cropland, wetlands, and forest. It is located in the New Madrid Floodway along an old oxbow lake. The ditches, ponds, and lake on the Conservation Area provide significant opportunities for local anglers. The Conservation Area also provides opportunities for small and big game hunting, as well as waterfowl hunting. The Donaldson Point Conservation Area lies largely outside the frontline levee along the Floodway, although a small portion lies inside the frontline levee. The Conservation Area covers approximately 5,785 acres of largely BLH forest, and bald eagles have been known to nest there.

4.10 WATER QUALITY

A detailed water quality analysis is contained in Volume II of the Phase I GDM & EIS Technical Appendices, Revised December 1981 (U.S. Army Corps of Engineers 1980). That analysis revealed that water quality of the streams and channels within the St. Johns Bayou Basin was characteristic of an intensively farmed river delta. Surface waters contain elevated levels of agrichemicals, turbidity, suspended solids, and nutrients. However, no water quality parameter was found at an unacceptable level to fish and wildlife or people. The conditions found in the early 1980s are considered to be applicable at this later time since land use patterns have not changed.

Different agrichemicals have come into use since the early GDM was written. Because of this, and the potential changes in crops, new water quality analyses were completed. These revealed no substantive changes in crops and cropping patterns or agrichemical use and very minimal changes in water quality both inside the basins and in the Mississippi River. The analyses are contained in Appendix J of this report. Since no wetlands will be lost other than the 167 acres required for construction, there will be no changes to overall acreage.

The Mississippi River is listed as impaired under Section 303(d) of the Clean Water Act. Because of this, the Corps checked the MDNR list of streams for which effective water pollution

control measures are not presently in place regarding the total maximum daily load (TMDL). Both the present 1998 list and the draft 2000 list were checked. The only thing listed for the Mississippi River reach adjacent to this project was for habitat loss in the river caused by channelization. All habitat losses will occur within the project area, and are fully mitigated. Since there will be no habitat loss in the Mississippi River, the Corps believes that Section 303(d) does not apply in this situation.

This project will not discharge pollutants into the waters of the U.S. after construction. Recent water quality analyses by WES revealed that post-project conditions would be similar to existing conditions. The overall meaning of Section 402 of the Clean Water Act appears to be aimed at construction projects, municipalities, industries or vessels discharging specific types and quantities of sediments, chemicals or sewage. The state would make a determination if a National Pollutant Discharge Elimination system (NPDES) permit is required when they review the Section 404(b)(1) in this document, and the request for water quality certification. If required, a NPDES permit will be applied for it in the usual manner.

4.11 RECREATION

Recreation resources for the overall project were discussed in Volume II, Section C of the Phase I GDM & EIS Technical Appendices, Revised December 1981. That section stated that outdoor recreational opportunities are limited in the study area. This limitation is particularly true for fish and wildlife related activities, which is a direct result of the conversion of woodlands to farm fields and streams to channelized ditches. Some alternative recreation is available in several towns in the study area.

Hunting takes place mostly on privately owned lands, although access is not guaranteed. Fall through early winter small game hunting for rabbit, quail, and mourning dove takes place along the ditches and in the fields. Squirrels are harvested wherever there are large mast producing trees sufficient to support a population. White-tailed deer are hunted in the fall in the few remaining larger tracts of woods and along the wooded ditch banks and fields. Migratory waterfowl arrive in early September and may stay through April. This provides limited waterfowl hunting along the Mississippi River, blue holes, borrow pits, the remaining wetlands, and portions of larger drainage ditches in the study area. The Tenmile Pond Conservation Area also provides fall waterfowl hunting. The waterfowl also provide birders an opportunity for nonconsumptive recreation. Furbearers are harvested during winter in the riparian habitat. A few wintering bald eagles arrive in November and December and stay to March, offering some nonconsumptive recreation opportunities. Some spring turkey hunting occurs in and around the larger wooded tracts.

There are few natural streams in the study area, and these have been adversely affected by sedimentation, agrichemicals, and channelization. However, the project area still supports diverse sport fish communities that provide angling opportunities. The recreational fisheries provided by these waters are important to this area of the State because of the lack of other fishable waters in the Bootheel. Fishing is somewhat poor in the smaller drainage ditches, but occasionally moderate to heavy at certain times of the year in the larger ditches, chutes, and borrow pits. Fishing pressure in the chutes, Setback Levee Ditch, Mud Ditch, St. Johns Bayou,

borrow pits, and blue holes is moderate to heavy, and fishing success is considered fair to good. These fishery resources are to a large extent a reflection of seasonal or periodic connection to the Mississippi River during high river stages. Such flood events can contribute significantly to both the fauna and habitat quality (high dissolved oxygen, inorganic and organic nutrients, etc.).

The lower New Madrid Floodway is the site of a seasonal white bass fishery. In the spring, white bass from the Mississippi River enter Mud Ditch in large numbers to spawn. This annual event attracts anglers from much of the surrounding area (Ranny McDonough, MDC, pers. comm.). In spring, Mud Ditch also provides significant angling opportunities for crappie, channel catfish, and flathead catfish as far upstream as the Tenmile Pond Conservation Area (Dave Wissehr, MDC, pers. comm.). When the New Madrid Floodway is inundated, bowfishing and gigging become common in the ditches and shallow ponded waters for several species of buffalo and carp that have entered from the river to spawn in the floodplain.

Big Oak Tree Lake and Hubbard Lake are two impoundments within the New Madrid Floodway that also are used for fishing. The blue holes, which are outside the project area, may possibly provide the best fishing available in southeastern Missouri. The fishery resources in the blue holes are to a large extent a reflection of seasonal or periodic connection to the Mississippi River during high river stages. Such flood events can contribute significantly to both the fauna and the habitat quality of those areas. Fish commonly caught from these non-flowing waters are largemouth bass, channel catfish, sunfish, bullheads, and several commercial fish (USFWS 1979).

Nonconsumptive outdoor recreation activities, such as bicycling, hiking, tennis, swimming, nature walking, picnicking, and tent camping, are also pursued. However, these are done in a few specific places. This general outdoor recreation season lasts approximately 150 days from May to September. Also in the spring, shorebird migrations peak in April and May, providing birders recreational opportunities. Recreation opportunities are limited, but there is some type of consumptive and nonconsumptive activity available throughout the year.

4.12 CULTURAL RESOURCES

The Bootheel of Missouri was home to many Native American people. Archaeologists identified four broad cultural/historical periods of habitation beginning around 15,000 B.C. and ending about A.D. 1500. The historical period began in 1673 with exploration by the Europeans Marquette and Joliet. Colonization soon followed with European and African settlers. With land clearing and the recent introduction of intensive agriculture, the low undulating character of the St. Johns Bayou Basin land surface and the relatively flat New Madrid Floodway have been drastically altered. This activity has resulted in the need for archaeological investigations. An intensive cultural resource survey was performed and a report prepared, which was included in the Technical Appendices, Revised December 1981, of the GDM. Another survey was performed that documented a number of prehistoric and historic sites within the project area (Klinger *et al.* 1988). All surveys were coordinated with the Missouri State Historic Preservation Officer (see Appendix H of this report).

5.0 ENVIRONMENTAL CONSEQUENCES

This section describes the effects of each alternative on the significant resources of the project area and serves as the source of information for Table 2-1, Comparative Impacts of Alternatives, in Section 2. The resources described in this section are those recognized by laws, executive orders, regulations, and other standards of Federal, State, or regional agencies and organizations. The dynamic nature of the study area and necessity of long-range projections made quantitative assessment of project impacts difficult. In cases where impacts could not be assessed quantitatively, qualitative assessments were made based on available information and professional judgement.

With the Avoid and Minimize Alternative, agricultural production would be lost on approximately 219 cropland acres n the St. Johns Bayou basin and 3 cropland acres in the New Madrid Floodway. This is an irretrievable commitment of resources. Reforesting 9,557 cropland acres would mitigate the 64 woodland acres in the St. Johns Bayou Basin and the 14.5 woodland acres in the New Madrid Floodway required for construction. More importantly, though, without the project, irretrievable losses of agricultural production will continue in both basins every time flooding occurs. There would be no irreversible commitments of any resources with the project.

5.1 AGRICULTURAL LAND

5.1.1 Alternative 1: Without-Project

Existing conditions within both basins are expected to remain the same under the Without-Project Alternative. No changes in cropping patterns are expected.

5.1.2 Alternative 2: Authorized Project

Channel enlargement and the pumping station in the St. Johns Bayou Basin would reduce agricultural damages on 44,545 acres below elevation 300 feet NGVD (Table 3-1). Backwater flooding from interior drainage that cannot drain when the control gates are closed at high Mississippi River stages would be reduced by approximately 31 percent for a two-year frequency flood event in the St. Johns Bayou Basin or by approximately 2,717 acres (Table 5-1). The project would also provide protection from headwater flooding to farmland along the channels. About 232 acres of agricultural land and 17 acres of pasture would be lost due to channel excavation, with subsequent revegetation to BLH.

NRCS stated that prime and unique farmland may not be located within the project ROW, because the methods used to determine prime and unique farmland in each county were based only on soil type, and no on-site surveys were conducted. Some prime farmland impacts are listed. In general, frequently flooded agricultural land (which would be impacted by this project) should not be classified as prime and unique. The percentage of prime farmland acres in the ROW required for this project is minimal, and the loss is therefore considered insignificant.

The levee closure would reduce duration and frequency of Mississippi River backwater flooding on up to 61,800 cropland acres in the New Madrid Floodway below elevation 300 feet NGVD (Table 3-1). The pump station would evacuate rainfall runoff and keep the interior ponding to a minimum, except for waterfowl flooding during the winter if this plan was implemented. Farmers would be able to till the ground earlier due to reduced flooding conditions, which may permit increased double cropping of winter wheat with soybeans. Even though market distances and colder weather discourage it, rice could be grown in some fields. Approximately five acres of cropland and herbaceous land would be lost due to construction of the levee closure and pumping station. Backwater flooding would be reduced by approximately 87 percent for a two-year frequency flood event on approximately 10,319 acres (Table 5-1).

Excavated material for the Setback Levee raise would cover existing grass that is used for pasture along some sections of the levee and berm. This land would be taken out of production for a few weeks until after project completion, when new grasses would be established.

5.1.3 Alternative 3: Avoid and Minimize

Impacts of this alternative would be nearly identical to Alternative 2 except for higher start and stop pump elevations of 282.5 feet NGVD and 280 feet NGVD, respectively, and for slight acreage changes along the channel ROW. St. Johns Bayou Basin channel construction would require about 38 fewer cropland acres when the channel width is reduced from 200 feet to 120 feet Between Missouri Rt. 80 and Missouri Rt. 00, the work bank on St. James Ditch will shift to the right bank for 2.6 miles to avoid high-quality woodland habitat. This would require 50 additional cropland acres for the ROW. The upper 3.7 miles of St. James Ditch would be eliminated from the project to avoid impacts to the golden topminnow and its habitat. About 25 acres along this ROW section would no longer be required. The impacts to prime farmland in the ROW with this alternative are insignificant as described under Alternative 2.

Within the St. Johns Bayou Basin, the two-year frequency flood would reduce damages on about 2,717 acres, or about 31 percent of the cropland (Table 5-1). Table 5-1 also shows the mean water elevations in the sump by month and the amounts of cropland that would be flooded at each elevation. Impacts to the New Madrid Floodway would be similar to Alternative 2, except for higher start/stop pumping elevations. The pumps would start when interior water elevation reaches 282.5 feet NGVD and would evacuate water down to 280 feet NGVD. The two-year frequency flood would be reduced as described in Alternative 2.

5.2 WOODLANDS

5.2.1 Alternative 1: Without-Project

Recent surveys indicate that forest loss within the Mississippi Alluvial Valley (MAV) has slowed (National Biological Service 1995). The amount of land that could have been economically cleared and planted in soybeans has been cleared to the maximum extent since the mid-1970s when soybeans dramatically increased in price. The distribution of forested habitats

in Missouri compared to the total forested lands remaining among the other states within the MAV has increased from three percent in 1957 to six percent in 1992. Further woodland clearing

Table 5-1.
St. Johns Bayou Basin Mean Monthly
Sump Elevations (1943-1974) and Agriculture Acres Flooded
(2-year Frequency Flood Event)

Month	Existing		Authorized			A&M		
	Elevation	Acres	Elevation	Acres	Change*	Elevation	Acres	Change*
Jan	274.4	12	284.7	1,794	1,782	284.7	1,794	1,782
Feb	277.1	34	275.5	17	-16	276.1	18	-16
Mar	281.5	310	279.2	36	-274	279.9	153	-157
Apr	282.8	398	280.3	152	-246	280.9	213	-185
May	280.1	165	277.9	29	-136	278.6	37	-128
Jun	274.1	12	273	1	-11	273.4	1	-11
Jul	270.5	8	269.7	0	-8	270	0	-8
Aug	265.9	5	265.5	0	-5	265.5	0	-5
Sep	264	4	263.3	0	-4	263.3	0	-4
Oct	263.9	4	263.3	0	-4	263.3	0	-4
Nov	266.1	5	265.5	0	-5	265.5	0	-5
Dec	270.1	8	279.3	0	-8	279.3	37	29
Mean	272.5	10	273.1	1	-10	273.4	1	-9
2YR FREQ	291.8	8,764	290.2	6,047	-2,717	290.3	6,047	-2,717

New Madrid Mean Monthly Sump Elevations (1943-1974) and Agriculture Acres Flooded
(2-year Frequency Flood Event)

Month	Existing		Authorized			A&M		
	Elevation	Acres	Elevation	Acres	Change*	Elevation	Acres	Change*
Jan	274.6	19	282.3	325	306	282.3	325	306
Feb	278.1	32	273.1	14	-18	274.8	19	-13
Mar	282.2	325	274.9	19	-306	277.5	32	-293
Apr	283.7	1,014	275.7	24	-990	278.5	40	-974
May	280	56	275	19	-37	277.2	28	-29
Jun	274.5	19	272.3	11	-8	273.3	14	-5
Jul	270.7	9	269.5	7	-2	270.2	7	-2
Aug	265.5	3	265.7	3	0	265.8	3	0
Sep	264	-	264	-	0	264	-	0
Oct	264.4	-	264.3	-	0	264.3	-	0
Nov	266.1	3	265.9	3	0	266	3	0
Dec	269.9	7	271.7	11	4	277.6	32	25
Mean	272.8	14	271.7	11	-2	272.6	14	0
2 YR FREQ	290	11,837	284.8	1,518	-10,319	284.9	1,518	-10,319

* Represents change in acres flooded under project conditions

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is not expected to be practical and is not foreseen even if agricultural prices increase. This trend is indicated in Missouri Department of Conservation forest surveys, which show no change in the percentage of forested acres in six Bootheel counties from 1972 to 1989 (Lynn Barnicol, pers. comm.). This information indicates that the trend in the clearing of forested areas in Missouri has been reduced and appears to be minimal. Several factors account for this trend, including government incentives such as the Wetland Reserve Program (WRP), which encourages private landowners to plant or retain forests. The extent of woodland areas within both basins is expected to remain the same under the Without-Project Alternative unless modified by the landowners. Lands in timber company and public ownership are expected to remain wooded. Any lands that still have the potential to be cleared for agriculture are in small plots and are subject to the preference of the landowner.

The MDNR states that existing agricultural drainage improvements outside Big Oak Tree State Park, a National Natural Landmark, prevent the park from retaining runoff during the growing season. This is causing a progressive drying of the park's swamp and a lack of BLH regeneration. The large champion trees are dying, different understory plant species are invading, and there is little or no oak tree regeneration. Water retention in the park is necessary to maintain its BLH and cypress-tupelo swamps. Without regeneration, the health of this only remaining old growth forest would eventually decline (Thomas Lange, pers. comm.). An embankment/levee was recently erected west of Tenmile Pond. It begins at the southeast side of Bogle Woods (near Pinhook, Missouri), and extends southward along the east side of Tenmile Pond Ditch and Wilkerson Ditch, tying into the frontline Mississippi River levee. The levee crown is about 300 feet NGVD (Mike Hamra, pers. comm.). Under future without-project conditions, Big Oak Tree State Park would continue to receive periodic high Mississippi River backwater flooding that is essential in maintaining the park's ecological integrity. However, the levee will prevent intermediate flood stages from reaching the park. Because of this, without an increased quantity and a different source of water, the park's integrity will be severely threatened or possibly lost. The increasingly rare plant and animal communities would continue to contribute significantly to the State's biodiversity. However, species composition is expected to change when vegetation characteristics of the park change.

Conditions over the entire area are unlikely to change appreciably without project implementation, because existing wetland protection should minimize conversion of small wooded wetlands to other uses. Mature forested wetlands will continue to degrade from previous hydrologic alterations unless water control programs are implemented to restore historic water levels. Forested wetlands along the lower reaches of St. Johns Bayou may change to include species with greater water tolerance (e.g., bald cypress and buttonbush), responding to higher water levels when the St. Johns gravity drainage structure is closed.

5.2.2 Alternative 2: Authorized Project

In the St. Johns Bayou Basin, channel improvement would result in the initial loss of about 747 wooded acres within the project ROW. The terrestrial HEP, which was used to measure terrestrial wildlife values of wooded areas, revealed that 2,754 average annual habitat

units (AAHUs) for five representative species would be lost due to construction (discussed in more detail under wildlife resources and in Appendix C of this report). To partially mitigate losses, conservation easements would be acquired on all 585 acres of new embankments. These easements would prohibit grading the excavated material onto adjacent fields and farming to the channel edge. The excavated material would be left in rough embankments, fertilized, and seeded with a mixture of Korean lespedeza and switchgrass. These would provide wildlife cover, food, and a shrubby/brushy habitat, which is currently lacking within the project area. Due to periodic channel maintenance, it is likely that some of the embankments would remain largely as shrubby habitat. However, it is expected that most of the ROW would eventually become wooded. Vegetated embankments would also help reduce erosion and subsequent sedimentation in the channels, thus reducing the need for frequent maintenance.

In the New Madrid Floodway, 14.5 acres of wooded land would be cleared to construct the levee closure and pumping station. Seven of these acres are wetlands. About 2.2 acres would then be permitted to revegetate. This would result in the loss of approximately 66 AAHUs. No wooded lands would be cleared to raise the Setback Levee. No channel enlargement work would be performed in the New Madrid Floodway.

The Phase II GDM originally authorized purchasing 2,500 acres of cropland in the Tenmile Pond area and planting it in BLH species to mitigate woodland and wetland losses for the overall project. The recent terrestrial HEP revealed that approximately 2,118 cropland acres would be required to be reforested by planting acorns for mitigation of direct construction impacts. The recommended mitigation plan is contained in Appendix B of this report and is described further under the wildlife impacts.

In the New Madrid Floodway, Big Oak Tree State Park would no longer experience occasional prolonged Mississippi River backwater flooding throughout the spring growing season and into early summer. The forest tree species in the park are not only adapted to frequent and prolonged flooding, but require occasional flood waters. Drier upland species would continue to replace the wet forest/swamp species in the understory and midstory tree layers in the event that flooding is reduced. These more shade-tolerant tree species have the potential to quickly replace the more light-dependent oaks and thus shade out the ground-layer herbaceous species and young trees. Impacts would be similar to those discussed under Alternative 1. This is discussed in more detail under Big Oak Tree State Park in the significant resources section of this report.

The USFWS states that indirect impacts would be caused by the implementation of this project. They concluded that based on historical land use changes, this alternative would lead to conversion of significant tracts of forested wetlands that would no longer be subject to backwater flooding. The USFWS states that the affected land would lie between elevations 277 and 290 feet NGVD in the New Madrid Floodway and between 287 and 290 feet NGVD in the St. Johns Bayou Basin. Based on this assumption, the USFWS recommended that protective covenants be placed on the forested tracts noted above. If this is not possible, the USFWS recommends mitigating indirect impacts by purchasing an additional 2,120 acres for St. Johns Bayou Basin habitat losses (2,823 AAHUs) and 4,878 acres for habitat losses in the New Madrid Floodway (6,496 AAHUs).

The Corps expects no further woodland clearing in the future even if agricultural prices increase. The amount of land that could have been economically cleared and planted in soybeans has been cleared to the maximum extent since the mid-1970s when soybeans dramatically increased in price. This trend is indicated in Missouri Department of Conservation forest surveys, which show no change in the percentage of forested acres in six Bootheel counties from 1972 to 1989 (Lyn Barnicol, pers. comm.).

Wetland areas were delineated, mapped, and then ground-verified by Memphis District engineers and regulatory functions biologists using the latest satellite imagery, GIS data, and following guidelines of the 1987 Wetland Delineation Manual. Every aspect of this delineation was approved by the USFWS and the MDC. Most existing wooded wetlands in the project area, particularly BLH, lie in depressional areas around major drainage features. These areas are subjected to regular overflows on an annual basis from rainfall and interior headwater flows, in addition to backwater inundation from the Mississippi River. These lower areas (particularly Edward's Woods in the St. Johns Bayou Basin and the Tenmile Pond, Bogle Woods, Hubbard Lake, and Eagles Nest areas in the New Madrid Floodway) tend to retain surface water due to their soil characteristics and topography (lower land elevations). They would continue to experience inundation during interior rainfall events, even under with-project conditions, contributing further to their wetland status.

Hydrologic, geotechnical, and regulatory reviews indicate that wooded wetlands will continue to remain as wetlands. This is discussed in more detail in the wetland section of this report and in Wetland Appendix D. Private land classified as wetlands is expected to remain protected under Section 404 of the Clean Water Act. Any post-project work in the wooded wetlands that may be done by private individuals will be under Section 404 jurisdiction and have to be evaluated on a case-by-case basis with on-site determinations made regarding specific wetland impacts.

The USFWS position is that the existing hydrology has limited land clearing in the project area and that increased drainage due to the project will dewater existing wooded wetlands that will then become economically profitable to farm. The USFWS position is detailed in their Coordination Act Report contained in Appendix C of this report.

Although flood reduction may provide some incentive to clear wooded habitat, especially in the lower portions of the St. Johns Bayou Basin and in the Tenmile Pond areas, there are controls in place that discourage clearing. These include "Swampbuster" provisions of the Food Security Act of 1985 and the permitting requirements under Section 404(b)(1) of the Clean Water Act. The permitting process requires mitigation for significant wetland losses. Forested wetland clearing not part of an ongoing silvicultural operation would require mitigation by the landowner at the time of impact. The Corps has no control over any actions that landowners may take with respect to their land until those actions fall under Section 404 jurisdiction or Section 10 of the Rivers and Harbors Act

To fully mitigate BLH direct losses (2,820 AAHUs), the terrestrial HEP determined 2,118 acres of agricultural land would be purchased in fee title and reforested in BLH. To

mitigate indirect impacts, the USFWS recommends reforesting an additional 6,998 acres. All direct and indirect woodland impacts would be fully compensated by 113 percent under the fishery mitigation recommendation, which includes purchasing 10,312 acres of flooded agricultural land in fee title and reforesting it with BLH species. This is discussed in more detail in Appendix B, the Mitigation Appendix.

5.2.3 Alternative 3: Avoid and Minimize

Within the St. Johns Bayou Basin, about 2.6 miles of old embankment are forested along the east (left-descending) bank of St. James Ditch between Missouri Rt. 80 and Missouri Rt. 00. Pedestrian surveys revealed large and mature red oaks, pond cypress, hickories, pecan, and sugarberry growing on the old embankment. This embankment now contains some of the highest-quality woodland habitat along the project area ditches. Changing work from the east to the west bank along this portion of St. James Ditch would preserve approximately 44 acres of BLH. No work would be done on the upper 3.7 miles of St. James Ditch to avoid impacts to the State-endangered golden topminnow. This would also preserve about 76 acres of existing trees along both banks of the ditch. Avoiding the nine-foot strip in the Setback Levee Ditch to preserve mussel habitat would preserve an additional 66 acres of wooded ditchbank habitat.

This alternative includes reducing the improved channel bottom width on St. Johns Bayou from 200 feet to 120 feet and working from the right bank instead of both banks. This would further reduce the amount of woodland losses by approximately 166 acres. When one considers the avoid and minimize features with the reduced channel width, approximately 470 acres of woodland would be lost in the ROW. Only 78 acres of the total 470 acres are wooded wetlands. However, conservation easements on 406 acres of the new embankment and ROW would partially compensate the construction impacts. Overall, adverse impacts to BLH are less with this alternative than with Alternative 2. Other impacts to woodlands in the St. Johns Bayou Basin outside the ROW would be similar to Alternative 2. Therefore, only 470 acres would be initially cleared.

As described in Alternative 2, the USFWS maintains that there will be significant indirect, project-related impacts to forested lands because of hydrologic changes. They also maintain that conversion of forested wetlands to other land uses would result in the loss of approximately 2,823 AAHUs in the St. Johns Bayou Basin and 6,217 AAHUs in the New Madrid Floodway. In addition, as described in Alternative 2, they state that these losses should be avoided by placing conservation easements on forested wetlands between elevations 290 and 287 feet NGVD in the St. Johns Bayou Basin and 290 and 281 feet NGVD in the New Madrid Floodway. If easements cannot be obtained, they recommend purchasing in fee title sufficient croplands to fully compensate habitat value losses from induced development of those wetlands (2,120 acres in the St. Johns Bayou Basin and 4,669 acres in the New Madrid Floodway). The Corps does not recommend mitigating these indirect impacts as explained in Alternative 2, but the USFWS and Corps agree that this loss would be fully mitigated by the recommended fishery mitigation.

To fully mitigate BLH direct losses (2,058 AAHUs), the terrestrial HEP indicates that 1,546 acres of agricultural land would need to be purchased in fee title and reforested in BLH.

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The USFWS recommends reforesting an additional 6,789 acres to mitigate indirect terrestrial habitat value losses. Both of these impacts (direct and indirect) would be compensated by approximately 115 percent under the fishery mitigation recommendation, which includes purchasing in fee title and reforesting 9,557 acres of frequently flooded agricultural lands.

5.3 WETLANDS

5.3.1 Alternative 1: Without-Project

A total of 67,396 acres of wetlands of all types were delineated in the project area, containing all lands that could be impacted by project implementation. Of the total acres, 30,622 acres are located in the St. Johns Bayou Basin (Table 4-1) and approximately 36,774 acres are located in the New Madrid Floodway (Table 4-2). Approximately 75 percent of total wetlands are cropland, and 15 percent are BLH. Herbaceous vegetation and open water comprise the remaining 10 percent.

Existing conditions within both basins are expected to remain the same under the Without-Project Alternative. The agricultural lands in the St. Johns Bayou Basin will still be subject to flooding from interior rains whenever the control structure gates are closed at high river stages. The New Madrid Floodway will continue to be periodically inundated by the Mississippi River.

Almost all the forested wetlands that can be economically cleared have been cleared and converted for agriculture. Non-forested wetlands around borrow pits are expected to remain and continue their natural succession to wooded land over time. Overall impacts of this alternative would be similar to the impacts to bottomland hardwood forests.

Under the Without-Project Alternative, the "Swampbuster" provision of the Food Security Act should limit the conversion of wetlands to agricultural lands. Section 404 of the Clean Water Act regulates the discharge of dredged or fill material in wetlands and would require individual landowners to obtain a permit from the Corps prior to converting wooded wetlands to agriculture. However, certain types of logging operations are exempt from USACE wetland regulations assuming best management practices are employed, enabling landowners to harvest the timber.

Present trends at Big Oak Tree State Park can be expected to continue. The park will continue to dry out from lack of water and the effects of the low embankment/levee to the west of the park. Without hard mast producing tree regeneration, the health of this unique old growth forest and National Natural Landmark would eventually decline. Without an increased quantity of water, the park's integrity will be severely threatened, or possibly lost.

The USFWS agrees that existing conditions are unlikely to change appreciably without project implementation, because existing wetland protection should minimize conversion of small wetlands to other uses. Some landowners may take advantage of programs that offer financial incentives to restore or improve wetlands. However, present low participation in these programs indicates that they will have small effects in the future. The USFWS states that mature forested wetlands will continue to degrade from previous hydrologic alterations unless water control programs are implemented to restore historic water levels.

5.3.2 Alternative 2: Authorized Project

As presented in Table 4-1, the GIS landcover information revealed that only 121 acres of wetlands in the St. Johns Bayou Basin would be impacted directly through ditch enlargement. The 121 acres are composed of 107 acres of BLH, six acres of cropland, five acres of herbaceous vegetation, and under three acres of open water and pasture, as outlined in further detail in Wetland Appendix D. Other impacts of this alternative to the St. Johns Bayou Basin would be similar to the Alternative 2 impacts to bottomland hardwood forest previously discussed. In addition, dredged material would be placed on approximately 65 acres of wetlands interspersed within the ROW along St. Johns Bayou. Some of this material would be later removed and used for the levee raise and levee closure construction items. The only sizeable block of woodland along the channels in the St. Johns Bayou Basin is in timber company ownership, and this block is not expected to be cleared as a result of the project. Thus, it is unlikely that channel work will lead to wooded land clearing. The existing wooded wetlands are expected to remain with this alternative.

In the New Madrid Floodway, approximately 12 acres of wetlands (seven acres of BLH, three acres of croplands, and two acres of herbaceous) would be impacted by the levee closure (Table 4-2). No wetlands would be cleared for the Setback Levee raise. Other impacts of this alternative to the New Madrid Floodway would be similar to the Alternative 2 impacts to bottomland hardwood forests, as previously discussed.

The Authorized Project would reduce Mississippi River inundation because the control gates would be closed and pumps would evacuate interior drainage. Table 4-1 shows that in the St. Johns Bayou Basin, flooding would be reduced on about 6,710 acres below 300 feet NGVD. This figure is based on the April 22, 1993, satellite image that also includes saturated acres. In the New Madrid Floodway, periodic inundation would be reduced on about 29,770 wetland acres of all types (forest, scrub/shrub/marsh, cropland, pasture, herbaceous, open water) below 300 feet NGVD according to the Corps' delineation (Table 4-2).

Corps hydraulic and geotechnical engineers and regulatory biologists conducted a thorough review of historical rainfall data, Mississippi River gage data, soil surveys produced by NRCS, geological maps of the area, and wetland vegetation. This review determined that even with reduced Mississippi River inundation, wetlands within both basins will continue to remain as wetlands and under the jurisdiction of Section 404 of the Clean Water Act. This will be the result of normal rainfall and the high groundwater table in the sandy aquifer underlying both basins during high Mississippi River stages. Groundwater will penetrate the surface strata at drainage ditches and in areas of more permeable soil strata such as sand lenses intermingled with the upper clay material. This combination of rainwater and seepage during high Mississippi River stages will pond water at the surface of the low or wetland areas. The water will tend to remain in these areas because of the low permeability of the clay soils in the upper soil strata. This was illustrated by the April 22, 1993 satellite scene used for delineating landcover and wetland areas. The Landsat photograph of the 1997 flood (Plate 3) also illustrates this. Plate 3 also shows the identical wetland conditions existing in cropland and forested wetlands outside the project area (above 300 feet NGVD). This hydrology helps explain the source of existing

wetlands located above the five percent continuous inundation elevation due to backwater flooding.

Nearly all the wetland functional values for water quality will remain unchanged based on recent water quality analyses and area hydrology, as discussed under Alternative 3. However, there will be some wetland functional values within the project area either lost or reduced by implementation of the project. Mitigation has been recommended to offset losses to significant resources (terrestrial, waterfowl, and fisheries). These are covered in the HEP and mitigation sections of this report.

The NRCS presently classifies most of the wetlands in the project area as prior converted (PC) wetlands, including approximately 85.3 percent in the St. Johns Bayou Basin and 90.9 percent in the New Madrid Floodway (NRCS 1998). The authority to change the current classification of these areas rests with the U.S. Department of Agriculture, NRCS. Because NRCS currently classifies nearly all of the croplands within both basins as PC, local landowners have the flexibility to use their land with no limitations from any agency. This flexibility will not change under any of the proposed project alternatives.

Lower wooded tracts (particularly Edward's Woods in the St. Johns Bayou Basin; and the Tenmile Pond, Bogle Woods, Hubbard Lake and Eagles Nest areas in the New Madrid Floodway) tend to retain surface water because of their topography (lower land elevations). They would continue to be inundated by internal rainfall even under project conditions, further contributing to their wetland status based on groundwater effects during high river stages. No additional woodland clearing is expected as a result of reduced inundation associated with this alternative.

Borrow pits are influenced primarily by rainfall and interior runoff. This will not change with this alternative. The impacts to borrow pits are expected to be similar to the impacts discussed in Alternative 1.

The impacts to Big Oak Tree State Park would be the same as for Alternative 1 except that periodic Mississippi River inundation would be reduced. This alternative does not provide for supplemental water to mimic the periodic river inundation. Without supplemental water, the park may continue to dry out, even with the MDNR's water retention project in place.

The USFWS states that the proposed pumping operations (for waterfowl ponding) could prevent years where little or no flooding occurs in many areas. These are conditions needed for many tree species to regenerate. The waterfowl ponding plan may be detrimental to bottomland hardwoods in the lower elevations of the basins because prolonged static flooding (2,400 acres with this alternative) that overtops red oak species during the dormant season could lead to high mortality and further stress the remaining BLH.

Based on information generated by the hydrologic investigation, the Corps believes that the forested wetlands located within the project area will remain as wetlands after project implementation due to groundwater, as influenced by high Mississippi River stages, as well as internal headwater and rainfall events. The amount of land that could have been economically converted to cropland was cleared to the maximum extent in the late 1970s when soybeans

dramatically increased in price. Further woodland clearing is not expected in the future even if agricultural prices increase or cropping patterns change. This trend is indicated by Missouri Department of Conservation forest surveys, which show no change in the percentage of forested acres in six Bootheel counties from 1972 to 1989. The economic analysis reached this same conclusion (see Appendix E).

Changes to wetland habitat values will be mitigated through results from the analyses of terrestrial, waterfowl, shorebirds, and fishery species. To mitigate losses to forested wetlands, the HEP team first determined the gains associated with reforestation of frequently flooded cropland. Based on this analysis, the HEP team determined that 1,546 acres of cropland should be reforested to compensate for the direct project impacts in both basins. As discussed in the fishery section, the Corps determined that mitigating spawning losses to agricultural land and rearing losses to BLH and permanent waterbodies would fully mitigate fishery impacts as well as compensating for all wetland functions.

The recommended mitigation plan for this alternative involves reforesting approximately 10,312 acres of frequently flooded cropland for fishery mitigation (1,456 for St. Johns Bayou Basin impacts and 8,856 for New Madrid Floodway impacts). In addition, the plan includes purchasing flood easements on 791 acres of fallow land for shorebirds (120 acres for St. Johns Bayou Basin impacts and 676 for the New Madrid Floodway impacts). This plan would mitigate losses to terrestrial species (direct and indirect impacts), waterfowl, fisheries, and shorebirds. The mitigation plan will also result in significant gains in terms of wetland functional values and detrital export. Water quality of both basins and the Mississippi River would also improve with reforestation. The Corps and USFWS will continue to look for opportunities to mitigate in-kind permanent waterbody losses on mitigation lands. If opportunities arise, the amount of reforestation acreage would be reduced. The possible location of the mitigation land would be determined during the site selection process (described in more detail in Appendix B, the Mitigation Appendix).

The USFWS provided comments that included concerns about the proposed project and project impacts. USFWS concerns have been answered throughout the main body of this FSEIS. Concerns were also contained in USFWS's formal comment letter to the DSEIS. The Corps responses to these comments are contained in the responses to the public comment letters section in Volume III, Appendix L of this report.

5.3.3 Alternative 3: Avoid and Minimize

The St. Johns Bayou Basin channel improvements would result in the direct conversion of approximately 90 acres of wetlands (78 acres of forested land, seven acres of cropland, five acres of herbaceous, and under one acre of pasture and open water) to the project rights-of-way. Approximately 565 acres of forested wetlands will experience reduced inundation (Table 4-1). There would be 29 fewer wetland acres impacted with this alternative as a result of reduced channel sizes and a shorter work reach. Other impacts to the St. Johns Bayou Basin are similar to those discussed under Alternative 2 and under Alternative 3 for Woodlands. As discussed under Alternative 2, dredged material would be placed on approximately 65 acres of wetlands within the ROW along St. Johns Bayou. Some of this material would later be removed and used for the levee raise and levee closure construction items.

In the New Madrid Floodway, direct construction impacts to the wetlands within the levee closure ROW are identical to those discussed in Alternative 2. Approximately 5,138 acres of forested wetland will experience reduced inundation (Table 4-2). Impacts would be similar to those previously discussed in the Bottomland Hardwood Forest section under Alternative 3.

Approximately 36,056 acres of wetlands below the 300 feet NGVD elevation in both basins would experience reductions in inundation (6,680 acres in the St. Johns Bayou Basin and 29,376 acres in the New Madrid Floodway). As shown in Table 4-1 and Table 4-2, backwater flooding would be reduced on up to 22 percent of the land the Corps evaluated as wetlands in the St. Johns Bayou Basin and 80 percent of the land in the New Madrid Floodway. As discussed in the previous sections and in Alternative 2, no wetlands associated with the project will be drained. Thus, there would be no wooded wetland loss related to this project. Impacts to existing borrow pits would be the same as under Alternative 2.

Impacts to the wooded wetlands of Big Oak Tree State Park would be similar to those discussed in Alternative 2. However, under this alternative the Corps would assume the MDNR's $1.2 million water retention project, with a few changes to ensure its stability, as part of the proposed mitigation plan. This would permit the MDNR to use the $1.2 million for other conservation or wildlife habitat projects. The Corps would also install 20 artesian-type wells and one well pump that would provide water and permit the MDNR to mimic Mississippi River backwater inundation water regimes. Another structure would be included to direct sediment-laden surface runoff water to the park. Engineering and construction details will be worked out between the MDNR and the Corps. After construction, the MDNR would manage the wells and water levels to maximize benefits. This feature is discussed later in the Big Oak Tree State Park section of this report.

Table 5-2 displays the acreages which are eligible (based on hydrology) for classification as farmed wetlands under FSA and the acres which could lose that eligibility when periodic flooding is reduced with project implementation. The project will impact a maximum of 1,302 acres in the St. Johns Bayou Basin and 5,961 acres in the New Madrid Floodway.

Table 5-2. Inundated Cropland Acres in Both Basins

St. Johns Bayou Basin				New Madrid Floodway		
NRCS Existing 15 Day 289.0 ft. NGVD	NRCS A & M 15 Day 286.2 ft. NGVD	NRCS Reduced Inundation		NRCS Existing 15 Day 288.3 ft. NGVD	NRCS A & M 15 Day 280.0 ft. NGVD	NRCS Reduced Inundation
3,514	2,212	1,302		6,012	51	5,961

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In both basins, higher start pump elevations would occur up to 282.5 feet NGVD, an increase of 3.5 feet in the St. Johns Bayou Basin and 4.5 feet in the New Madrid Floodway. Soil saturation from groundwater would remain dominated by high Mississippi River stages.

The Corps and USFWS recommend mitigating habitat value losses of these wetlands based on the terrestrial HEP, waterfowl, shorebird, and fishery analyses. Impacts to forested wetlands were evaluated using the terrestrial and aquatic HEP and the USFWS Waterfowl Assessment Methodology (WAM). Scrub/Shrub/Marsh habitat was evaluated using the terrestrial and aquatic HEP. Cropland, pasture, and herbaceous habitats were evaluated using the shorebird and aquatic HEP and the WAM. Open water was evaluated using the aquatic HEP. Additional details on each covertype are discussed in Appendix D, Wetlands.

Previously addressed hydrologic, geotechnical, and regulatory evaluations concluded that all existing areas that are presently considered wetlands (either through saturation or inundation) will remain as wetlands. Except for the direct loss of 167 acres required for direct construction, no other wetlands will be drained or destroyed. The impacts to wetlands would result from loss of periodic Mississippi River inundation during the spring growing season. Since there will not be a loss of wetlands, many of the functional values of wetlands will not be significantly impacted. The functional values are addressed as follows:

1. Water Quality: There is concern that the project would adversely affect the ability of wetlands to filter water and negatively affect Mississippi River water quality. The WES study concluded no discernable water quality change in the backwaters or the river with or without the project. Low water conditions with the project would tend to retain pesticides/sediments within the Floodway. This would benefit the river, but the effects are not discernable. Mitigation lands (reforestation of 9,557 acres of agricultural lands) would benefit water quality, especially if some of the reforestation occurs in the batture lands.

2. Nutrient Cycling: Nutrient concentrations (except phosphorus) were not excessively high except during periods of elevated flow. Concentrations within the Floodway were not substantially different from those of the Mississippi River. Thus, reducing periodic inundation would not produce measurable changes in existing conditions.

3. Groundwater Recharge: Groundwater levels in the project area are affected much more by Mississippi River levels than by wetlands. Therefore, the project will not have any significant impact on groundwater recharge.

4. Floodwater Storage: Steady-state project design flood tests showed that the difference in response of the Mississippi River system for the with and without-closure condition would be negligible in terms of stage and duration.

5. Sediment Retention/Export: Sediment concentrations were generally lower than those in the Mississippi River and increase, as expected, with runoff. Sediment retention in the Floodway resulting from backwater flooding is estimated to be low (a value of 10 percent was used in mass balance assessments) based on little evidence of

deposition following major high flow events. Sediment export from the area would be expected to decrease by about 50 percent with the project in place due to a decrease in runoff associated with earlier inundation of fallow croplands.

6. Special Areas (Big Oak Tree State Park): There might be some reduction in nutrient and sediment input from river overflows. However, the park is so far removed from the river, the effects are thought to be minimal. Part of the proposed mitigation plan is to divert sediment-laden surface runoff water to the park to provide the required sediments. Water quality analysis yielded results similar to existing conditions with no flooding. The park would benefit from the project, and its ecological integrity would be ensured.

7. Fish Habitat: This alternative will cause a reduction in available spawning and rearing habitats during the spring. Reforestation of agricultural lands fully mitigates this loss.

8. Shorebird Habitat: Reduction in backwater flooding on shallow openlands in the spring eliminates a food source during spring migration. Mitigation by permanent easement on 765 acres of managed openlands fully compensates this loss.

9. Waterfowl Habitat: This alternative will cause a reduction of backwater habitat during the spring migration. Winter ponding of 6,400 acres (especially if reforested) and improved gate operation, plus reforestation of seasonally inundated agricultural land more than mitigates this loss.

10. Wildlife Habitat: This alternative will cause a reduction in backwater flooding on croplands and wooded lands during spring. Reforestation of 9,557 acres and permanent easement on 765 acres of managed herbaceous lands fully compensates this loss.

11. Wetland Quality: Overall quality of wetland habitat and functional values will greatly increase with the conversion of 9,557 acres of croplands to bottomland hardwood forests. This reforestation would eventually double the amount of existing forested land.

Some wetland functions may still be adversely impacted, but the impacts are difficult to quantify and mitigate. Since the life history of fishes is relatively well documented in the project area, fishery reproduction is a wetland function that can be reasonably quantified. Other wetland functions (e.g., nutrient cycling, maintenance of water quality, organic export) are more difficult to quantify, but high fish diversity generally indicates a high-quality wetland environment. It was determined that the greatest adverse impact of the project would be to fish, which could no longer use flooded croplands in spring and summer for spawning and rearing habitat. Therefore, mitigation of fishery habitat losses compensates for impacts to other wetland functions.

Recent water quality analyses revealed that water quality could improve with this alternative. Fewer agrichemicals would be washed into the Mississippi River because the levee

closure would reduce periodic cropland inundation. Providing 9,557 acres of restored BLH in the project area would improve water quality in the project area and in the Mississippi River during high rainfall events. However, locating the mitigation lands within the batture would improve water quality in the Mississippi River even more.

Under the recommended mitigation plan, the Corps and USFWS will continue to look for opportunities to mitigate losses to permanent waterbodies by creating new ponds or borrow pits (if opportunities are identified, the amount of reforestation would be reduced). To mitigate shorebird losses, easements would be purchased on 105 acres of herbaceous land in the St. Johns Bayou Basin and 660 acres in the New Madrid Floodway, and this land would be seasonally flooded.

5.4 WILDLIFE

A terrestrial HEP was used to evaluate the impacts of the First Phase of the St. Johns Bayou Basin and New Madrid Floodway Project on the wildlife habitat values of forested wetlands and scrub-shrub/marsh. Results of the HEP analysis are found in Appendix C of this report. An interagency team composed of biologists from the USFWS, the MDC, the Corps, and a private consulting firm, Gulf Engineers and Consultants, Inc. (GEC) selected eight HEP evaluation species to represent the overall wildlife population and oversaw the HEP analyses. The USFWS and the MDC took the lead in selecting the model species, the sampling areas, and the number of sampling sites. Basically, the resource agencies determined species and sampling regimes; then the Corps and GEC did the sampling and calculated the results.

The evaluation species represented guilds of all mammals, birds, amphibians, and reptiles that would be found throughout the complete range of habitats in the project area. The team developed assumptions for existing, future with-project, and future without-project conditions to quantify habitat changes. The habitat changes to any one of the evaluation species would be reflected on all the species within that particular guild. For example, the bottomland hardwood forest required by the barred owl and fox squirrel and the marshy and ditchbank wetlands required by the red-winged black bird and muskrat would represent amphibians and reptiles normally associated with those habitats. Separate amphibian and reptile HEPs were not required.

GEC and Corps biologists collected field measurements throughout the project area to determine baseline habitat conditions. Using eight HEP species models, those measurements were mathematically combined to obtain a value between 0.0 and 1.0. That value is termed the habitat suitability index (HSI), where 0.0 represents no habitat value for an evaluation species and 1.0 represents optimum habitat value. Habitat units are the product of the evaluation species' HSI and the acreage of available habitat at a given target year. The habitat unit (HU) is the basic unit of HEP to measure project effects on fish and wildlife.

Changes in habitat units reflect changes in both habitat quality (HSI) and quantity (i.e., acres). Those changes are predicted for selected target years over the period of analysis under future without-project and with-project conditions. Those values are then annualized over the economic life of the project to determine the average annual habitat units (AAHUs) available for each of the modeled species. The difference in AAHUs under future with-project conditions

versus without-project conditions provides a quantitative measure of expected project impacts. An increase in AAHUs indicates that the project will benefit the evaluation species. A decrease in AAHUs indicates the project will negatively affect evaluation species. Further details regarding field data and the evaluation species selected are contained in the U.S. Fish and Wildlife Service Coordination Act Report, located in Appendix C of this report.

5.4.1 Alternative 1: Without-Project

The rainfall in the project area and Mississippi River flooding regimes would remain the same without project implementation. Periodic seasonal flooding of the larger tracts of BLH and the wet croplands would continue to provide valuable habitat for migratory waterfowl, wading birds, shorebirds, songbirds, and numerous species of reptiles and amphibians. This flooded habitat is especially important to spring migrants and essential as refugia for meeting specialized reproductive needs of various reptiles, amphibians, and fish. There would be no changes to the existing wildlife populations with this alternative unless private landowners modify the existing ditches, wooded tracts, or other habitat on their lands. The borrow pits along existing ditches would continue to receive water from rainfall, field runoff, and periodic Mississippi River inundation. Their vegetation compositions will continue to succeed to drier species associations, as they normally will under existing conditions.

As addressed in other sections, Big Oak Tree State Park would continue to experience drying, and plant species composition would change in the park over time. Animal species would change as the forest composition changes. This change would be somewhat alleviated by the MDNR's water retention project. Waterfowl would not have as much resident and migratory habitat area available with the loss of wet BLH areas in the park. The loss of Big Oak Tree State Park BLH would adversely impact migratory and resident waterfowl that use the periodically inundated forests. The USFWS states that the project area is designated by the Partners in Flight Program as a "bird conservation area" containing significant forested wetlands required for breeding neotropical songbirds. It is well known that the decline in many neotropical songbirds because of habitat loss has become an international issue. The USFWS also indicates that recent research has pointed to sharp population declines in several neotropical migratory species (e.g., white-eyed vireo, northern parula warbler, cerulean warbler), particularly those that require large forested tracts to successfully reproduce. In addition to waterfowl and songbirds, all other species using the BLH would be impacted with the aforementioned habitat changes inside the park.

5.4.2 Alternative 2: Authorized Project

Constructing the project would alter the habitat types on 1,083 acres within St. Johns Bayou ROW. About 747 of these acres are wooded lands. Larger, mobile wildlife would be displaced but could move to the other areas during project construction. More sedentary and smaller species could be displaced during excavation or covered with excavated material. These wildlife populations would recover over time once vegetation has matured on the 585 acres of conservation easements. Table 5-3 outlines the acres impacted by each alternative in the St. Johns Bayou Basin.

Conservation easements have been acquired on the new embankment areas to permit their future use as deposition sites. These easements would prohibit farming to the channel edge. Excavated material would be left in rough condition, then fertilized and seeded with a mixture of Korean lespedeza, switchgrass, or some other wildlife cover crop. These would provide cover and food for wildlife. Periodic channel maintenance would require disposal of excavated material within the ROW. Prior to deposition, it would be necessary to remove existing plant

Table 5-3. Wildlife Habitat Acres Impacted by Each Alternative in the St. Johns Bayou Basin

Habitat	Without Project	Authorized	A & M
Bottomland Hardwood Forest	0	0	0
Scrub/Shrub Swamp & Marsh	0	0	0
Ditchbank BLH	0	747	536
Cropland	0	232	244

material. It must be noted that wherever channel maintenance is not required or is not performed for any length of time, the adjacent ROW habitat would mature naturally.

As previously described, the terrestrial HEP (Appendix C) was used to estimate the impacts of various project alternatives on terrestrial wildlife. These include mammals, birds, amphibians, and reptiles throughout all habitat ranges within the project area. The HEP indicated that 2,754 AAHUs would be lost throughout the St. Johns Bayou Basin with construction (Table 5-4). These losses would be partially replaced with restrictive easements and land purchases. Also, approximately 2,068 acres of agricultural land would be reforested to fully mitigate wildlife habitat value losses resulting from direct construction in the St. Johns Bayou Basin.

Table 5-4. Average Annual Habitat Units Lost by Each Alternative in the St. Johns Bayou Basin Due to Construction

Habitat	Without Project	Authorized	A & M
Bottomland Hardwood Forest	0	-2,754	-1,993
Scrub/Shrub Swamp & Marsh	NA	NA	NA
Cropland	0	-119	-104

There would be a loss of 14.5 wooded acres due to construction of the New Madrid Floodway levee closure (Table 5-5). This amounts to 66 AAHUs for the five evaluation species

(Table 5-6). Wildlife impacts from the levee closure would be partially mitigated with the restrictive easements on the ROW and embankments. Approximately 50 acres of restored BLH would be required to fully mitigate this loss.

Table 5-5. Wildlife Habitat Acres Impacted by Each Alternative in the New Madrid Floodway Due to Construction

Habitat	Without Project	Authorized	A & M
Bottomland Hardwood Forest	0	0	0
Scrub/Shrub Swamp & Marsh	0	0	0
Levee Footprint BLH	0	14.5	14.5
Cropland	0	3	3

Table 5-6. Average Annual Habitat Units Impacted by Each Alternative in the New Madrid Floodway Due to Construction

Habitat	Without Project	Authorized	A & M
Bottomland Hardwood Forest	0	-66	-66
Scrub/Shrub Swamp & Marsh	0	+4	+4
Cropland	0	-672	-657

Grassland habitat on the Setback Levee would be covered with excavated material from the channel to raise the levee. This temporary habitat loss would be restored to pre-project conditions upon construction completion. There would be no other direct construction impacts to wildlife in the New Madrid Floodway.

Full replacement of terrestrial habitat functions would not occur for many years given the time needed for the restoration areas to mature. This was taken into consideration when completing the HEP and then developing the mitigation plan for this alternative. This was done as an interagency team effort, with the MDC acting as lead agency. The MDC estimated that it would take at least 50 years for a mitigation site to approach the current habitat quality in the project area. In addition, using the direct seeding method (see Appendix B), the mitigation site may not compensate for lost habitat value to the pileated woodpecker (an evaluation species) during the life span of this project because of the woodpecker's need for mature forests. Only 85 wooded acres would be lost through direct project construction, and most of these existing trees do not meet habitat requirements for the pileated woodpecker. No woodlands (other than for direct construction) would be cleared with this project. The existing pileated woodpecker habitat will remain and increase in quality as the existing forests mature.

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The MDC informed the HEP team of an experimental root production method (RPM) that accelerates tree growth and provides a mature BLH forest earlier than would be the case with acorn planting. Approximately 218 acres of the proposed mitigation lands would be reforested using the RPM.

The USFWS and the MDC believe that there would be induced clearing of bottomland hardwoods (losses of 2,822 AAHUs in the St. Johns Bayou Basin and 6,496 AAHUs in the New Madrid Floodway) due to this alternative. This is further described in the wetland and woodland sections. They recommend purchasing restrictive easements or reforesting additional agricultural land (2,120 acres in the St. Johns Bayou Basin and 4,878 acres in the New Madrid Floodway) to mitigate these losses. The Corps and the USFWS agree that acquisition and reforestation of 10,312 acres for fishery mitigation fully compensates any terrestrial habitat value losses associated with the proposed project.

Three species (muskrat, red-winged blackbird, and great blue heron) were used to evaluate project-related changes in marsh habitat values. Most of the marsh habitat is found in the New Madrid Floodway, primarily along borrow pits. The HEP team assumed those acres would remain the same because those areas should receive enough rainfall and runoff to maintain marsh vegetation. Based on that assumption, HEP results indicate that project-related changes in marsh habitat values will be insignificant.

Changes in shorebird habitat throughout the Mississippi Flyway and in Canada have reduced shorebird population numbers of several species. Birds migrating north in April and May utilize the cropland/shallow-water edge as resting habitat and as a source of food required for continued migration and proper breeding condition. Much of this flooded edge would no longer be available with project operation. No shorebird analysis was conducted in of the earlier habitat evaluations (in previous reports) because no technology (i.e., GIS and hydrologic model) or habitat model was available to quantify project impacts.

Since a HEP model for shorebirds was not available, the interagency HEP team developed one to analyze the habitat impacts in the project area. Implementation of Alternative 2 would significantly reduce shorebird migration habitat value in both basins. In the New Madrid Floodway, this alternative would reduce shorebird habitat value by almost two-thirds. Alternative 2 would lower water levels in April and May (up to eight feet), virtually eliminating suitable shorebird habitat acreage in the years following project completion. After 50 years, suitable habitat would be only 4.5 percent of that provided under future without-project conditions. At the time the shorebird model was developed, the HEP team assumed that cropping patterns under future with-project conditions would include increased rice acreage. That assumption accounts for most of the shorebird habitat value under both project alternatives. The shorebird HEP addresses only spring migration habitat, since that timeframe was considered most critical throughout the year. In years when high river stages occur in June and July, backwater flooding and the thousands of acres of ephemeral ponds left behind would provide important habitat for fall migration, which begins in late July and early August.

Shorebird habitat losses could be mitigated by purchasing either cropland or herbaceous land. The acres required with each habitat type would be different. The HEP indicated a loss of

119 AAHUs in the St. Johns Bayou Basin. This amounts to about a 31 percent habitat reduction. With this alternative, 238 acres of flooded cropland or 120 acres of flooded herbaceous land that would not normally flood under with-project conditions would be required to mitigate the losses to shorebirds. The New Madrid Floodway would lose 672 AAHUs for a 70 percent shorebird habitat reduction. Approximately 1,345 acres of flooded cropland, or 676 acres of flooded herbaceous land that would not normally flood under with-project conditions, would be required to mitigate shorebird losses. The recommended mitigation for shorebird habitat value losses in both basins is the purchase of conservation easements on 796 acres of herbaceous land as discussed in detail in Appendix B.

The USFWS and Corps agree that proper implementation of a mitigation plan that includes reforestation of 10,312 acres of frequently flooded agricultural land and the purchase of 796 acres of shorebird easements would fully mitigate impacts to the habitat values of terrestrial resources lost under this alternative.

5.4.3 Alternative 3: Avoid and Minimize

Impacts and mitigation for both basins would be the similar to those described under Alternative 2 with the following exception: ROW acres in the St. Johns Bayou Basin would be less, and overall shorebird impacts would be slightly reduced. HEP results indicate that project-related changes in marsh habitat values will be insignificant, as indicated under Alternative 2. Impacts to borrow pits would be the same as described under Alternative 2.

In the St. Johns Bayou Basin, the terrestrial HEP indicated that 1,993 AAHUs would be lost due to direct construction impacts (Table 5-4). Approximately 1,496 acres of agricultural land would be restored to BLH to mitigate these losses. Scrub/shrub/marsh habitat gains would be the same as for Alternative 2. In the New Madrid Floodway, direct construction habitat losses would be the same as those described under Alternative 2. The recommended mitigation plan includes restoring 9,557 acres of frequently flooded agricultural land to BLH.

As described under Alternative 2 the USFWS states that indirect impacts would occur to bottomland hardwoods and requests that conservation easements be placed on BLH, which would no longer be seasonally inundated. If easements cannot be obtained, they request purchasing an additional 2,120 cropland acres to mitigate losses in the St. Johns Bayou Basin (2,823 AAHUs) and 4,669 acres for the New Madrid Floodway (6,217 AAHUs). However, Corps review indicates there would not be any woodland clearing as an indirect result of this project, and these areas would remain as wetlands protected under Section 404 of the Clean Water Act. Therefore, the recommended fishery mitigation fully compensates all bottomland hardwood habitat value losses associated with the proposed project.

Wildlife in the Big Oak Tree State Park would be preserved with this alternative. The proposed irrigation wells, pump, and water retention project would provide the required water and permit the MDNR to regulate the water regime within the park. This alternative would also enable the MDNR to work out a plan to restore the wetter conditions needed for successful mast-producing tree regeneration.

The proposed BLH reforestation would increase neotropical songbird habitat. It is the Corps' intent to reforest several large tracts as opposed to numerous smaller tracts. These larger BLH tracts provide optimal neotropical songbird habitat once mature.

The HEP indicated a shorebird habitat loss of 104 AAHUs in St. Johns Bayou Basin. This amounts to about a 27 percent habitat reduction. With this alternative, 209 acres of cropland or 105 acres of herbaceous land would be required for shorebird mitigation.

The New Madrid Floodway would lose 657 AAHU for a 68 percent shorebird habitat reduction. About 1,314 acres of cropland or 660 acres of herbaceous land would be required to mitigate shorebird habitat value losses. The Corps recommends mitigating shorebird losses in both basins by purchasing easements on herbaceous land. All direct and indirect impacts would be compensated under the fishery mitigation recommendation, which includes purchasing in fee title and reforesting 9,557 acres of frequently flooded agricultural lands.

The complete HEP is contained in Appendix C of this report and presents a detailed analysis of the wildlife impacts for each basin. The Mitigation Plan (Appendix B) outlines the acres required to mitigate terrestrial habitat value impacts in more detail along with the various planting scenarios that were considered.

5.5 WATERFOWL

5.5.1 Alternative 1: Without-Project

Future without-project conditions for resident and migrating waterfowl habitat plus potential foraging habitat for wintering waterfowl are expected to remain nearly the same as existing conditions. This assumes that existing laws and regulations that regulate development in wetlands remain. Waterfowl would continue to benefit from some seasonal flooding in the project area during spring and fall migration.

The Waterfowl Assessment Methodology (WAM) developed by the USFWS and the National Biological Service was used to quantity waterfowl impacts associated with each alternative. The WAM measured project impacts to forested wetlands during the 151-day (November 1 to March 30) waterfowl wintering and migration periods.

The WAM uses hydrology and land use data for future with-project and future without-project conditions to compare impacts on wintering waterfowl carrying capacity. The landcover types by acreage in one-foot contour intervals were computed with GIS. The WAM is based on food as an index for the carrying capacity of wintering waterfowl and is expressed in terms of duck-use-days (DUDs) instead of AAHUs. This methodology was modified from waterfowl appendices for other flood control projects to account for the effects of BLH and cropland seed consumption and decomposition. The complete waterfowl analysis is contained in Appendix C.

In the St. Johns Bayou Basin, approximately 386 cumulative acres are ponded with water less than 24 inches deep during the waterfowl season of November 1 through March 31.

Approximately 89,758 DUDs, are available over the entire waterfowl season, with 84,307 DUDs occurring during spring migration in February and March. Approximately 931 cumulative acres less than 24 inches deep are available to waterfowl in the New Madrid Floodway, providing a total of 243,402 DUDs with 238,392 occurring during spring migration. The combined DUDs for both basins during the entire waterfowl season is 333,160 DUDs.

Under the without-project scenario, no change in available DUDs is expected. The area would continue to receive periodic backwater inundation from the Mississippi River in the New Madrid Floodway, and the seasonal flooding in the St. Johns Bayou Basin would remain unchanged. There will be times when little or no backwater inundation occurs.

5.5.2 Alternative 2: Authorized Project

The Phase II GDM authorized the purchase of ponding easements on 4,900 acres of land adjacent to both control structures. At that time, all agencies considered this sufficient mitigation for waterfowl impacts. However, due to the date of the previous GDM, the cooperating agencies agreed that a new waterfowl impact assessment was warranted for this First Phase project. Recent improved estimates indicate that up to 6,460 acres of mixed farmland and BLH could be potentially flooded during the waterfowl season under this alternative.

Implementation of Alternative 2 would alter the habitat available for wintering and migrating waterfowl. One negative impact would be the loss of flooding diversity. Flood timing, duration, and depth would be controlled through pump operations, removing natural variability that contributes to the overall health and stability of wetland ecosystems. WAM results indicate that although Alternative 2 would potentially produce a net increase in total annual duck-use days (DUDs), those gains would appear in December and January, rather than February and March, during the critical spring migration. Moist soil and forested acreage flooded during spring migration would be significantly lower, reducing habitat that provides necessary protein sources particularly important to waterfowl migrating to their breeding grounds (Fredrickson and Heitmeyer 1988).

In the St. Johns Bayou Basin, Alternative 2 would increase total DUDs by 464,906. However, there would be a reduction in DUDs by 74,390 in February and March (Table 5-7). In the New Madrid Floodway, the Authorized Project Alternative would increase the total DUDs by 50,140 while reducing February and March usage by 225,823 DUDs; a pattern similar to that seen in the St. Johns Bayou Basin.

Increased DUDs during December and January are the result of ponding in the sump as specified by the Authorized Project Alternative. Originally under this alternative, 4,900 acres of bottomland hardwoods and croplands in the sump area were to be flooded annually to great depths for extended periods. The water was to be maintained at a constant elevation throughout the entire season. However, it has now been found that such inundation is detrimental to bottomland hardwood species (Fredrickson and Batema 1992) and could severely impact their long-term survival. The operational plan would be altered to allow for the greatest possible diversity of flood timing, duration, and depth during November through March. Altering the operational plan would also allow the river to ebb and flow into both basins during that time and

greatly benefit fisheries resources by maintaining periodic connection between the river and its floodplain.

Table 5-7. Change in Duck-Use-Days in the St. Johns Bayou Basin and New Madrid Floodway

Mitigation Option	Authorized Alternative	Avoid and Minimize Alternative
Change in total DUDs		
St. Johns Bayou Basin	+464,906	+545,856
New Madrid Floodway	+50,140	+53,374
Change in DUDs in February		
St. Johns Bayou Basin	-2,827	-35
New Madrid Floodway	-10,450	-6,943
Change in DUDs in March		
St. Johns Bayou Basin	-71,563	+6,145
New Madrid Floodway	-215,373	-215,645

*Even though a net gain in DUDs results over the entire season, the Authorized and the Avoid and Minimize scenarios show a net loss during the months of February and March, as indicated.

It is also important to note that the WAM does not consider the increasing importance of invertebrates in waterfowl diets during late winter and spring, when the project area traditionally has the highest waterfowl use (D. Wissehr and B. Allen, MDC, per. comm.). During that time, waterfowl are forming pairs, molting, and preparing to breed (Heitmeyer 1985). Furthermore, the WAM does not consider other forested wetland habitat components necessary for healthy waterfowl populations. Forested wetlands fulfill special waterfowl habitat requirements not found in open land (i.e., moist soil units and cropland). In addition to producing nutritious food for waterfowl, wooded habitats provide secure roosting areas, cover during inclement weather, loafing sites, protection from predators, and isolation for pair formation.

This alternative would reduce periodic flooding on up to 36,480 acres of wetlands in both basins. In the St. Johns Bayou Basin, about 592 forested and 295 herbaceous land acres would be affected (Table 4-1). The New Madrid Floodway would see a reduction in inundation on 5,330 forested acres and 1,572 herbaceous acres (Table 4-2). Reduced inundation of some forested wetlands and moist soil areas during spring migration will reduce some of the lands that provide protein sources particularly important to waterfowl at that time of year. The recommended mitigation plan (described below) includes BLH restoration over 7,052 acres of agricultural land, which would provide higher-quality habitat than exists within the project area at this time. As the forest matures on land that was once bare earth and soybean stubble, the habitat quality, diversity, and food resources would more than double the combined existing

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forested waterfowl habitat resources. After planting, this habitat will remain forested and will be managed by either the USFWS or the MDC, ensuring its availability for waterfowl populations.

Reestablishing approximately 1,221 acres of forested wetlands (with a mix of 70 percent red oak species) would compensate the reduction of spring waterfowl habitat. Acres reforested to compensate for fishery habitat losses could also compensate waterfowl habitat loss, provided the flooding regime was appropriate. If the waterfowl ponding scenario is modified, the gains in DUDs during the months of December and January would be reduced. Even if these gains are not realized, reforestation of approximately 10,312 acres of frequently flooded agricultural land would fully mitigate project impacts to waterfowl.

5.5.3 Alternative 3: Avoid and Minimize

As described under Alternative 2, implementation of this alternative would alter the habitat available for wintering and migrating waterfowl. In the St. Johns Bayou Basin, Alternative 3 may increase total DUDs by 545,856 primarily because of increased moist soil and soybean acreage (Table 5-7). Alternative 3 would also provide important forested wetland habitat during spring migration. In the New Madrid Floodway, Alternative 3 would potentially result in an increase of 53,374 total DUDs, but decrease late winter/early spring usage by 222,588 DUDs. Moist soil and BLH acreage flooded during spring migration would be lower, reducing habitat that provides necessary protein sources particularly important to waterfowl migrating to their breeding grounds (Fredrickson and Heitmeyer 1988).

Increased DUDs indicated by WAM during December and January for both basins are the result of ponding in the sump as specified by the operational plan. This will provide managed, inundated habitat that presently does not exist and greatly benefit both migrating and resident waterfowl. A net gain in waterfowl habitat in forested wetlands is achieved in both basins under each alternative.

Fluctuating water levels provide many more waterfowl benefits than constant water levels. To provide for maximum waterfowl benefits during the winter season, the gates would be opened periodically, and Mississippi River water would be permitted to flow on and off the land as it currently does. Approximately 6,400 acres could be flooded with this alternative. This would be shallow water that is usable by waterfowl. The USFWS and the MDC would manage the water levels for maximum waterfowl benefits.

Once water levels reach 285.0 feet NGVD in the St. Johns Bayou Basin and 284.4 feet NGVD in the New Madrid Floodway, the gates could be closed. Interior runoff water would continue to pond in both basins until it reaches 286.0 feet NGVD in St. Johns Bayou Basin and 285.4 feet NGVD in the New Madrid Floodway. If river stages are low, the gates would be shut to permit interior flooding up to the ponding elevations. The gates would be opened when the river level falls below the ponding elevations, then operated to manipulate various water levels inside the basins to maximize waterfowl habitat and duck use. It is possible that there would be an increase in DUDs with water level manipulation versus the constant elevations of the preferred plan. Maximum flexibility to manage water levels for waterfowl will be provided.

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The hydraulic period of record reveals that Mississippi River stages are below 282.5 feet NGVD for slightly over 14 days in March. Therefore, instead of the gates being completely shut by the end of February, they would now remain open through March until the river stage reaches 282.5 feet NGVD. This operations plan would thus avoid approximately half of the important waterfowl losses during spring migration.

Inundated BLH is the highest-quality waterfowl habitat. According to the model results, the reduction of inundated spring habitat could be compensated by reestablishing approximately 891 acres of forested wetlands (with a mix of 70 percent red oak species). No forested wetlands (other than the 85 acres for construction) will be cleared with this alternative. The acres reforested to compensate for fishery habitat losses could also compensate waterfowl habitat losses, provided the flooding regime was appropriate. As stated under Alternative 2, it is important to note that if the waterfowl ponding scenario is modified, the gains in DUDs during the months of December and January would be reduced. Although the importance of the loss of DUDs in the spring (critical time for waterfowl use for proper conditioning) may not be completely realized in the WAM, the Corps and USFWS agree that reforestation of approximately 9,557 acres of frequently flooded agricultural land would fully mitigate project impacts to waterfowl.

5.6 FISHERIES

5.6.1 Alternative 1: Without-Project

The aquatic HEP was used to quantify existing conditions and impacts of the project on fish habitat. An interagency team and personnel from the U.S. Army Engineer Research Development Center (EDRC) met to develop the study approach, select evaluation species, and finalize HSI values that were used to rate the quality of the fishery habitat. The team agreed that the aquatic evaluation would focus on early life stages (spawning and rearing) of fishes and how reduction of floodplain and in-stream habitats affect reproductive success.

HSI values were multiplied by area (acres of floodplain or in-stream habitats) to obtain habitat units (HUs) available for each project alternative. Appendix C explains the evaluation procedures and results in further detail. For the floodplain analysis, a fishery program was run using the hydraulic period of record (from 1943 to 1974) to determine the average number of acres that were flooded on a daily basis up to the limit of a two-year floodplain. Acres that were flooded at least one foot in depth and for eight continuous days were considered to provide suitable habitat for spawning, while other areas that were flooded at any depth and duration were considered as rearing habitat. The acre outputs from the fishery program were used along with the HSI values to conduct the fishery analysis.

Existing conditions would prevail without the project. No major change to the streams or streambank structures are expected. There would be short reaches of ditches in both drainage basins that would be periodically maintained to remove debris and sand shoals that accumulate. Impacts would be localized, and since maintenance would occur only once every 20 years, there would be time for the flora and fauna to recolonize these areas.

The St. Johns Bayou control structure would continue to operate as it has since the late 1950s. Interior runoff water would continue to be trapped in that basin and flood land when the control structure gates are closed during high Mississippi River stages. The amount of time the gates are open or closed varies every year. The following shows the percentage of days over a 30-year period of record when the floodgates were open and fish passage was possible during the spawning season:

Month	Percent of Days Open
March	32%
April	43%
May	60%
June	83%

These data reveal that the gates are normally open for prolonged periods throughout the spawning season, potentially allowing movement of fish between the Mississippi River and the St. Johns Bayou Basin. In the St. Johns Bayou Basin, the existing two-year floodplain provides about 3,070 acres of rearing habitat amounting to 3,657 HUs. Approximately 1,592 acres of these would be suitable for spawning, amounting to 1,844 HUs. These figures are the average for the entire spring spawning season (early, middle, and late to account for different spawning chronologies of the evaluation species). Recent fisheries survey data collected in St. Johns Bayou by the Missouri Department of Conservation (Christoff 1997) and the 1997 collections by Sheehan et al. (1998) indicated high species diversity and stable fish populations during the operational life of the outlet structure. No changes to fish populations are expected with the continued operation of the structure.

Since channel work is not planned for the New Madrid Floodway, no stream impacts would occur. The Mississippi River would still overflow through the levee gap and periodically flood agricultural land during the spring. Approximately 4,231 rearing acres are inundated once out of every two years, amounting to 3,174 HUs. Approximately 2,179 acres of these are available for spawning, amounting to 1,763 HUs.

5.6.2 Alternative 2: Authorized Project

In the St. Johns Bayou Basin, channel enlargement would consist of removing approximately 6,319,000 cubic yards of excavated material. The channel dimensions would be widened and lowered by the average feet indicated below:

	Increased Width, ft.	Increased Depth, ft.
St. Johns Bayou	120	1
Setback Levee Ditch	10	4
St. James Ditch	10	2.5

Killgore and Hoover (1998) quantified the reduction of in-stream fish spawning and rearing habitat caused by channel dredging and widening. Alternative 2 would remove 61.37 acres of riverbank structure in the St. Johns Bayou Basin, resulting in a net loss of 145 HUs.

Structure loss includes logs and debris (0.8 acres), live trees (28 acres), and aquatic vegetation (32.57 acres). No other forms of riverbank structure were noted during habitat surveys.

Unquantified hydrologic changes associated with the proposed channel widening may create unsuitable conditions for some aquatic life. Reduced water depths in the enlarged channels, uniform shaping and smoothing of the channel for flow conveyance, and loss of woody debris could decrease habitat diversity and food supplies for fish. Water temperatures may increase because of increased light absorption through removal of riparian corridor, decreased current, and expanded surface water (Ebert 1993). Stern and Stern (1980) documented summer temperatures up to 12.8 degrees Celsius warmer, and winter temperatures four degrees Celsius cooler in farm streams than in similar woodland streams. Similar patterns in nonforested reaches have been noted by Hansen (1971) and Karr and Schlosser (1978).

Existing channel dimensions and vegetation are such that very little overhanging canopy covers the ditches. Water temperatures are not expected to change appreciably after enlargement, and periodic channel maintenance would preclude the formation of a large canopy cover. In addition, water surface elevations in the unexcavated tributary channels would be lowered for only a short distance upstream during headwater flood events and would remain unchanged during normal flow conditions.

Fish are mobile and would be able to move out of the construction areas during channel enlargement. Based on the time span since previous channel modifications, the high numbers of fish species found, and the existing species composition in the channels, it is reasonable to assume the fishery would recolonize the work reaches shortly after project completion. Hydraulic analysis revealed that existing water elevations (depths) in the tributary channels would be slightly lowered for only a short distance upstream from the channel enlargement sections. No ambient water flows would be changed in any tributaries, especially in their upper reaches.

Restrictive easements in riparian corridors would protect these areas from future clearing and have a long-term positive influence on riverine ecology. The most common fish found in the ditches are those adapted to this habitat type. They would return to the project reaches once the channels and banks stabilize shortly after construction. Construction is only expected to temporarily displace the local fishery. In addition, recent hydrologic, geotechnical, and regulatory reviews concluded that there would not be any induced woodland clearing with this alternative. The woodlands and other wetlands would remain.

The golden topminnow, a State-endangered species, has been recently identified in the upper reaches of the St. James Ditch (Sheehan *et al.* 1998). The golden topminnow was found in aquatic vegetation. Alternative 2 would remove vegetation during clearing operations, thus impacting the species.

The most significant project impacts to aquatic resources are the reduction in duration and frequency of seasonal flooding in the St. Johns Bayou Basin and New Madrid Floodway. Under Alternative 2, the levee closure and pumping operations would reduce Mississippi River backwaters entering the Floodway and significantly reduce interior flooding in both basins.

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That, in turn, reduces spawning and rearing habitat for river and floodplain fishes. Killgore and Hoover (1998) used HEP to quantify project-related reductions in flooding on fish spawning and rearing habitat in both basins (Appendix C). It was assumed that fish could access the Floodway when the gates are open. Based on an average value of the three periods during the spawning season (early, mid, and late), rearing habitat in the St. Johns Bayou Basin would be reduced from 3,070 to 1,602 acres (47 percent loss), and spawning habitat would be reduced from 1,520 to 730 acres (54 percent loss). This results in an average loss of 1,719 HUs of rearing habitat and 988 HUs of spawning habitat for all species combined. Floodplain habitat losses are substantially higher in the Floodway. Rearing habitat would be reduced from 4,231 to 116 acres (97 percent loss), and spawning habitat would be reduced from 2,179 to 49 acres (97 percent loss). This results in an average loss of 3,064 HUs of rearing habitat and 1,704 HUs of spawning habitat for all species combined.

The purpose of this analysis was to evaluate baseline conditions that include a peaking hydrograph but not major floods that are too infrequent for maintaining baseline population levels. Major floods do not necessarily maintain baseline populations of the evaluation species. While such flooding occurs infrequently (greater than every two years), a substantially greater portion of floodplain habitat is available to fish during large floods. For example, river stages of 295 feet NGVD were equaled or exceeded in 10 of the last 35 years. See Plate 3 for a satellite image of the 1997 flood.

The USFWS states that river fishes such as white bass would lose most, if not all, of the extensive spawning, rearing, and foraging habitat provided by the Floodway. The USFWS also cites the following studies that have examined the relationship between floodplain habitat and fisheries productivity. Lambou (1962) noted that the timing and extent of overflow on the floodplain can significantly affect the year classes of fish. Barnickol and Starrett (1951) documented a reduction in game fish in a reach of the Mississippi River with reduced backwater habitat. Levees in southeastern Missouri are associated with reduced fish diversity and abundance of characteristic floodplain species such as starhead topminnow, banded pygmy sunfish, and bantam sunfish (Finger and Stewart 1978, as cited in Hoover and Killgore 1996). Where adjoining backwaters along the lower Colorado River were drained, there was a 100 percent reduction in fishery value (Beland 1953). Karr and Schlosser (1978) suggested that standing fish stocks may decline as much as 98 percent when floodplains are removed from the channel. Turner *et al.* (1994) state that eliminating fish access to floodplain areas can also alter the composition of river fish communities by limiting recruitment of certain species. In addition, Bryan and Sabins (1979) attributed the productivity and resiliency of the populations of commercial and sport fish species in the Atchafalya Basin to wide variations in water levels year to year.

Most of the fish collected in the New Madrid Floodway are commonly found throughout the Lower Mississippi River Valley. Even though spawning and rearing habitats would be reduced, the impacts to these ubiquitous species would be insignificant throughout the Mississippi River system. The New Madrid Floodway comprises approximately 3.1 percent of the Mississippi River two-year floodplain from the Ohio River (at Cairo, Illinois) to the White River (Table 5-8). In addition, the control gates would be open for part of the spawning season and throughout the entire year whenever river stages are lower than water elevation in the

Floodway. This would permit fish passage from the Floodway to the river. No fish species would be eliminated from using the St. Johns Bayou Basin or the New Madrid Floodway. When these factors are considered, no major adverse impacts are anticipated to the overall Mississippi River fishery. However, the Corps agrees there would be localized fishery impacts associated with this project.

Table 5-8. Comparison of the New Madrid Floodway to the Mississippi River Two-Year Floodplain from Cairo, Illinois to the Mouth of the White River, Arkansas

Two-Year Floodplain Habitat	Acres
Mississippi River (Ohio River to White River, Arkansas)	891,829
New Madrid Floodway Existing Conditions (elevation 290 and below)	17,284
Total floodplain habitat (Mississippi River + New Madrid Floodway)	**909,113**
New Madrid Floodway (A&M* Alternative; elevation 285 and below)	2,365
New Madrid Floodway (area no longer flooded under A&M)	14,919
Percent of total New Madrid floodplain	9.7%
Percent reduction of floodplain habitat compared to this reach of the Mississippi River	**3.1%**

*A&M: Avoid and Minimize Alternative

Project implementation will reduce flooding during the spring spawning season, including potential spawning and rearing habitat in the two-year floodplain (Plate 6). The habitat involved is predominantly bare earth with six-inch high soybean stubble that, when planted in crops, is regularly irrigated throughout the summer. The HEP team agreed on mitigating mid-season fishery habitat unit impacts, because these losses reflect habitat changes to a larger number of both floodplain and riverine species, and compensation based on those losses would benefit the majority of the fish fauna. The fishery HEP revealed that approximately 2,082 HUs of rearing habitat in the St. Johns Bayou Basin and 2,922 HUs in the New Madrid Floodway would no longer be available during mid-season.

Once the project is completed, the remaining river and inundated floodplain habitats in the basins can be utilized for spawning and rearing, but the extent of fish movement through both box culverts (especially in the New Madrid Floodway) is unknown. Fish passage can be confounded by high velocities, restricted openings, and head differentials. However, the existing gravity outlet structure at the lower end of St. Johns Bayou Basin has been operating since the mid-1950s, and the diversity of fish collected in the St. Johns Bayou Basin suggests there is fish movement through the box culverts. It also suggests that fish spawning has been very successful

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in the St. Johns Bayou Basin even though the gates have been closed at high Mississippi River stages. Since the New Madrid Floodway structure would operate similarly, adult and young-of-the-year fish movements through these culverts are expected.

Rearing habitat losses of all habitat types would be mitigated because of its importance to fisheries and overall ecological functions. Rearing acres, as specified and requested by the USFWS, include all acres flooded regardless of depth and duration. Therefore, spawning habitat value losses are also fully mitigated with this recommendation. Distribution of larval fishes in floodplain habitats is not well understood, and consequently, there has been some debate on the need to mitigate rearing habitat losses of areas less than one-foot deep on flooded agriculture fields. Available data on fish use of flooded agricultural fields is varied. Data from fish sampling of floodplain habitats near Cape Girardeau, Missouri, show that several fish species use agricultural fields as rearing habitat, while other reports described later in this section do not confirm this conclusion. In 1993, large numbers of larval fish were collected by trawl from agricultural fields up to 3/4 of a mile away from permanent waterbodies. The most abundant larval fishes were drum, silversides, various species of minnows, and several species of darters (Bob Hrabik, Cape Girardeau Long-term Resource Monitoring Station, pers. comm., 1998). Hrabik (pers. comm.) also collected various species of minnows from flooded agricultural fields in water less than one foot using an electroshocker.

While larval fishes may prefer deeper water, shallow water can provide significant floodplain functions (detrital input, nutrient cycling, floodwater storage, etc.). The widespread, shallow-water flooding in both basins provides a large surface area for plankton production driven by sunlight and warm temperatures. Floodplain waters (including shallow waters) are important for the production of phytoplankton and zooplankton (Robert Sheehan, pers. comm.). Hrabik (1994) also noted the extremely high zooplankton productivity on a wide floodplain near Cape Girardeau, Missouri. Plankton organisms are the principal food source for larval fish (Pflieger 1997). In addition, a major factor involved in the transition of larval fish from endogenous (yolk sac) to exogenous nutrition is the density of food organisms (Hall and Lambou 1990).

For the Yazoo Backwater Reformulation Stuady, Killgore and Hoover (2000) collected larval fish from various floodplain habitats in the Big Sunflower River system in Mississippi. In contrast to information provided above, invasive and ubiquitous species such as carp and shad were most often found on flooded agricultural and fallow land. Other species, such as suckers, black bass, white crappie, and other small sunfishes, were abundant in frequently and extensively flooded bottomland hardwoods or in permanent floodplain waterbodies such as oxbow lakes and tributary mouths. Although many species regularly spawn in seasonally inundated lands, data from this study suggests that those larvae migrate into the river or remain in permanent floodplain waterbodies (Killgore and Hoover 2000).

Suitable spawning habitat for fishes was previously defined as areas that are inundated for at least eight consecutive days with a minimum depth of one foot. Rearing habitat, in contrast, is not limited by period of inundation or water depth, as free-swimming larvae can potentially use any area of inundated floodplain. In addition, lateral movements of larval fish on the floodplain have not been extensively documented. A few studies have shown that movement

decreases exponentially with reduced discharge (Kwak 1988), that spawning failure can occur if water levels remain low and population numbers high (Starrett 1951), and that larval and juvenile fish abundance varies with water depth (Hoover *et al.* 1998). Reduced fish movement and spawning success and changes in availability of preferred depths will result in reduced population recruitment. Reductions in flood duration and extent are significantly correlated with reductions in abundance of numerous species (Ross and Baker 1983, Turner *et al.* 1994, Killgore and Baker 1996, Raibley *et al.* 1997). Although these studies suggest that water permanence and depth are critical factors in larval abundance, specific habitats and depths inhabited by larval fishes are infrequently quantified.

Relationships between water depth and larval fishes are available for the Yazoo River Backwater, Mississippi (Killgore and Hoover, unpublished data). This area is a sump similar in hydrogeomorphic characteristics to the New Madrid Floodway/St. Johns Bayou Basin sump. Floodplain habitats sampled in the Yazoo Backwater were the same as those evaluated in the St. Johns/New Madrid project, with agricultural land and bottomland hardwood forests predominating. Species assemblages were also comparable between the Yazoo Backwater and this project. Dominant taxa were gizzard shad, common carp, buffalo, catfish, crappie, minnows, and freshwater drum. Data indicate that extremely shallow water (less than one foot) is not extensively used by larval fishes (Table 5-9). Fish abundance asymptotes at moderate depths (one to four feet) and decreases in deeper water. "Selection" indices for specific depths inhabited by larval fishes, expressed as a ratio of utilization (normalized number of larval fishes observed) to availability (normalized number of samples taken), suggest that depths of three to four feet are preferentially exploited by larval fishes (Killgore and Hoover, unpublished data).

Table 5-9. Number of Larval Fish Collected with Light Traps According to Depth in the Yazoo Backwater Project Area.

Depth Range		Utilization (u)		Sample Size (s)		Selection Index
(ft)	No.	Normalized	No.	Normalized	u/s	Normalized
0.5 - 1.0	17	0.003	6	0.04	0.08	1
1.1 - 2.0	988	0.170	29	0.19	0.90	17
2.1 - 3.0	1459	0.252	28	0.19	1.33	25
3.1 - 4.0	1689	0.291	23	0.15	1.94	36
4.1 - 5.0	209	0.036	14	0.09	0.40	7
> 6.0	1436	0.248	50	0.34	0.73	14
Total	5798	1.000	150	1.00	5.38	100

Note: The normalized selection index, expressed as percent frequency of capture, was corrected for sample size.

Use of shallow water by larvae generally coincides with the presence of vegetation, shade, submerged branches, or other forms of structure. Absence of cover (such as in flooded

agricultural land), particularly in shallow water makes fish more vulnerable to predation and possible stranding during receding water levels. Without predators, numbers of small fishes remain high in shallow water, food and space become limiting, and competition is likely (Wallus *et al.* 1990, Killgore and Hoover 1998). Based on these studies, the majority of agricultural and fallow land flooded to depths less than one foot for less than eight consecutive days has only limited value as rearing habitat. The Corps believes that mitigating the impacted spawning acres would fully compensate fishery impacts.

The levee closure in the New Madrid Floodway will prevent or reduce access to permanent waterbodies by Mississippi River fish. However, these areas would continue to provide fish habitat. Consequently, habitat losses of permanent waterbodies may be overestimated under both alternatives. The method used to measure fishery losses was to analyze changes in the Mississippi River inundation (sump area) within the St. Johns Bayou Basin and New Madrid Floodway, but did not consider that many of the permanent waterbodies could hold water year-around. Based on a review of GIS data, approximately 383 acres of permanent waterbodies in the New Madrid Floodway and eight acres in the St. Johns Bayou Basin will remain, but may not always be connected to the Mississippi River during the spawning season. Changes in faunal composition are likely to occur, and these areas may no longer contribute to the ecology or the Mississippi River. However, the fish community is likely to represent more lake-dominated species because recruitment from river species will be partially eliminated and provide expanded recreational fishery opportunities.

Reestablishing forested wetlands is an effective measure to compensate losses of floodplain fisheries habitat, provided the site has adequate access for riverine fish from March through June. Borrow pits have been shown to function as effective fish nurseries if they are properly constructed (Sabo and Kelso 1991, Cobb et al. 1984). After an initial review of costs and the feasibility of constructing borrow sites, it was determined that providing the initial number of borrow pits was not practical. Constructing borrow pits would result in excess excavated material. Disposal of the material would be costly and environmentally damaging if deposited in wetlands. In addition, borrow pits constructed within the project area would not be fully accessible to fish due to gate operations. Also, since the project would not significantly impact (reduce) permanent wterbody habitat units (See Page B-17 in Appendix B) any habitat losses would be replaced by reforesting with the fishery mitigation plan. Flooded agricultural land does not provide similar habitat to permanent waterbodies, but these differences are reflected in the HSI scores and ultimately the HUs required for mitigation. Permanent waterbodies have higher habitat value to rearing fishes than do seasonally inundated lands, including bottomland hardwood forest. Therefore, mitigation requirements are greater for permanent waterbodies and would result in a disproportional increase in reforested lands to achieve full compensation (Dr. Jack Killgore, WES, pers. comm. 1998). If opportunities for in-kind mitigation are identified, the amount of reforested agricultural land required would be reduced.

Fishery rearing habitat losses with this alternative would be mitigated by purchasing and reforesting approximately 10,312 acres (1,456 acres for St. Johns Bayou Basin losses and 8,856 acres for the New Madrid Floodway) of frequently flooded agricultural land. This measure fully mitigates important fishery and wetland functions impacted by implementation of Alternative 2.

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In addition, both agencies agree to review opportunities to provide in-kind mitigation for permanent waterbody losses on mitigation lands. If opportunities are identified, the amount of land required to reforest would be reduced.

By mitigating rearing losses, reforesting over 10,300 acres of cropland would eventually increase detrital export to the Mississippi River compared to soybean crop residue inside the Floodway. Soybean residue consists of very small pieces of the original plant that rapidly decay, releasing a large amount of detrital nutrients in a very short time. BLH leaf detritus would take longer to decompose than mulched crop residue. As the tree leaves are transported throughout the river system, they would gradually release nutrients into the aquatic food chain over a much longer time period. This could last throughout the following spring and summer.

Mitigation lands that may be located within the Floodway would provide similar detrital nutrients to the Floodway streams and eventually to the Mississippi River. With reduced backwater flooding, rainfall runoff would be the only means of transporting the nutrients, thereby taking them longer to reach the river. However, the leaf litter that accumulates on the forest floor would benefit the plant and animal communities that colonize the forests. It should be noted that detrital inputs to the Floodway streams are expected to remain the same as under existing conditions, since this transport is influenced by rainfall runoff. The supplemental water quality analyses indicated that organic matter and nutrient concentrations in the headwater were relatively similar to concentrations in the Mississippi River. A change in source water to the wetlands would not likely impact primary or secondary production, since nutrient supplies do not appear to be limiting.

5.6.3 Alternative 3: Avoid and Minimize

Alternative 3 reduces construction impacts by alternating banks to avoid forested riparian zones and by reducing channel width. Approximately 2,432,000 total cubic yards of material would be excavated from the channels in the St. Johns Bayou Basin. Instead of a 200-foot channel, St. Johns Bayou would only be widened by 40 feet for a total bottom width of 120 feet. Approximately 979,815 cubic yards of material would be removed from St. Johns Bayou, with approximately 263,750 cubic yards of this excavated material used to construct the levee gap closure levee. Another 340,000 cubic yards of material would be used to raise the Setback Levee. Approximately 376,065 cubic yards would remain as a low embankment on about 65 acres of the St. Johns Bayou ROW after project construction. This alternative would reduce construction impacts by avoiding 36.17 forested acres (58 HUs). In addition, alternating banks in St. James Ditch would avoid 5.9 acres of large, mature trees. A total of 18.83 acres of aquatic vegetation, which provides habitat for the golden topminnow (*Fundulus chrysotus*), would be avoided by designating the upper 3.7 miles of the St. James Ditch as a no-work reach.

The HEP team detemined that several rock dikes should be used to replace lost instream structure and habitat diversity in St. Johns Bayou. Nine transverse rock dikes, spaced at 1/2 mile intervals, would be constructed on alternating banks of the lower four miles of St. Johns Bayou. These dikes would be two to three feet high, extend 1/4 the way across the channel bottom, and slope channelward from the top bank. The dikes would provide a substrate for benthic invertebrates and structure for fish. A sinuous and deeper thalweg would develop at low water,

which would provide cooler water compared to a shallow, wide, flat bottom, resulting from Alternative 2. Deeper pools would also develop around the dike ends, which would increase habitat diversity. The nine dikes are estimated to create 3.6 AAHUs. No dikes would be placed in the narrower Setback Levee or St. James Ditches, since they would reduce water conveyance and are expected to silt in rapidly, negating their habitat benefits.

Riprap bank protection would also be placed at the confluence of Setback Levee Ditch with St. Johns Bayou and at the confluence of St. James Ditch with the Setback Levee Ditch to maintain bank stability at these locations. The rock contained in these structures would also provide additional fishery and benthic invertebrate habitat. Along with natural revegetation of the ditch bank, adding a total of nine dikes would fully compensate HUs lost in St. Johns Bayou. No channel work would be done in the New Madrid Floodway. Thus, no direct adverse impacts would occur to the stream fishery or riverine habitat in the New Madrid Floodway.

Additional measures to protect other aquatic resources include the avoidance of approximately 66 acres of bottomland hardwoods along the St. Johns ditch ROW, construction of hard points (riprap at channel intersections), and the avoidance of a nine-foot strip along the right-descending bank in the Setback Levee Ditch. These measures would also provide fishery benefits.

The fishery HEP revealed that during the spawning mid-season, approximately 1,884 rearing HUs would be lost. In the New Madrid Floodway, floodplain rearing HUs would be reduced by approximately 2,719 HUs. These impacts are outlined further in the USFWS CAR (Appendix C).

To increase fish access during the spawning period from that available under Alternative 2, the gravity outlets for both basins would remain open until the Mississippi River stage reaches 27 feet on the New Madrid gage, which corresponds to 282.5 feet NGVD. Based on an average of the period of record, the numbers of days that the river is less than or equal to 27 feet are 14.3 in March and 12.9 in April. Therefore, the gates would be open periodically during the spawning season, permitting fish movement between the Mississippi River and the two basins. Adult and young fishes can move back to the river whenever river elevations are lower than interior water elevations. When waters recede, the ponded areas would provide rearing areas. As explained under Alternative 3, the extent of fish movement through the box culverts at both control structures (especially in the New Madrid Floodway) into remaining floodplain habitat is unknown. However, high species diversity in the St. Johns Bayou Basin suggests that a viable fishery will persist in the New Madrid Floodway after levee closure, although species composition and abundance may change. During high-water years, the gates would remain closed, and fish passage would be reduced or even prevented. However, during periods of extremely low Mississippi River stages, the Floodway may not be inundated, and spawning may be restricted to the stream channels and permanent floodplain water bodies. This flooding cycle could occur for several consecutive years, as indicated over the period of record.

Higher start pump operations of 3.5 feet (282.5 feet NGVD) in the St. Johns Bayou Basin and 4.5 feet (282.5 feet NGVD) in New Madrid Floodway would increase the available flooding for spring fisheries compared to that available under Alternative 2. However, the difference in

spawning habitat as a result of higher water elevation between this alternative and the Alternative 2 is only approximately six percent (Killgore and Hoover 1998).

The Corps proposes to mitigate spawning and rearing habitat losses by reforesting 9,557 acres (1,318 acres for the St. Johns Bayou Basin and 8,239 acres for the New Madrid Floodway) of frequently flooded agricultural land. This mitigation option will fully mitigate fishery and other wetland functions impacted by this alternative.

Detrital and nutrient transports would be similar to those discussed under Alternative 2. However, a lesser amount of mitigation land (9,557 acres) would be required.

5.7 MUSSELS

Deepening and widening existing channels in the St. Johns Bayou Basin would impact the local mussel fauna. The most direct effect would be the physical removal and destruction of mussels in the dredge path. Potentially, some individual mussels could be missed by the dredge and survive. Barnhart (1998) found a number of mussels in Setback Levee Ditch of ages that predated the last dredging event. These individuals were generally found along the wooded bank at sites where only one side was cleared at the time of the dredging. Since the proposed project also involves widening, the impacts to mussels are likely to be far more extensive than past dredging events.

The mussel assemblage in the project area is particularly vulnerable from the direct effects of the proposed enlargement. The majority of the species have relatively small populations. Twenty of the 24 species found by Barnhart (1998) each made up less than five percent of the 998 individual mussels collected. The proposed work area also contains the greatest diversity and abundance of mussels found in the project area (Barnhart 1998). Since mussels are relatively immobile, recovery of depleted populations will depend upon recruitment of juveniles transported by fish hosts from adjacent populations unaffected by the dredging. These "seed" populations would largely be restricted to the upper Setback Levee Ditch and St. Johns Ditch. The mussels in these areas are relatively less abundant and species rich relative to the proposed dredged area.

5.7.1 Alternative 1: Without-Project

Existing conditions would prevail without the project. No changes are anticipated to the mussel populations in either drainage basin.

5.7.2 Alternative 2: Authorized Project

Excavation would remove a large portion of the mussel fauna within the three project channels in the St. Johns Bayou Basin. The loss of fish spawning and rearing habitat in the project area could potentially affect freshwater mussel populations through alteration of the fish community. Mussels are susceptible to such changes because their life cycle includes an obligatory parasitic larval stage on fish. The larval stage (glochidia) of mussels must attach to the appropriate fish host to complete development (Neves 1993). The representative fish species

used by Killgore and Hoover (1998) to report the losses in spawning and rearing habitat described previously include largemouth bass, white crappie, channel catfish, and freshwater drum. Those fish species are important hosts for the majority of mussel species found in the project area. Several mussel species, including the abundant threeridge, use the sunfish family (i.e., largemouth bass, bluegill, and white crappie) as hosts. Catfishes serve as hosts for members of the genus *Quadrula*, and the yellow sandshell utilize gar. Several species appear to rely solely on freshwater drum. These include *Leptodea*, *Potamilus*, and *Truncilla* species. Reduction or loss of those fish populations and suitable habitat could potentially reduce recruitment into, or exchange among, mussel populations throughout the project area.

According to the USFWS and the MDC, it is uncertain whether Lee Rowe Ditch would serve as an adequate seed population. Channel enlargement would slightly lower the bottoms of the Setback Levee Ditch and St. James Ditch. As a result, the USFWS and the MDC believe Lee Rowe Ditch could become perched during base flows, resulting in decreased water velocity. Therefore, they believe the natural succession to follow may transform this area into a more lentic environment that few mussel species can tolerate (Fuller 1974, Oesch 1995). Hydraulic evaluation indicates that flows of tributaries to project ditches would not be altered. They are not expected to become perched or develop into lentic environments at low stream flows. Thus, there should be no long-term adverse impacts to these mussel populations.

5.7.3 Alternative 3: Avoid and Minimize

Impacts would be similar to those described in Alternative 2, except for the following: the left bank of St. Johns Bayou would not be excavated; 2.6 miles of St. James Ditch would switch the work to the opposite bank to preserve the woods along that bank; and the upper 3.7 miles of St. James Ditch would be avoided. In the Setback Levee Ditch, a nine-foot strip along the bottom of the opposite work bank would be avoided. These features would reduce direct adverse impacts to mussel populations in the ROW. Prior to construction, mussels would be relocated to areas outside the ROW. Rock hardpoints would provide bank stability at the confluence of St. James Ditch with Setback Levee Ditch. Channel gradient control structures would not be necessary at these locations, because the bottom elevation of these ditches would be the same. Also, gradient control would not be necessary at the upper end of channel construction, since the grade differential is minimal. At the upper limit of construction, lateral transitions to existing channel dimensions would be constructed to minimize bank caving.

A 10-year monitoring plan would be implemented after construction to study mussel recolonization of the excavated channels. The monitoring plan would also determine the value of the dikes and rock hardpoints as mussel habitat by studying mussel colonization. The Corps will work with the resource agencies to develop this monitoring plan.

Construction impacts and impacts to the larval stage of mussels are expected to be the same as outlined under Alternative 2. The Setback Levee raise would not impact any mussel populations, since the excavated material would be deposited on dry berm and existing levee.

5.8 ENDANGERED SPECIES

The Corps has maintained informal consultation with the Columbia, Missouri, office of the USFWS throughout the project. Through additional coordination, the USFWS recommended (in November 1996) that the Corps prepare a stand-alone Biological Assessment (BA). The USFWS noted that should an EIS be needed for the project, a BA would be required. On June 16, 1998, a draft BA was mailed to the USFWS, and on December 4, 1998, the final BA (Appendix F) was sent to the USFWS along with a request for formal consultation under Section 7 of the Endangered Species Act. In a December 30, 1998, letter to the Corps, the USFWS acknowledged receipt of the consultation request and concurred with the Corps' determination that the project is not likely to adversely affect the Federally endangered pallid sturgeon. However, the USFWS did not concur that the project is not likely to adversely affect the Federally threatened bald eagle or the Federally endangered interior least tern. One active eagle nest is located within the project area. The USFWS provided formal response to the BA in their final BO (Appendix F) on the effects of the project on the bald eagle, interior least tern, and pallid sturgeon on June 11, 1999.

5.8.1 Alternative 1: Without-Project

This alternative should not adversely impact any State or Federally threatened or endangered species.

5.8.2 Alternative 2: Authorized Project

Enlarging the St. Johns Bayou Basin channels should not adversely impact interior least tern colonies that use the three Mississippi River sandbars located outside the project area nor the overall least tern population. No nesting habitat is available in the channel limits, and none would be created after channel enlargement. Other than the levee closure and slightly raising the Setback Levee, there would be no construction in the New Madrid Floodway. Therefore, no construction impacts would occur.

Removing floodwaters from St. Johns Bayou Basin and preventing overbank flooding in New Madrid Floodway during much of the spring fish spawning season would reduce transport of small fish back into the river during receding flood waters. This reduction in forage fish may slightly affect the three local least tern colonies early in the nesting season. No measurable adverse impacts are expected to the overall least tern population in the lower Mississippi River due to the frequency of overbank flooding, the abundance of the forage fish, the period of time when forage fish are available, and the vast floodplain adjacent to the nearby interior least tern colonies,

Pallid sturgeon rarely inhabit areas other than the main channel of the turbid Mississippi River. Even though pallid sturgeon were released into the Mississippi River in 1994 and 1997 by MDC, none were captured in the channels or flooded fields of either drainage basin during the late summer 1997 and spring 1998 fish surveys. No pallid sturgeons were collected during fishery surveys of the St. Johns Bayou area from 1977 through 1991 (Christoff 1997). Therefore, this alternative should not adversely impact the pallid sturgeon.

The bald eagle presently occurs as a regular winter resident and recently as a year-round resident in the lower part of the New Madrid Floodway. One active nest is in the Hubbard Lake area. This nest was probably built at this location because unusually high water for the past five out of the last six years has flooded the land well into July. Normally, the surrounding land would be cultivated by late spring. Channel enlargement in St. Johns Bayou Basin should have no adverse impact on the resident eagle pair. Other than the levee closure, there would be no construction in the New Madrid Floodway. Therefore, channel work is not expected to have any perceptible impact on the resident eagles or the overall eagle population.

There is a possibility that flood reduction in both basins during spring could reduce the availability of forage fish for the eaglets. Adults would have to fly further away from the nest, or the short distance to the Mississippi River, for food. However, spring flooding does not reach Hubbard Lake every year under existing conditions. During years, adult eagles have probably adapted to fly further down the Floodway to forage. Thus, it is reasonable to conclude that any additional flight distance brought about by this project would not adversely impact the adults or young.

No induced woodland clearing is predicted to occur in either basin with reduced flooding, which should ensure future nesting, resting, and wintering roosts for the eagle. Agricultural production in both basins is predicted to begin earlier in the year with reduced flooding. Other than earlier tillage, no cropping practices are expected to change. Existing cropping conditions would prevail. There is concern that this earlier tillage may induce some adverse impacts to the nesting eagles at Hubbard Lake when eaglets are hatching in early April. The actual impacts to one nest cannot be specifically determined. However, based on the age of the nest, its proximity to cropland, the remoteness of the area, and the acclimation of the adults to farm machinery, the Corps does not expect adverse impacts to occur to the nesting eagles and to the overall bald eagle population.

The State-endangered golden topminnow was believed extirpated from southeastern Missouri for many years until collected in the upper 3.7 miles of St. James Ditch during the summer fishery survey for this project (Sheehan *et al.* 1998). The left bank cover habitat would be removed with left bank channel widening. This would adversely impact the survival of the small existing population.

5.8.3 Alternative 3: Avoid and Minimize

Direct construction impacts to the three Federally endangered species from channel enlargement and levee construction should be the same as discussed in Alternative 2.

Impacts of this alternative on the interior least tern would be similar to those discussed in Alternative 2 with the following changes. With modified gate operations during spring to benefit fish spawning, transport of fish will continue, but size and abundance may decline. Reforesting approximately 9,557 acres of seasonally flooded agricultural land would compensate the spawning and rearing fishery habitat losses in the New Madrid Floodway and the St. Johns Bayou Basin. Young fish would continue to be carried into the river with receding floodwater

where they could be preyed upon by least terns. Project impacts would be negligible to the overall least tern population along the lower Mississippi River and in the interior United States.

The impacts to the pallid sturgeon would be similar to those discussed in Alternative 2. No adverse impacts are expected.

Indirect impacts to the bald eagle would also be similar to Alternative 2, with a slight reduction in potential adverse foraging impacts. Operation of the gates as described in the fishery section for this alternative would provide some forage in the spring where none would exist with Alternative 2. The impacts to the nesting eagles at Hubbard Lake as well as the transient and resident eagle populations within the area are not readily quantifiable; however, they are expected to be negligible. As the reforestation area matures, it would provide additional nesting areas for bald eagles.

To avoid any adverse impacts to the golden topminnow and its habitat, the upper 3.7 miles of St. James Ditch would be eliminated from the project.

The USFWS BO indicated that two bald eagles could be taken (incidental take) as a result of the proposed action. The incidental take is expected to be in the form of harassment because of increased human disturbance and reduced foraging area for adult bald eagles in and around the nest during the breeding season. Incidental take in the form of harassment of interior least terns may also occur. However, this will be very difficult to determine because least terns are wide-ranging, may change nesting colonies from year to year, and reduced reproductive success may be masked by annual variability in tern numbers. The potential level of take is based on the permanent loss of a significant portion of the forage base for the tern colonies in and around the project area.

The USFWS BO included reasonable and prudent measures to minimize the amount or extent of incidental take of listed species. For the bald eagle, the BO requires minimizing human disturbance near the Hubbard Lake eagle nest; monitoring eagle reproductive success at the Hubbard lake eagle nest; and monitoring eagle movements in the project area. For interior least tern, the BO requires the Corps evaluate the availability, use, and importance of least tern foraging and nesting habitat in and adjacent to the project area.

5.9 BIG OAK TREE STATE PARK AND OTHER STATE CONSERVATION AREAS

5.9.1 Alternative 1: Without-Project

Without the project, Mississippi River backwater would continue to periodically inundate the land. However, according to the MDNR, existing agricultural drainage improvements on land surrounding Big Oak Tree State Park have altered the areas hydroperiod. One example of this is the continuous embankment (levee) that was erected four years ago on the west side of Big Oak Tree State Park that extends from the Tenmile Pond Wildlife Management Area to the Mississippi River levee. This prevents all but the highest river stages from reaching the park. The progressive drying of the swamp and altered flooding regimes are threatening loss of the swamp and BLH forests along with a substantial portion of the park's species diversity.

The MDNR intends to construct a low levee around the park with a gate to control water levels. Also included is a pump to supply water from a nearby ditch. The objective is to capture and retain rainfall runoff to increase the quantity of water received by the park. A Corps hydraulic review of the project plans revealed the possibility of levee failure at prolonged high-water stages and rainfall because of the small levee dimension and the outlet structure's small water conveyance capacity.

In the New Madrid Floodway, Tenmile Pond Conservation Area is surrounded by small levees and contains various pumps and structures to manage ponded water levels throughout the year. Without the project, the Tenmile Pond Conservation Area and the Donaldson Point Conservation Area (which lies largely outside of the frontline levee) would continue to receive periodic inundation. Fish passage in the ditches from the Mississippi River to Tenmile Pond would be unimpeded.

5.9.2 Alternative 2: Authorized Project

Closing the levee gap at New Madrid would reduce periodic Mississippi River backwater flooding. Big Oak Tree State Park would no longer receive the periodic Mississippi River inundation that is occasionally needed to help maintain the current ecosystem within the park. Without this unique vegetation, the park's designation as a National Natural Landmark would be jeopardized.

The existing hydrology of the Floodway streams draining into Tenmile Pond would not change with this alternative. They would continue to receive groundwater at high Mississippi River stages. Yearly rainfall in the Tenmile Pond watershed is such that sufficient water would be available to supply all water needs for the management area. Existing levees would continue to impound water required to maintain the area's wetlands. Construction of the project would not require additional pumping operations to maintain the environmental habitat levels that would exist without the project. Periodic inundation from Mississippi River backwater flooding would also be reduced in the Tenmile Pond area. The impacts would be similar to the impacts discussed in previous sections regarding bottomland hardwood forests, wildlife, waterfowl, and fisheries.

5.9.3 Alternative 3: Avoid and Minimize

Impacts to the Big Oak Tree State Park would be similar to those described under Alternative 2. Due to the anticipated adverse impacts, the Corps is working with MDNR to ensure that the park would continue to have water when needed to support the ecosystem within the park. This plan is contained in Appendix B (Mitigation) of this report and is summarized below.

The Corps proposes to construct the MDNR's water retention project as part of the mitigation package. This would save Missouri $1.2 million that the MDNR would be able to use for other wildlife and fishery projects. To ensure structural stability, the Corps redesigned several of the original features. These include a larger and higher levee that should withstand prolonged high-water levels and a larger outlet structure to efficiently evacuate interior water.

Added features would include the installation of several relief wells and a well pump within the park to capture groundwater flows at high Mississippi River stages. The MDNR would decide where these would be located.

Under existing conditions, the river has to be up to 16 feet high on the riverside of the Mississippi River levee before backwater coming through the levee gap at New Madrid reaches the park. This condition will be even more restrictive with the existing levee that has been erected on the west side of the park. The proposed mitigation would provide water to the park whenever there is a high Mississippi River stage, and it would not be necessary to depend entirely on backwater flooding that in some years, does not reach the park. Another positive impact is that the MDNR would be able to manage the amount of water on the land and mimic periodic Mississippi River inundation for optimum forest and swamp conditions.

Recent water quality analyses by WES indicated that well water would not harm the park. Conditions with this alternative would be similar to those with river inundation. For some parameters, well water would be of better quality than surface runoff. These data are presented in the Water Quality Appendix J and in the water quality sections throughout this report. A structure design to direct sediment-laden surface runoff from an adjacent ditch into the park would be provided. Specific engineering details of this structure would be worked out between the MDNR and the Corps.

Corps hydrologic, geotechnical, and regulatory review indicated that no wooded wetland would be drained or cleared as secondary impacts from the levee closure. Thus, the ecological functions of the park's wetlands are not expected to change. These have previously been discussed in the wetlands section of this report. Moreover, with more water that will be made available for the MDNR to mimic the natural periodic inundation, fishery and wildlife habitat values are expected to increase as a "wetter" water regime reestablishes the original habitat conditions.

Impacts to the Tenmile Pond Conservation Area would be similar to those discussed in Alternative 2. The impacts to spring fisheries would change in that a higher Mississippi River water elevation of 282.5 feet NGVD would be permitted before the New Madrid Floodway control structure gates are closed. The hydraulic period of record indicates that the New Madrid Floodway control structure gates would be open about 14.3 days in March and 12.9 days in April to permit fish passage (especially the white bass run) upstream to Tenmile Pond.

5.10 WATER QUALITY

5.10.1 Alternative 1: Without-Project

Without the project, water quality in both basins is expected to remain unchanged. There will be future periodic channel maintenance by the drainage districts, which would slightly increase turbidity and lower water quality at the work site. However, this impact would be temporary and is not expected to affect the overall water quality for each basin.

5.10.2 Alternative 2: Authorized Project

Water quality would be similar to that described in the following section.

5.10.3 Alternative 3: Avoid and Minimize

The St. Johns Bayou bottom width would be reduced to 120 feet, and the upper 3.7 miles of St. James Ditch would be removed from the project. However, impacts associated with flooding reduction were reassessed with additional analyses. These are presented below.

Based on supplemental water quality analyses conducted by WES and summarized as an attachment to Appendix J, relative changes in water quality are expected to be minimal with this alternative compared to existing conditions. Inundation of headwater earlier in the winter would increase retention and provide processing of material (e.g., sediments, nutrients, and pesticides, specifically atrazine) that would normally be available for transport as runoff prior to the spring flooding season. This should be considered a potentially positive benefit when considering wetland water quality functions for improving water quality in the headwaters. Potential negative benefits may occur with increased loading of material during an extended growing season. The potential for these negative impacts was assessed in the supplemental water quality analysis (U.S. Army Corps of Engineers 2000) and are summarized below.

Water quality, nutrient cycling, detrital import and export, and floodwater storage were assessed and quantified. Mass balances were used to quantify changes, and comparisons were based on relative changes in mass and not on the specific mass of selected constituents. Detailed changes in mass associated with wetlands were evaluated using literature values and results from detailed studies of the Cache River system, which is in close proximity to the study area. Detailed changes in mass balances for flooded upland or agricultural lands were assessed using runoff estimates from the literature. Input and rationale for material processing was developed in consultation with agencies listed above and applied to the project area using hydrologic and land use information provided by the Memphis District to assess material transport for different hydrologic scenarios. Using this approach, a relative change in mass was less than 0.1 percent for selected water quality constituents, and potential negative impacts are expected to be minimal. Potential positive impacts associated with increased material retention in the headwater and improvements associated with 9,557 acres of restored wetlands would compensate for any negative impacts.

Agricultural experts in the project area (University of Missouri Delta Research and Extension Service in Portageville, Missouri) indicated that intensification would likely be a change to higher-yield soybeans in the area impacted by reduced inundation normally associated with backwater flooding. Economic analysis described in Appendix E indicated that only about five percent of the currently farmed land will be impacted (i.e., intensified through earlier planting), and an increase in total farmed lands is not anticipated. Consequently, little increase in fertilizer application is anticipated. For a change to higher-yield soybeans, which utilize atmospheric nitrogen, increased application of nitrogen is not anticipated. Analysis of soil types in the area indicated a high phosphorus content, suggesting that application of phosphorus would not be expected to increase.

For increased corn production, an increase of atrazine applications is a potential concern. In areas where increased production of corn may occur, the proximity to surface waters was considered by the local agricultural experts to be adequate. Applications of atrazine should not increase concentrations in surface waters except for well-drained areas, which are minimal. Since the effectiveness of application is diminished with concurrent precipitation, application with a high potential for runoff is not a normal practice. Appropriate timing of application, coupled with a relatively short life, suggests a very limited potential for elevated concentrations in surface waters. Analysis of atrazine application in the project area indicated that pre-emergent application rates were expected to be one to two pounds ai/A, which is less than post-emergent applications and would be applied to about 25 percent of the total area planted in corn. Pre-emergent applications may occur during the pumping season, but would likely occur during periods of no rain, when pumping would not be conducted.

The actual loss of wetlands is expected to be 167 acres associated with construction. The change in the timing of flooding and associated source water (headwater versus Mississippi River and headwater combination) does not decrease the available wetland area but changes the wetland function for the area. Major changes regarding water quality include reduced runoff from post-season cropland, increased retention of headwater, early winter processing of retained material, and loss of inundation/processing of Mississippi River water.

Results of this method indicated that the change in mass of selected nutrients and sediments (those constituents most likely contributing to the hypoxia/anoxia in the Gulf of Mexico) with the alternative are less than 0.1 percent of the total mass available. This very low change in mass may be attributed to similar concentrations in the Mississippi River and the headwater runoff in the project area drainage basins. Thus, there will be no real change in the amount/duration of water inundated or increased retention of headwater material under the Alternative. Water quality improvements associated with the reforestation of 9,557 acres of cropland to wetland would offset the loss of retention of Mississippi River water and the limited material processing and potential for transport associated with inundation of fallow soybean fields.

Hydrologic analysis indicated that the amount of water (from either source) associated with the period of inundation was 0.57 percent of the water balance, and the limited processing of material associated with the floodwaters would likely not be discernable to the total load provided to the Gulf of Mexico. The potential benefit to water quality from the mitigation of 9,557 acres would most likely decrease the load from current conditions, especially if the areas are cropland taken out of production and increased wetland function for water quality is established with planting of wetland tree species. Location of these reestablished wetlands in the downstream area of the basin or in proximity to allow inundation through the Mississippi River would optimize reductions of the total load to the Gulf of Mexico. Real-time benefits would occur with the removal of production cropland, while increased wetland function for water quality might not be realized until plantings reach an effective state.

A water quality certification will be requested from the Missouri Department of Natural Resources, Water Pollution Control Program when the FSEIS is circulated for public review.

5.11 RECREATION

5.11.1 Alternative 1: Without-Project

Recreation patterns and activity are not expected to change in the future over most of the project area. The MDNR's water retention project will restore some of the inundation required by Big Oak Tree State Park. This has the potential to change the park's recreational use.

5.11.2 Alternative 2: Authorized Project

In the St. Johns Bayou Basin, recreational impacts that would occur along the project area under this alternative would be much the same as those addressed in the original GDM. Man-day usage rates for different types of recreation have not changed significantly since the GDM was written, even though the population has increased. The proposed channel improvements and pumping plant construction would temporarily reduce the recreational values of these areas until revegetation occurs. There will be an overall loss of BLH along the channel banks due to excavation of the ditches, as discussed in the wildlife section. However, most of the ROW is in crop production. Restrictive easements would be placed on the new embankments, which ensures their return to a brushy edge habitat that is presently lacking in the project area. This would provide some increased small game hunting as well as nonconsumptive recreation opportunities on the new embankments. Most of the strips of the new embankments would eventually succeed into young BLH. After mitigation lands are established, habitat losses to terrestrial species would be mitigated by 113 percent. There would be no overall recreational change along the grassy Setback Levee after it is raised since it would be replanted with grasses.

White bass and other fish make spring runs up the ditches or use inundated croplands and woodlands for spawning. A smaller resident population would remain in the streams of both basins, but the migratory river population would be greatly reduced or denied access when the gates are closed. Recreational fishing along the streams would be expected to decrease proportionally. Fishing or harvesting fish in flooded cropland would be reduced or eliminated in the St. Johns Bayou Basin with pumps evacuating interior runoff. Gate operation in New Madrid Floodway would reduce flooding on croplands and any associated fishing as well.

During the winter, cropland is seldom flooded by high Mississippi River water stages. The lower portions of both basins that would be ponded for winter waterfowl would maintain a constant amount of flooded land at controlled elevations. The WAM revealed a significant increase in duck-use-days during December, January, and part of February with this alternative

Although the WAM resulted in gains in waterfowl habitat over the entire waterfowl wintering season (specifically December and January), project implementation would reduce duck-use-days during spring migration (February and March) when protein sources are particularly important to waterfowl migrating to their breeding grounds. Increased DUDs in December and January are the result of ponding in the sump as specified by the operational plan. The USFWS believes that these potential gains are questionable because one area (The Eagles Nest Wetland Reserve Program tract) has been annually flooded during fall and winter for hunting, but this area receives significantly less waterfowl in dry years than in years when the

region is wet from flooding. The USFWS is concerned that prolonged inundation of bottomland hardwoods in the sump area may be detrimental to their long-term survival. Due to these concerns, the operational plan was altered to allow for the greatest possible diversity of flood timing, duration, and depth during November through March, which would provide more benefits to waterfowl. Altering the plan would also allow the river to ebb and flow into both basins during that time, greatly benefiting fisheries resources by maintaining connectivity between the river and its floodplain.

Based on the WAM data, gains in fall and winter waterfowl habitat are possible because water would now be made available on the land. However, the USFWS believes there would be adverse waterfowl losses in spring, even though their WAM revealed there would be an overall increase in waterfowl use. The Corps acknowledged this spring loss and agreed to mitigate for it by reforesting 10,312 acres of soybean fields, which would provide much better and more extensive waterfowl migratory and winter habitat than what presently exists. Many of these lands would continue to be inundated from rainfall events and overbank flooding of the streams. Fall and winter waterfowl would use these areas, especially as the forest matures. It is reasonable to conclude that waterfowl hunting opportunities on a large part of the 10,312 reforested acres and in the waterfowl ponding area would provide increased recreational opportunities.

Prolonged spring flooding has lasted into the month of July during five of the past seven years. Comments obtained from local residents at the scoping meeting indicated this has significantly reduced turkey and swamp rabbit populations. This alternative would greatly reduce prolonged flooding and allow the populations of these animals to recover in both drainage basins. However, even though periodic flooding will be reduced, no wetlands will be drained and no induced clearing of forested wetlands will occur.

5.11.3 Alternative 3: Avoid and Minimize

The impacts on wildlife recreation in the project area in the St. Johns Bayou Basin would be similar to those in Alternative 2, except that less habitat would be lost with a reduced St. Johns Bayou channel size and switching work banks on St. James Ditch. This would decrease adverse impacts to recreation opportunities. Fishery recreation would experience similar construction impacts as Alternative 2. However, fishing opportunities should return along the vegetated bank. The small, low dikes that would be placed in St. Johns Bayou would reduce construction impacts once the channel and low water thalweg stabilize, and provide additional fishing locations.

Fishing recreation impacts within both basins would be similar to those with Alternative 2. Some recreation opportunities would remain in spring with a modified gate operation, which would leave the gates open longer than with Alternative 2 until river elevation reaches 282.5 feet NGVD. This would permit some fishing in the channels during spawning runs and some fishing in the reduced acres of flooded fields. Any off-channel ponds (borrow pits) that may be excavated would partially offset overbank fishing recreation lost during spring. More importantly, these ponds would provide permanent fish habitat and offer increased fishing opportunities throughout the year.

Instead of closing the gates and ponding water at a constant elevation in the sump areas of both basins during the winter waterfowl season, water elevations would be managed by the gates and pumps to maximize duck use on the ponded acres. This operating plan is expected to provide more waterfowl hunting than could be realized with Alternative 2.

The exact locations of 9,557 acres of mitigation lands cannot be specified at this time, but it is reasonable to conclude that reforestation will benefit turkey, swamp rabbit, waterfowl, squirrel, and deer hunting, as well as nonconsumptive recreation.

5.12 CULTURAL RESOURCES

5.12.1 Alternative 1: Without-Project

This alternative would not require that any cultural resources work be conducted. There will be no impacts to the cultural resources.

5.12.2 Alternative 2: Authorized Project

A cultural resources survey was conducted within the project ROW. A report was prepared that is included in the Technical Appendices, Revised December 1981, of the GDM. Another survey documented a number of prehistoric and historic sites within the project area (Klinger *et al.* 1988). The survey resulted in the discovery of 21 previously unrecorded prehistoric and/or historic archaeological sites, including seven cultural resources sites along St. Johns Bayou. Twelve sites were determined not to be significant in terms of National Register of Historic Places criteria. Nine sites were determined to contain significant information, and they required further testing. Two of these sites were found to be significant and eligible for inclusion in the National Register of Historic Places. The project has been designed to avoid all of the potentially significant and significant cultural resources sites. For more information see Appendix H of this report.

In response to the State Historic Preservation Officer's letter dated April 21, 1999, concerning the St. Johns Bayou and New Madrid Floodway DSEIS, the District agreed to conduct a cultural history of the entire project area. A Memorandum of Agreement (MOA) has been developed and signed in which the Memphis District agrees to conduct a historic cultural history of the area. The study will include: the history of the Mississippi River Commission as it relates to the affected areas; the history of the legislation that led to the New Madrid Floodway construction; a history of the New Madrid Floodway construction; a history of the social events and happenings related to the Floodway, its construction and use; a study of the flood control and drainage systems, as historic properties, for both St. Johns Bayou and the New Madrid Floodway; and photographs, drawings, film footage, personal interviews, or anything that would show/relate the history of the areas and their flood and drainage control systems. At this point, the MOA has been signed by all parties and a scope of work is being written. The signing of a contractor(s) and beginning the fieldwork will occur near the end of the summer (2000).

5.12.3 Alternative 3: Avoid and Minimize

In this First Phase of the overall project, a portion of the work on St. James Ditch is to be switched from the east (left) bank to the west (right) bank. A cultural resources survey was originally conducted on the east bank only along this reach of the project ROW. Therefore, a cultural resources survey will be initiated along the west bank. If cultural resources are found within the revised reach, they would be tested or the ROW designed to avoid them. Cultural resources that are found to be significant and unavoidable would undergo mitigation under provisions of the National Historic Preservation Act. All cultural resources investigations and survey results would be coordinated with the Missouri State Historic Preservation Officer and other appropriate parties. Any inadvertent discoveries of cultural resources sites would be fully addressed under provisions of the National Historic Preservation Act and other applicable laws. The MOA and historic study described in Alternative 2 will also be conducted for Alternative 3.

5.13 SECTION 122 ITEMS

Without the project there would be little change in those items identified by Section 122 of the 1970 Flood Control Act with either the Authorized or Avoid and Minimize Alternative. The following impacts could be expected:

5.13.1 Noise

Noise would increase during channel enlargement and pumping plant construction due to equipment operation. Noise level increase would be confined to the immediate work site and not spread over the entire ROW all at one time. The noise generated would be similar to that associated with agricultural equipment. Following construction, noise levels should return to normal over most of project area. The use of totally electric pumps would slightly elevate the noise at the stations. Due to the remoteness of the stations, the impacts should be negligible.

5.13.2 Air Quality

Machinery emissions and airborne dust during construction and maintenance activities would slightly degrade air quality. Construction will be done such that all applicable State and Federal air quality guidelines will be followed. However, it is anticipated that project-related impacts to air quality would be minor and of short duration. The project area is in attainment for all air quality standards, and the project would not jeopardize attainment status.

5.13.3 Aesthetic Value

Vegetative clearing and pumping station construction would reduce the aesthetic value of the project area. However, establishment of a grass cover on the ROW should offset adverse impacts associated with construction of project features. The proposed mitigation described for Alternative 3 (9,557 acres of reforestation) would also greatly increase aesthetics.

5.13.4 Displacement of People

None of the alternatives would result in the displacement of people. Under future with-project conditions, the area's agricultural income would be enhanced over the levels expected without the project. The potential for business immigration to East Prairie may entice people to move into the community.

5.13.5 Community Cohesion

The communities of East Prairie and Pinhook, Missouri, are enthusiastic about the prospect of flood protection. Farmers also express their support for an alternative that would permit them to increase production. No adverse impacts to community cohesion are anticipated.

5.13.6 Local Government Finance, Tax Revenues, and Property Values

Alternatives 2 and 3 would halt or significantly reduce the erosion of property values and tax base expected under future without-project conditions, thereby maintaining tax revenues for local government entities. The potential for increased businesses relocating to East Prairie could also increase tax revenues.

5.13.7 Displacement of Businesses and Farms

No businesses or farms are expected to be displaced either directly or indirectly as a result of any of the alternatives. The area's agricultural income would be enhanced over the levels expected without the project, which would maintain the profitability of the area's businesses and farms. However, the mitigation proposal for the preferred alternative calls for purchase and reforesting of 9,557 acres of cropland or the approximate equivalent of 10 average sized farms in the area. There were approximately 735 farms in Mississippi and New Madrid Counties in 1992. Purchase of the mitigation lands could cause the displacement of a very small number of these farms.

5.13.8 Public Services and Facilities

Alternatives 2 and 3 would prevent the erosion of property values and corresponding decrease in tax base expected under future without-project conditions. This would maintain the area's ability to provide such basic public services as education, police protection, and roads and bridges.

5.13.9 Community and Regional Growth

Alternatives 2 and 3 would not contribute substantially to regional growth. However, there is potential they would increase East Prairie's business in addition to the area's agricultural and agricultural related production, farms, and businesses. This would benefit the overall income, employment, and tax bases of the urban and rural populations that would provide the public services necessary to maintain the area's economy at present levels.

5.13.10 Employment

All construction alternatives would increase business, agricultural and agricultural related employment, and secondary employment compared to future without-project conditions. There would also be some opportunities for new employment associated with project construction, operation, and maintenance.

5.14 SOCIOECONOMICS

5.14.1 Alternative 1: Without-Project

The overall socioeconomic structure of the area is not expected to change without the project, as the area would continue to be agriculture based. The population within the study area is projected to increase by 15.6 percent by the year 2040, while the State of Missouri is expected to have a corresponding increase of 16.8 percent. Total aggregate employment in the study area is not expected to grow as fast as the population. This component of the economic sector is only projected to increase by 6.0 percent by 2040. Mississippi County's per capita income is expected to increase 53.5 percent by 2040, while New Madrid County's per capita income is expected to increase 57.0 percent. This compares to an expected 92.7 percent increase for the State of Missouri. This shows that per capita incomes are expected to continue to lag behind the cities and more urbanized areas.

5.14.2 Alternative 2: Authorized Project

Closure of the New Madrid Floodway is a feature of the MRL project and as such has a project discount rate of 2.5 percent. All other features use a discount rate of 7.35 percent.

Total annual benefits for the levee closure feature of Alternative 2 are presented in Table E-II-19 of Appendix E. Agricultural benefits account for 91 percent of the project's benefits. Inundation reduction benefits comprise 71 percent of the project benefits followed by intensification at 29 percent. The benefits of all other features are presented in Table E-II-20 of Appendix E. The agricultural benefits of all other features account for 90 percent of the project benefits. Inundation reduction benefits comprise 76 percent of the project benefits, followed by intensification at 23 percent. The remaining one percent is composed of betterment and advanced replacement benefits, which are due to improving or replacing area bridges during construction.

Annual costs for Alternative 2 are also presented in Table E-II-19 of Appendix E. The annual costs for features other than the levee closure are presented in Table E-II-20 of Appendix E. Annual interest and sinking fund costs reflecting the financing costs of the project account for 96 percent of the cost of the features. The remaining four percent is operation and maintenance, which is primarily operation and maintenance of the two pumping stations and associated facilities.

It would appear that Alternative 2 is the alternative that maximizes excess economic development benefits over costs. However, this alternative does not include all of the

environmental effects or the necessary cost of mitigating for potential environmental effects associated with project features other than the levee closure. The most prominent potential environmental effect would be in the upper St. James Ditch portion of the project where an endangered species has been found. This area is avoided in Alternative 3. The mitigation costs for Alternative 2 would be much greater than those estimated for Alternative 3 and would be much greater than any benefit forgone by Alternative 3. Since no mitigation costs are included for the features of Alternative 2 other than the levee closure, it becomes readily apparent that this alternative is not the NED plan.

5.14.3 Alternative 3: Avoid and Minimize

Alternative 3 is a refinement of Alternative 2, but incorporates measures designed to avoid some of the detrimental environmental effects. Included in these features are a downsizing of the channel along St Johns Bayou and shortening the work reach on St James Ditch to avoid a potential endangered species problem. The levee closure feature of this alternative is identical to Alternative 2. All of the levee closure benefit and cost data presented in Table E-II-19 are the same for Alternative 3 and for Alternative 2.

Annual benefits for all other project features of Alternative 3 are presented in Table E-II-21 of Appendix E. As with Alternative 2, the majority of benefits are agricultural and inundation reduction. Downsizing or eliminating portions of the above channel items reduces annual benefits by $293,000, or 4.5 percent of total benefits.

The project downsizing also reduces annual costs for the other project features. Annual costs are reduced by $43,000, or 1.1 percent. This is somewhat misleading, since Alternative 3 includes mitigation costs while Alternative 2 does not. Mitigation costs for the other project features of Alternative 2 have not been developed, but are expected to be substantially greater than the mitigation costs for the other project features of Alternative 3 due to the significantly greater channel size on St Johns Bayou and the potential endangered species effects on the upper portion of St James Ditch.

When the potential environmental effects of Alternative 2 are fully accounted for, it becomes evident that Alternative 3 is the NED plan. Because of this and because of the non-monetary detrimental environmental effects of Alternative 2, Alternative 3 has been chosen as the preferred plan for construction.

5.15 HAZARDOUS, TOXIC, AND RADIOACTIVE WASTES

No HTRW survey was conducted when the St. Johns Bayou and New Madrid Floodway, Missouri Phase I and Phase II General Design Memorandums were completed in the early 1980s. At that time, no HTRW survey was required.

A Phase 1 Assessment for this First Phase project was prepared under the guidance of the Corps of Engineers Regulation, ER 1165-2-132, Water Resources Polices and Authorities for Hazardous, Toxic, and Radioactive Waste (HTRW) for Civil Works Projects, June 26, 1992. A visual inspection of the project rights-of-way was conducted from 7 October 1996 through

11 October 1996. Two illegal dumps were identified during this inspection. Site #1 was located on St. James Ditch approximately 1.25 miles west of the intersection of Missouri Rt. 102 and the Birds Point New Madrid Setback Levee. It consisted of general trash and an old water heater. The second and larger dump (Site #2) was located approximately 0.67 mile upstream of the first site where Missouri Rt. 525 crosses St. James Ditch. The channel appeared to be completely blocked on both sides of the bridge by the contents of a residence. A follow-up inspection was made on 18 June 1998 and verified that no changes had occurred at the two sites. In addition, inspection of recent aerial photography did not find any new HTRW sites.

A land use history of the area was developed to help focus the HTRW investigations. Records searches for potential sources of contamination within the project area were performed through contacts with the EPA, several divisions of the MDC, the MDNR, the National Response Center (NRC) in Washington D.C., and various local officials regarding information about any known HTRW problems. Records listing Federal National Priorities List and Superfund sites were examined by the Kansas City EPA, and no sites are located within or bordering the project area. A list of occurrences (spills) for Mississippi and New Madrid counties was obtained from the NRC, and no releases have been reported in the project area since 1990. A list of RCRA sites has been examined, and none occur near the project area. Contact with MDC personnel indicated that due to the rural nature of the project area, the possibility of any documented HTRW sites was unlikely. The East Prairie and New Madrid Fire Departments were contacted to determine the possibility of hazardous waste contamination due to pesticide, herbicide, or chemical fires. They reported that none have occurred within the timeframe covered by their records. The St. Louis-Southern Railroad has a line that runs through the project area. Contact with railroad personnel revealed no indication of contamination due to a hazardous substance release or train accident.

This Phase 1 Assessment did not encounter information relating to the potential presence of hazardous wastes sites within the project area. It also does not guarantee the nonexistence of HTRW sites within or affecting the project area. The analysis, conclusions, and recommendations in this report are based solely on information obtained from the record searches and visual site survey. The report did not constitute a guarantee or certificate of the nonexistence of HTRW contamination at any location. Based upon information gathered during the preliminary assessment for the study area, it is reasonable to assume that no hazardous, toxic, or radioactive wastes would be encountered during the construction of this project. No additional HTRW investigations are recommended. No other analysis is required, unless new information is developed or HTRW is discovered during construction. The information discussed above is contained in the HTRW Phase 1 Assessment contained in Appendix I.

The EPA expressed concern that intensification of agricultural practices in both basins, but mainly in the New Madrid Floodway after the levee closure, and the corresponding increase in the use of agricultural chemicals would contribute to the hypoxia problem in the Gulf of Mexico. They surmised that instead of being limited to a single soybean crop, more corn and winter wheat and even some rice would be planted. With either construction alternative, high water would no longer flood the land to dissolve agrichemicals and then carry them to the Mississippi River. Revegetation of the enlarged channel berms and reforestation of cropland along several streams for mitigation purposes would create buffer strips to impede and filter

chemicals that may be in runoff water from the fields. Reforesting 9,557 cropland acres would remove those lands from agrichemical application and act as a filter/purifier of surface runoff and/or Mississippi River water. Overall, it is believed there would be a reduction in the quantity of chemicals entering the Mississippi River, and the project would not contribute to the hypoxia problem in the Gulf of Mexico. This has been addressed in the water quality sections throughout this report and is addressed in Appendix J.

5.16 MISSISSIPPI RIVER STAGE IMPACTS AND NEW MADRID FLOODWAY OPERATION

Typically, the Mississippi River system response to flood events can be characterized by slow rising stages with prolonged crests. To compare the existing conditions of the Mississippi River Levee System with those resulting from closing the existing 1,500-foot gap at the lower end of the New Madrid Floodway, a review of the Mississippi Basin Model was conducted. Model test results are included in a report entitled Transmittal of the Mississippi Basin Model Letter Report 89-1, Birds Point-New Madrid Floodway Reconnaissance Study, dated July 27, 1990. The report reflected steady-state Project Design Flood (PDF) tests and PDF hydrograph tests, considering the 1986 Plan of Operation for the New Madrid Floodway.

The results from the steady-state PDF tests comparing current conditions with and without the 1,500-foot levee closure indicate very little difference in stages at Mississippi River gage locations. The only measured increases in stages with the closure were at Hickman, Kentucky, and H.W. 173, which were 0.1 feet and 0.3 feet higher, respectively. A 0.1 foot decrease in stage was measured at the New Madrid gage for the test with the closure. The maximum increase in water surface elevation at stations along the riverside of the frontline levee was 0.5 feet at levee mile 81. The model tests also revealed that the closure of the 1,500-foot gap would require raising portions of the Setback Levee to protect the St. Johns Bayou Basin from Mississippi River flooding during the operation of the New Madrid Floodway. The grade of the Setback Levee would be increased when necessary to maintain the authorized freeboard.

The evaluation resulted in a determination that under project conditions the difference in response of the Mississippi River system with the 1,500-foot closure compared to current conditions would be negligible both in terms of stage and duration. Therefore, no change in the operation of the New Madrid Floodway is anticipated subsequent to closing the gap at the lower end of the Floodway.

5.17 CUMULATIVE IMPACTS

The President's Council on Environmental Quality defines cumulative impact as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions." Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. Impacts (or effects) include both direct effects and indirect effects. Ecological effects refer to effects on natural resources and on the components, structures, and functioning of affected ecosystems, whether direct, indirect, or cumulative.

In assessing cumulative impact, consideration is given to (1) the degree to which the proposed action affects public health or safety, (2) unique characteristics of the geographic area, (3) the degree to which the effects on the quality of the human environment are likely to be highly controversial, (4) the degree to which the possible effects on the human environment are highly uncertain or involve unique or unknown risks, and (5) whether the action is related to other actions with individually insignificant but cumulatively significant impacts on the environment.

Cumulative effects can result from many different activities including addition of materials to the environment from multiple sources, repeated removal of materials or organisms from the environment, and repeated environmental changes over large areas and long periods. More complicated cumulative effects occur when stresses of different types combine to produce a single effect or suite of effects. Large, contiguous habitats can be fragmented, making it difficult for organisms to locate and maintain populations in disjunct habitat fragments. Cumulative impacts may also occur when the timing of perturbations are so close in space that their effects overlap.

This analysis begins with a description of the area prior to European settlement and chronicles the changes in land uses and the landscape through the years. Typically, descriptions of the area become increasingly precise through the years. Very little quantitative data is available from presettlement times; but combined with the descriptions of historic activities, the trends of change are evident. Mississippi County and the New Madrid Floodway are emphasized, but most of the information applies to the entire Lower Mississippi Valley. The information used in this report has been gathered from published sources, internal Corps of Engineers documents, and the Lafferty and Hess (1996) archaeological report (which incorporates government documents, published sources, personal interviews, etc.).

5.17.1 Past

The project area stands at the top of the Central Mississippi River Valley and is part of larger area known as the Cairo Lowland. In or adjacent to the area are mountains, highlands, prairies, braided streams, and meander belt features. The lowland area, approximately 640 square miles, is 15 percent prairie, 51 percent meander belt, and 34 percent braided stream surface. In pre-settlement times, Missouri's Bootheel region was composed of more than two million acres of wilderness swamps and bayous interspersed with low, sandy ridges. A mosaic of river meanders, oxbows, natural levees, forested wetlands, marshes, and open water covered the area. Rich alluvial soils supported forests of towering trees. Wildlife, including the black bear, mountain lion, deer, turkey, and many species of birds, were abundant (Missouri Department of Natural Resources 1987).

Human adaptation to the southeast riverine area of Missouri has a long history, from the Paleo-Indian (10,000 BC) to the present. The Quapaw Nation occupied the area prior to European settlement and were hunters, fishers, and farmers. There is some evidence of large, long-term settlements in the area, but much of the archaeological evidence in the area has been washed away. In 1673, two Frenchmen, Marquette and Joliet, passed through the area from the north on their voyage down the Mississippi. They saw no signs of human life, but there had been

teeming populations in the valley 130 years earlier when De Soto entered the valley. It was at the confluence of the Mississippi and Ohio rivers that Marquette and Joliet and many other explorers noticed drastic changes in the landscape such as the abundance of canes (Arundinaria) and mosquitoes.

The first European settlement of importance was the site, which became the town of New Madrid. This settlement relied on hunting and trapping, but failed to thrive. Cape Girardeau became the local center for hunting and trapping. Steamboats first appeared in the area in 1811. The small communities along the river supplied the steamboats with fuel (wood) prior to the Civil War. The Civil War forced shippers to switch to coal and that remained the fuel of choice. The demand for wood for the steamboats created a thriving industry along the river and undoubtedly had major impacts on the forests most convenient to the river.

The New Madrid Earthquake of 1811-1812 influenced the development of the region, although local historians believe its effects were overestimated. Only two people from New Madrid are known to have relocated to Scott County. The earthquake did give the region a bad name and discouraged people from settling.

In the 1850s, the two principal concerns in Mississippi County were drainage and flood protection and securing a railroad to tie into the facilities at Cairo. The promoters of these projects underestimated the difficulties and the costs. In 1859, a State Almanac stated that the "whole county is susceptible of being made a perfect garden, the soil being a rich loam which can be rendered dry in the wettest seasons by a little drainage and rich enough to produce every thing that can mature in this latitude."

The first attempts at drainage and flood control came locally. A Swampland Convention met in Bloomfield in 1847 and endorsed cooperation with Arkansas. Two years later the New Madrid – Stoddard Canal Company was chartered but failed to progress. The next opportunity came from the Federal Government. The Swamp Land Acts of 1849 and 1850 gave the states possession of unsold swamp and overflow lands bordering the Mississippi River. The Act provided that proceeds from the sale of the lands would be used to construct levees and drainage ditches (MRL 1998). Congress designated 3,346,936 acres of unsold land in Missouri as Swamp Land and gave it to the State, even though at least one million of those acres were not under water. An area-wide development plan lasted two years before the State gave proceeds from the sale of these lands to the counties.

Mississippi County was a prime beneficiary of these land sales and soon had a large internal improvements fund. The year 1858 saw a major flood on the Mississippi River, with water rising 18 inches higher than in 1844 and equaling the 1815 flood levels. Work began the next year on building a levee. Starting from Birds Point, the county had constructed 30 miles by the time the Civil War started. In 1917, Congress authorized Federal participation in the levee building program. This, in conjunction with the Swamp Land Acts, combined to provide further impetus to levee building activities. Following the devastating 1927 flood, the MR&T (Mississippi River and Tributaries) Project was initiated with the passage of the 1928 Flood Control Act.

Even with the beginnings of improvement, frontier conditions prevailed. Martha J. Woods, who came through the area in 1857 noted, "We have been passing through the Mississippi bottom which is the richest land I ever saw, though nearly entirely in woods, only a few huts to be seen occupied by woodcutters. The trees on this bottom are the tallest and largest I ever saw and suppose not many larger in the world." A later survey placed an unusually large number of State record trees in Mississippi County. Of 24 State record trees reported in 1884, nine, including sycamore, cottonwood, pecan, red chestnut, sassafras, white ash, persimmon, red bud and paw paw, were from Mississippi County. From Cairo, Illinois, to Memphis, Tennessee, forests contained cottonwood, willow, sycamore, ash, hackberry, and a variety of oaks and other species (U.S. Army Corps of Engineers 1976).

Agricultural development began along the banks of the Mississippi River during Colonial times. As early as 1790, a few American farmers in the northern end of the valley were clearing forested land to cultivate corn, cotton, wheat, tobacco, flax, and hemp. The levees seemingly provided protection from flooding, and attention turned to drainage in the early 1900s. Mississippi County rapidly transformed into a cotton planting culture. Tenant farming increased to nearly 90 percent in New Madrid and Mississippi counties.

During the teens and early 1920s, a land boom was in progress for the landowners. They hired families to clear land for $8-12 per acre after the timber had been harvested. The newcomers considered the rich soil a "Promised Land," and many of the old landowners sold out. Churches and schools crowded the floodplain. Later in the 1920s, low commodity prices undermined the region's economy. The cost of land clearing exceeded rentals, and ditching taxes ate up profits. Many highly leveraged owners failed, and insurance companies and absentee owners became the primary landholders. As the default rate increased, drainage districts were unable to fund bond payments. Not until Federal assistance became available in the late 1930s did the drainage districts recover financial solvency.

During the Depression, the price of cotton fell below the cost of production. The area's agricultural system tottered on the verge of collapse in the early 1930s. Cotton surpluses continued to pile up as no plan of voluntary acreage reduction could be implemented. Foreign sales decreased and no other crops were available. After the election of Franklin Roosevelt in 1932, the Federal Government came to the aid of the region through a program of reducing cotton production. Poor administration of the program led to a variety of social problems, especially for the poorer tenant farmers. Unions for tenant farmers were formed, and the conflict escalated and eventually culminated in the Sit Down Strike of 1939.

The onset of World War II created a labor shortage, and planters who had been anxious to get rid of excess tenants now had trouble keeping labor. To make up for an increasing shortage of labor, farmers relied more on machines. Tractors came first, arriving in the 1930s; the cotton picker followed in the 1940s and 1950s. Cotton reached its peak just after the war, but began a serious decline in 1950. Corn remained profitable and, beginning in the 1960s, the soybean market boomed.

Machines removed the need for farm labor, and the small communities vanished. Those still living and working in the area did not build homes because of the creation of the Floodway. East Prairie, Charleston, New Madrid, and Sikeston grew as people moved to the other side of

the levees. The opening of the Brown Shoe Company plant in 1937 was part of an unsuccessful attempt to establish industry in the area. The loss of rail service in the county in the 1980s and the emergence of large discount stores left the downtowns of Charleston and East Prairie largely empty. The consolidation of crop processing led to the closing of small elevators and gins, virtually ending the economic life of smaller communities.

The best known flood in American history occurred in 1927. Primarily a Mississippi River flood, the volume of water forced the Ohio River to back up. In all, 16,570,627 acres in seven states were flooded; between 250 and 500 people died. Most of the damage was in Arkansas, Mississippi, and Louisiana. Many believed that floods of this magnitude should be preventable in the 20th century. The dominant philosophy for the previous 50 years had been that of the Mississippi River Commission (MRC). Established in 1879 and funded locally ($170,000,000) and Federally ($71,000,000), the MRC was dedicated to stopping flooding by raising the height of levees. The MRC's only response to each of the five major floods after 1879 had been to raise the height of the levees a few more feet. No consideration had been given to spillways, reservoirs, or diversion channels, and the problem of causation, including agricultural and timbering practices in the valley. Later 20th century problems included urbanization's devotion to parking lots and increased channelization of tributary streams.

After the 1927 flood, both the Corps of Engineers (COE) and the MRC decided that more than just raising the levees was required. The MRC plan rejected a Missouri Floodway to protect Cairo on the grounds that further study was needed. The COE proposed flooding 225 square miles of Missouri and dislocating some 3,000 people residing there in order to save Cairo. The COE plan (Jadwin Plan) was chosen, primarily because it was cheaper. The decision to create the Floodway angered local residents and court battles ensued. Eventually, the new Setback Levee was built and the fuseplug was placed in the frontline levee at Birds Point. Landowners were offered small settlements that many refused.

The first and only test of the Floodway came in the winter of 1937. Early winter rains in the Ohio River watershed produced 165 billion tons of water. By January 18, the Ohio River was flooded from Cincinnati to Cairo, and unremitting rain continued until the 25th. All along the river, previous flood records were broken. At Cairo, the crest was 19.6 feet above flood stage and 3.2 feet above the previous high-water mark. Almost 1.5 million people were flooded, and there were 137 deaths. Damages were estimated at $300,000,000.

On January 21, the Corps issued a warning giving spillway residents 48 hours to evacuate. The Red Cross and the Missouri State Highway Department aided in evacuation, and Army airplanes dropped warning messages on isolated farmsteads. Although the Control Levee was still working and flooding was not a problem on the upper Mississippi River, the Corps decided to blow the fuseplug on January 25. The explosion toppled chimneys in Charleston, and crews rushed to defend the Setback Levee from the surge of water. Not all area residents had fled, and others had gone back to put possessions on scaffolds. Rescue parties were quite active in getting the last people out.

The operation of the Floodway had little effect except for the tremendous damage it caused in the Floodway. Blowing the fuseplug only dropped the water 2.38 to 3.38 feet at Cairo instead of the expected six-foot drop. Federal authorities stood ready to evacuate Cairo as

sewers backed up and engineers worked frantically to raise the levees. Although the Jadwin Plan had been sold as protection from a maximum flood, the 1937 water episode had been merely an Ohio River affair. In 1950 when floodwaters again threatened, the Floodway was evacuated; and although the fuseplug was not blown, area residents were left out of their homes for months.

Considerable improvements have taken place since 1937, and flooding has diminished yearly. Approximately 167,000 acres were inundated in 1943 and approximately 141,902 acres the next year. The declines continued, so that in 1951 only 2,700 acres were affected. Almost all the land was cleared and put into production in the years after World War II because the threat of flooding was reduced and crop prices were steady. This created significant problems for local drainage districts trying to discharge their water, and they could not afford to maintain the levees and ditches. In 1965, Congress approved a new plan for operation of the Floodway that spurred new legal battles regarding easements, maintenance of the levees, and eminent domain. An updated plan of operations was issued in 1986. In 1987, Congress passed a resolution, which resulted in a Floodway Reconnaissance Report released in 1990. This report did open some new issues, namely Big Oak Tree State Park and Towosaghy State Historic Site. It also documented that 98 percent of the Floodway was in agricultural production. The report concluded that there was "no Federal interest in pursuing feasibility studies" for alternative Floodway operation plans.

The New Madrid Floodway and surrounding areas have a long history of development, levees, ditches, agriculture, and controversy. With the exception of the Floodway, much of what has been done in the project area is typical of the entire Mississippi River Valley. Federal construction on the Mississippi River mainline levees has been continuous since the passage of the Flood Control Act of 1928. Since 1844, over 1,500 miles of mainline levees have been built on the lower Mississippi River between New Orleans and Cairo. These levees have reduced the historic floodplain by 90 percent. The lateral width of the floodplain near Vicksburg during high flows (1882 and 1927) was almost 70 miles. Similar large floods are now contained between levees that average four miles apart (Rutherford *et al.* 1995).

Drainage ditches replaced the majority of natural streams, leaving the ditches as the principal habitat for aquatic resources (Pflieger 1997). Changes in aquatic fauna were undocumented, but this large-scale disturbance undoubtedly altered the original assemblage of species. Many species characteristic of lowland habitats have managed to persist in the area, but not necessarily in their former abundance. Exotic species such as common carp are able to exploit these highly altered habitats and have displaced native species.

Land clearing began almost as soon as European settlers reached the area. The need for wood as fuel and housing material and the great value of the area for agriculture has converted 98 percent of the area to cropped agricultural land. Of an original 2.5 million acres of forested wetlands in southeast Missouri, approximately 50,000 acres remain (L.H. Fredrickson, cited in MDC 1989).

5.17.2 Present

Present conditions for most resources have been discussed throughout this document. This section summarizes the points that are most pertinent to the discussion of cumulative impacts.

Floodplains provide important hydrologic exchange between terrestrial habitats and the aquatic system. The project area still functions as an integral part of the Mississippi River ecosystem and provides breeding, migration, and overwintering habitat for numerous species. The New Madrid Floodway, although highly altered, still performs floodplain functions important to regional fish and wildlife resources. The St. Johns Bayou Basin is only connected to the Mississippi River through a gated control structure. It is operated such that Mississippi River waters do not back up into the basin.

Forested wetlands in the area, a small remnant of a once extensive forest complex, are scarce and critical as refugia to numerous species that once flourished on the floodplain. In spite of numerous modifications, the project area supports significant fish and wildlife resources that greatly contribute to the State's biodiversity and to the ecological integrity of the lower Mississippi River.

Annual flooding in the Floodway is part of an important natural cycle of the Mississippi River. The New Madrid Floodway is 3.1 percent of the two-year Mississippi River floodplain between the Ohio River and White River confluences. Although the majority of lands in the Floodway subject to backwater flooding are now in agriculture and no longer the natural wetlands that once existed, they still play an important role in the overall ecology of the area. Backwater flooding provides significant spawning, nursery, and foraging habitat for river fish (Sheehan *et al.* 1998). There are also backwater areas associated with the Hatchie River, Forked Deer Rivers, Obion River, Bayou de Chien, Mayfield Creek, and Obion Creek. These backwater flood events greatly enhance fish stocks and play an important role in maintaining fish diversity in the Mississippi River and floodplain. There has been very little land clearing since the mid- to late-1960's for soybean production. This has been previously mentioned in this document. This project will not induce woodland clearing inside both basins or in the batture lands between the levees. This project will also have no affect on Mississippi River inundation of the batture lands.

Big Oak Tree State Park is in the New Madrid Floodway. The park contains wetland resources of state and national significance that are very susceptible to damage from drainage projects. The progressive drying of the swamp and altered flooding regimes that result from existing drainage networks are threatening the swamp and bottomland hardwood forests along with a substantial portion of the park's community and species diversity. The USACE is working with the MDNR to capture and hold rainwater and to provide pumps and relief wells to mimic Mississippi River water levels. These improvements are included in Alternative 3 of this project, but do not depend on the project for construction.

The Missouri Department of Conservation (MDC) manages two conservation areas in the project area. The Tenmile Pond Conservation Area covers 3,793 acres of cropland, wetlands, and forest. It is located in the New Madrid Floodway along an old oxbow lake formed when the

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Mississippi River meandered over that section of the floodplain. The ditches, ponds, and lake provide significant opportunities for anglers. The Donaldson Point Conservation Area consists of approximately 5,785 acres of mostly bottomland hardwoods that lie largely outside the frontline levee along the Floodway.

Clearly, wildlife habitat and wetland values have been reduced as a result of human activity in the project area. In the absence of mitigative measures, additional losses could be considered significant given the cumulative losses of this resource. However, in recognition of the significance of bottomland hardwood resources and the degree to which the resource has been depleted, legislative, regulatory, and policy changes have been implemented in recent years to address this concern.

Legislative authorities have addressed the issue of wetland protection and restoration in recent years. Section 404 of the Clean Water Act requires permits for the discharge of dredged or fill material in waters of the U.S. The Food Security Act 1985 (Swampbuster) removed some incentives for wetland development by eliminating agriculture subsidies to parties that produce commodities on wetlands converted after enactment. The USDA Wetlands Reserve Program (WRP) is a voluntary program to restore wetlands. Participating landowners can establish conservation easements of either permanent or 30-year duration or can enter into restoration cost-sharing agreements where no easement is involved. There are currently three WRP sites located within the project area. The USDA also sponsors the Conservation Reserve Program, which has 2,843 enrolled areas in Missouri totaling 144,706 acres, the seventh highest acreage in the US. However, only three or four are near the project area and none are in the Floodway. Tennessee, Kentucky, Illinois, and Arkansas have sites along the Mississippi River.

The two-year floodplain of the Mississippi from the Ohio River to the White River is approximately 550,000 acres, of which 17,000 are in the New Madrid Floodway. Of that total acreage, 86 percent has been tentatively mapped (not jurisdictionally delineated) as wetland. There are 130,000 acres of cropland, 190,000 acres of open water, and 127,000 acres of forested lands. The soils throughout the area are relatively fertile and are productive farmlands. Most of the lands that could be cleared for crop production have long since been cleared. There is some ongoing tree removal around the edges of fields, but this activity is not affecting significant forest resources. Some timber harvesting is occurring within the floodplain, but these lands are expected to regenerate.

5.17.3 Future

The Commerce Levee Raise and Drinkwater Pumping Station items of the Mississippi River Mainline Levees Enlargement and Seepage Control Project (MRL) are in the project area and were addressed in a 1998 SEIS. The entire MRL project, which extends from Cape Girardeau to New Orleans, will affect 4,800 acres of bottomland hardwoods, but the mitigation for this project will reforest 5,900 acres of frequently flooded agricultural lands. In the area from the Ohio River to the White River, approximately 639 acres will be replanted. Channel maintenance and dike and revetment construction are ongoing on the main river channel. Maintenance on existing levees and ditches will continue. Farming practices will change as

technology advances. Two harbors, Pemiscot and New Madrid, are likely to be expanded. These activities will have little or no effect on vegetation in the floodplain

This document evaluates proposed channel enlargements and improvements in the St. Johns Bayou Basin, the construction of a levee closure in the New Madrid Floodway, and the construction of pumping stations in both basins. The preferred plan would curtail the possibility of infrequent (25+ year interval) Mississippi River backwater flooding events that could inundate areas up to elevation 300 feet NGVD (approximately 75,000 acres) in the New Madrid Floodway. In a similar scenario, flooding would be reduced on approximately 36,000 acres of wetlands (about 27,000 cropland acres and 5,700 forested acres) in the New Madrid Floodway.

A variety of waterfowl, numerous other wetland-dependent birds, amphibians, invertebrates, and mammals benefit from those habitats. Some of the largest remaining forested wetland tracts in southeast Missouri are found in the project area. The Corps, based on qualitative hydraulic and geotechnical reviews, determined that these wooded wetlands would be saturated and will remain jurisdictional under Section 404 of the Clean Water Act and FSA. The character of the wetlands may change somewhat, but they would remain jurisdictional under Section 404. Mitigation for these losses was determined based on species-based habitat evaluation procedures (HEP).

The New Madrid Floodway is designed to reduce large Mississippi River floods and would be operated if flood stages reach the project design elevation. Construction of the St. Johns Bayou Basin and New Madrid Floodway Project will have no effect on the operation of the Floodway. Breaching the levee would cause tremendous damage to croplands and the small communities within the Floodway. Sand and silt from the floodwaters would deposit on land in the upper end. Scouring is likely in small streams and ditches. There may be some additional investment in irrigation equipment in the Floodway, but no changes in land use or infrastructure are expected. Closing the 1,500-foot gap in the levee will have no measurable change on Mississippi River flood stages.

The mitigation plan would result in a net gain of 9,557 acres of BLH and flood easements on 765 acres of herbaceous land to provide shorebird habitat. Reforestation would likely occur in batture lands adjacent to the project impact area. Potential areas for reforestation contain ridges and swales and would be reforested with a variety of tree species to provide benefits to both terrestrial and aquatic life. It would be similar to the once vast floodplain forest that was located throughout the region.

The New Madrid area floodplain is approximately 8.4 percent of the available two-year floodplain along this 113-mile reach of the Mississippi River. The majority of fish that use the floodplain for spawning are species common throughout the entire Mississippi River and its floodplain and spawn in many habitats throughout the Mississippi River floodplain. The appropriate implementation of the proposed mitigation plan would compensate the impacts to fish and wildlife resources. Over time, the maturing mitigation land forests would significantly increase the terrestrial habitat value.

5.17.4 Conclusion

Mitsch and Gosselink (1993) identified four common actions that directly or indirectly alter wetlands: (1) draining, dredging, and filling, (2) modification of the hydrologic regime, (3) mining and mineral extraction, and (4) water pollution. The first two are especially relevant in the Missouri Bootheel. Wetland values can be reduced without the actual conversion of bottomland hardwoods to another land use, but most of the forested wetlands in southern Missouri have been converted to croplands. Therefore, not only have the wildlife and wetland values been eliminated or reduced on the areas previously cleared, but it is likely that the remaining fragmented bottomland hardwoods have been altered to the point where original functions have been modified to an unknown degree.

The St. Johns Bayou Basin and New Madrid Floodway are highly altered landscapes and their functional value has declined. Past activities have resulted in significant reductions in forested lands and wetlands throughout the area. State parks and conservation areas have been set aside to preserve the largest remaining stands of bottomland hardwood forests. Legislative regulations have been implemented to restrict further loss of wetlands. Incentive programs are in place to encourage restoration of wetlands. The MRL project will impact forested wetlands, but the mitigation for that project will fully compensate for any losses. The St. Johns Bayou Basin and New Madrid Floodway Project will directly impact 167 acres of wetlands, all of which will be replaced. The project will indirectly affect approximately 30,000 acres of wetlands in the New Madrid Floodway, 5,000 of which are forested. All of these acres will remain wetlands, and none of the forested acres will be lost. The mitigation plan was developed to compensate for losses of fish rearing habitat, which constituted the greatest impact among the resource categories evaluated. The plan recommends reforesting 9,557 acres of frequently flooded agricultural lands. This acreage will certainly not restore the Missouri Bootheel Region to its presettlement condition, but it will be an incremental improvement over the present condition.

6.0 RECOMMENDED MITIGATION

The New Madrid Floodway is the only significant portion of the historic Mississippi River floodplain in Missouri still connected to the river. However, since the original forestland has been cleared and the main Mississippi River levee was built, high river stages do not flow freely over the forest floor like they originally did. High river stages now back up into the New Madrid Floodway and, in essence, water is pond on thousands of acres of mostly bare earth and soybean stubble. This connection provides hydrologic exchange between mostly agricultural fields and the aquatic ecosystem of the Mississippi River. According to the USFWS and the MDC, the lands within the project area are known to support more diverse habitats and natural communities than elsewhere in the Bootheel. These diverse habitats were evaluated under the Avoid and Minimize Alternative (the preferred plan), and unavoidable impacts to fishery, terrestrial, waterfowl, and shorebird resources were identified. Specific planning objectives have been developed to guide the formulation of alternative measures to compensate these unavoidable losses.

Impacts to fishery, terrestrial, waterfowl, and shorebird resources were reduced by incorporating environmental design features into the preferred plan as discussed throughout this

report. The preferred plan included the processes of avoiding and minimizing impacts through project design prior to developing compensatory measures for unavoidable impacts.

An evaluation of the preferred plan has identified unavoidable impacts to fishery, terrestrial, waterfowl, and shorebird resources. Specific planning objectives have been developed to guide the formulation of alternative measures and then to compensate these unavoidable losses. The planning objectives are:

1. To formulate measures to offset 100 percent of the 2,059 terrestrial AAHUs lost.

2. To formulate measures to offset 100 percent of the 4,603 fishery rearing HUs lost in the floodplain. In addition, formulate measures to offset losses of 58 in-stream fishery HUs.

3. To formulate measures to offset 100 percent of the 761 shorebird AAHUs lost.

4. To formulate measures to offset 100 percent of the 214,800 waterfowl DUDs lost during spring migration.

5. To formulate measures to reduce detrimental affects to the freshwater mussel habitat during project implementation and for future projects.

6. To formulate measures that compensate for as many resource categories as possible on the same real estate.

The Corps' recommended mitigation plan for the Avoid and Minimize Alternative (Alternative 3, preferred alternative) is described below:

6.1 ST. JOHNS BAYOU BASIN

1. Terrestrial: Mitigated with both the St. Johns Bayou Basin and New Madrid Floodway fishery mitigation option. In addition, the enlarged channel dimensions would be reduced, and restrictive easements would be placed on the channel embankments.

2. Fisheries: Fee title land acquisition of approximately 1,318 acres of agricultural land, which would be reforested by planting 85 percent acorns and 15 percent RPM trees to mitigate for floodplain rearing fishery impacts. This would also mitigate part of the terrestrial losses, the remainder of which would be mitigated under the New Madrid Fishery losses. Attempts will be made to purchase mitigation lands in large tracts as close as possible to the lower end of the basin.

3. In-Stream Fishery Losses: The in-stream losses would be mitigated by the avoidance of bottomland hardwoods within the ROW (66 acres), construction of bank stabilization measures (riprap at channel intersections), and the avoidance of a nine-foot strip along the right-descending bank in the Setback Levee Ditch. The upper

3.7 miles of St. James Ditch will be removed from construction to avoid adverse impacts to the State-endangered golden topminnow.

4. Waterfowl: Mitigated with both the St. Johns Bayou Basin and New Madrid Floodway fishery mitigation option. The MDC and the USFWS would manage (fluctuate) the water levels on up to 6,400 acres (both basins combined) to maximize winter waterfowl benefits.

5. Shorebird: Lease (or purchase) and flood approximately 105 acres of herbaceous land.

6. Mussels:

   (a) Avoid a nine-foot strip along the right-descending bank of the Setback Levee Ditch.

   (b) Relocate mussels from sites within the dredge path to other locations within the project area.

   (c) Monitor mussel repopulation to determine the timing of recovery due to dredging.

6.2 NEW MADRID FLOODWAY

1. Terrestrial: Mitigated with the New Madrid Floodway fishery mitigation option.

2. Fisheries: Fee title land acquisition of approximately 8,239 acres of seasonally flooded agricultural land, which would be reforested by planting acorns to mitigate for floodplain rearing fishery impact. Attempts will be made to purchase mitigation lands in large tracts as close as possible to the lower end of the Floodway. During the process of selecting mitigation lands, the Corps will work with the USFWS and MDC to review the possibility of mitigating in-kind permanent waterbody losses in the mitigation tract. If this is possible, it would reduce the number of acres of mitigation land required (based on HUs gained).

   (a) Locating or enhancing borrow pits inside mitigation tract.

   (b) Re-connecting backwaters, old river channels to stream channels.

This recommendation would also mitigate for the remaining terrestrial losses in the St. Johns Bayou Basin and all of the terrestrial and waterfowl losses in the New Madrid Floodway.

3. Waterfowl: Mitigated with reforestation for fishery losses. The MDC and the USFWS would manage (fluctuate) the water levels on up to 6,400 acres (both basins combined) to maximize winter waterfowl benefits.

4. Shorebird: Lease (or purchase) and flood approximately 660 acres of herbaceous land.

In order to best meet the needs of mitigation for fishery, terrestrial, waterfowl, and shorebird habitats, the following would be desirable qualities of mitigation lands:

1. Floodplain Fishery: Purchase in fee title land to be reforested that is currently flooded and has significant access for riverine fish from March through June.

2. Fishery Borrow Pits: Purchase in fee title land that is subject to flooding. The borrow pits should maintain connections to the Mississippi River so that spawning adults can access the ponds and young-of-the-year fish can pass to the river as water levels recede. USFWS requests that the pits be constructed properly (Corps Guidelines by Aggus and Ploskey 1986) and that they be seasonally accessible to the Mississippi River from March through June to provide the estimated habitat benefits. The Corps and USFWS have agreed to examine opportunities to improve existing borrow pits, construct new ones, or reconnect old river channels on mitigation lands.

3. Terrestrial: Fishery criteria listed above meet all the terrestrial needs.

4. Waterfowl: Purchase land as listed under fishery criteria, but must ensure it is flooded to a depth of 18 to 24 inches to be accessible to most dabbling and diving ducks in the project area. The mitigation recommended for fishery mitigation would meet USFWS waterfowl concerns.

5. Shorebird: Lease herbaceous land that is inundated during the months of March, April, and May. Seasonally inundated land during the month of March can also be used by white bass and other spawning fish.

6.3 ACQUISITION OF MITIGATION LANDS

The Water Resource Development Act of 1986 directs that acquisition of lands to mitigate losses to fish and wildlife shall be undertaken or acquired either: (1) before any construction of the project commences; or (2) concurrently with the acquisition of lands and interests in lands for project purposes; and (3) that mitigation measures will generally be scheduled for accomplishment concurrently with other project features in the most efficient way. Section 906(b) of WRDA 1986 provides authority for the Secretary of the Army to mitigate damages to fish and wildlife without further specific Congressional authorization, but limits post-authorization acquisition or interests in lands for mitigation to willing sellers.

The total amount of land required to mitigate project impacts is 9,557 acres of frequently flooded agricultural lands and 765 acres of shorebird easements. Of this amount, 1,857 acres of reforested agricultural land and 105 acres of shorebird easements will be the acquisition responsibility of the local sponsor. These mitigation requirements are attributed to the impacts of the St. Johns Bayou Basin portion of the project. The remaining 7,700 acres of agricultural lands and 660 acres of shorebird easements will be the responsibility of the Corps. These

mitigation requirements to reforest are attributed to the impacts of the levee closure, a feature of the Mississippi River Levees Project. The St. Johns Levee and Drainage District is the local sponsor of the project. They are actively identifying tracts of marginal cropland that could be used as mitigation for their purposes as well as those of the Corps. The Corps will continue to work with the Drainage District and other local interests to identify willing sellers and insure that mitigation is implemented concurrently with project construction.

6.4 PROJECT FEATURE MITIGATION COSTS

The costs of implementing this project were broken down by impacts associated with pump operations, closure of the levee, and ditch work (tables 6-1 and 6-2). The impacts attributed to the pump operations and the channel enlargement would be funded by the local sponsor for the St. Johns Bayou and New Madrid Floodway Project. Impacts from the closure would be funded under the Mississippi River Levee Project. Table 6-2 outlines the mitigation percentage and cost per habitat unit gained for the preferred plan.

Table 6-1. Mitigation Recommendations by Basin and Construction Item

Basin	Construction Item	Mitigation Feature	Cost	Habitat Units Gained	
St. Johns Bayou Basin	Pumps	Fishery Mitigation: Reforestation of 1,318 acres by 85% acorns/15% RPM	$ 2,454,041	1,884	HUs
		Shorebirds: Flood easements on 105 acres of herbaceous land	$ 16,800	104	AAHUs
	Ditch Work	Mussel Relocation	$ 11,100		NA
		Mussel Monitoring Plan	$ 83,411		NA
	Total St. Johns Bayou Basin		**$ 2,565,352**		
New Madrid Floodway	Pumps.	Fishery Mitigation: Reforestation of 539 acres by planting acorns	$ 954,569	178	HUs
	Total St. Johns Bayou Basin Project Feature		$ 3,519,921		
	Closure	Fishery Mitigation: Reforestation of 7,700 acres by planting acorns	$ 13,637,293	2,541	HUs
		Shorebirds: Flood easements on 660 acres of herbaceous land	$ 105,600	657	AAHUs
	Total New Madrid Floodway		**$ 18,217,383**		
	Total MRL Project Feature		$ 13,742,893		
Total Both Basins			**$ 20,782,735**		

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Table 6-2. Mitigation Percentage and Cost Per Habitat Unit for the Preferred Plan

Recommended Mitigation: Purchase and reforest 9,557 acres of agriculture land and shorebird easements on 765 acres of herbaceous land				
Resource Category	Units Impacted	Units Gained	Percent Mitigated	Cost Per Unit ($)
Terrestrial (AAHUs)*	11,099	12,711	115%	***
Waterfowl (DUD)**	215,645	2,312,794	1073%	***
Shorebird (AAHUs)	761	761	100%	$ 161
Fisheries (HUs)	4,603	4,603	100%	$ 3,677

*Terrestrial Direct and Indirect Losses (as assumed by USFWS)

**Losses in February and March

***Mitigated under fishery recommendation

7.0 PUBLIC INVOLVEMENT

7.1 PUBLIC INVOLVEMENT PROGRAM

A Notice of Intent to prepare an EIS was published in the Federal Register on April 15, 1997. A public scoping meeting was held in New Madrid, Missouri, on May 15, 1997, to obtain input from the public regarding issues and concerns they wished to be addressed during the study. Over 150 people attended this meeting. Interested individuals as well as representatives from State and Federal agencies, the U.S. House of Representatives, and private organizations were in attendance. Several other project briefings were held between the Corps, project sponsor, local interests, and State and Federal agencies during the conduct of the draft study. The Notice of Availability of the Draft SEIS (DSEIS) was published in the April 9, 1999, Federal Register, and the draft was mailed to approximately 145 individuals, public, or governmental interests. A 45-day comment period was established; however, the comment period was extended for 30 days, until June 25, at the request of the U.S. Fish and Wildlife Service. A public hearing was held on May 20, 1999, in East Prairie, Missouri, to receive comments on the DSEIS. Over 75 were in attendance, including representatives of Federal, State, and local agencies, and individuals. Twenty-one individuals presented testimony; all spoke in favor of the project. A total of 48 written comments were received during the comment period, and comments ranged from total support to total opposition of the project. Although many reasons were presented for opposition to the project, a recurring concern was project impacts to wetlands. Twelve written (letter or e-mail) comments were received after the close of the comment period. They, also, were accepted and considered during the preparation of the Final SEIS (FSEIS). The letters of comment and the Corps response to comments are contained in the comment and response appendix (Appendix L). Copies of this FSEIS have been provided to those individuals and organizations that made substantive comments on the DSEIS, in addition to Federal and State agencies and local governing bodies.

7.2 COORDINATION

Numerous environmental planning meetings were held throughout the study. These were designed as interagency meetings where all worked as a team to assess fishery and wildlife impacts. Some meetings were broad in scope, while others were held to identify and address environmental issues and concerns relative to the overall project. The Memphis District, the Missouri Department of Conservation, and the U.S. Fish and Wildlife Service were the agencies comprising the team. The objectives of these meetings were to minimize environmental conflicts, miscommunication, and project delays; maximize environmental expertise available for consultation; facilitate the development of the environmentally sensitive alternative and how various project features relate to NEPA; identify potential environmental project features; and identify possible survey and impact assessment procedures. Environmental meetings were held to address specific environmental issues. Meetings were also held to identify and select appropriate measures for assessing and sampling baseline conditions of and impacts to shorebirds, terrestrial wildlife, and aquatic resources. Throughout the study process, all scopes of work, survey data, and reports from contractors were developed and reviewed by the interagency team. Documents written by one agency were reviewed by the team members, with questions and concerns discussed. In addition to the three primary team agencies, representatives from MDNR, EPA, NRCS, WES, and Gulf Engineers and Consultants (the HEP contractor) were also involved at various meetings. The USFWS used information and data throughout the study process to prepare their Coordination Act Report (Appendix C).

Subsequent to release of the DSEIS and during the comment period on that document, the EPA elevated concerns they had on the project to the Council on Environmental Quality (CEQ). CEQ convened a meeting on July 13, 1999, to discuss EPA concerns. Representatives from USFWS were also in attendance. At this meeting, EPA raised concerns related to a number of issues, including wetland impact, alternative analysis, purpose and need, mitigation, cumulative impact, and water quality analysis, and stated a desire that a revised draft of the DSEIS be prepared. CEQ directed that the Corps work these issues with EPA and others at the regional level and report back to them at a later time. The Assistant Secretary of the Army for Civil Works [ASA(CW)] granted a time extension to EPA to provide comments on the DSEIS. The Corps and EPA subsequently conducted several meetings and a site visit to work issues, and representatives from other agencies were often in attendance. In order to better address EPA concerns, a detailed water quality analysis was performed by ERDC(EL), and additional analysis and clarification were added to the FSEIS. The Corps and EPA reported back to CEQ in a March 3, 2000, meeting during which results of reanalysis and coordination were discussed. The EPA provided their formal letter of comment on the draft SEIS by letter dated March 20, 2000, and the Corps response to that letter is contained in Appendix L. Additional studies and analyses substantiated the recommendations of the draft report, and information has been added to this final report to clarify issues and impacts.

7.3 FISH AND WILDLIFE COORDINATION ACT RECOMMENDED CONSERVATION MEASURES

The following recommendations were provided by the USFWS in the final Coordination Act Report. Corps responses follow each recommendation.

Recommendation 1: Consider alternatives that specifically address East Prairie flooding problems including ring levees, flood-proofing, and local drainage improvements. If additional flood control work is necessary, limit that work to the St. Johns Bayou Basin. Work in the New Madrid Floodway will not provide flood relief to areas in and around East Prairie.

Response: Several alternatives, including a ring levee around the town of East Prairie, additional channel work within the town to solve interior drainage problems, and nonstructural alternative, were analyzed. These alternatives do not address the project purpose of providing flood control to both basins and are not economically justified. These alternatives were addressed throughout the SEIS. Limiting the work to the St. Johns Bayou Basin only was economically justified, but does not fully meet the needs of the local sponsor as described above and is not the NED or economic optimum plan.

Recommendation 2: Minimize dredging and channel modifications to the maximum extent possible by implementing the following conservation measures:

Recommendation 2a: Installing gradient control structures at the upper end of all work reaches and at the mouths of all major tributaries to prevent headcutting.

Response: To maintain bank stability at the confluence of St. James Ditch with Setback Levee Ditch, bank stability structures would be provided. Channel gradient control would not be necessary at these locations, because the bottom elevation of the ditches would be the same. Also, gradient control would not be necessary at the upper end of channel construction, since the grade differential is minimal. At the upper limit of channel construction, lateral transitions to existing channel dimensions would be constructed to minimize potential bank caving.

Recommendation 2b: Installing transverse dikes in the Setback Levee Ditch and the St. Johns Bayou reach to offset fisheries habitat losses from shallower water depths. Those dikes should be designed to maintain a sinuous, continuous thalweg along the length of the channel.

Response: Nine dikes will be constructed in the St. Johns Bayou Basin as part of the Avoid and Minimize Alternative, but additional dikes are not suitable elsewhere due to narrow channel widths. Installing dikes in the Setback Levee Ditch will result in sedimentation behind the dikes. Any dike construction in the Setback Levee Ditch would be limited in height to a maximum of 18 inches to prevent loss of channel capacity. Routine channel maintenance along reaches where dikes are placed would be difficult due to the presence of riprap used to construct the dikes. Environmental benefits would be minimal, since shortly after channel construction low-flow meanders should form in excavated ditches and achieve results similar to those expected for the transverse dikes.

Recommendation 2c: Constructing a low-head weir where the Lee Rowe Ditch branches off the St. James Ditch to prevent perching that channel during base flows.

Response: Due to the channel excavation of St. James Ditch, base flows may be reduced, but should be available in Lee Rowe Ditch. Pre-project base flow levels can be maintained in Lee Rowe Ditch by leaving a plug in the St. James Ditch just downstream of the junction between the two ditches at approximately mile 3.7 of St. James Ditch.

Recommendation 2d: Constructing vortex weirs in the St. James Ditch to compensate for habitat losses from shallower depths along those reaches. They may function as grade control structures.

Response: Vortex weirs should not be used in the St. Johns Bayou Basin because these large stones would eventually sink into the channel bottom as local scour and channel adjustment occur. The low velocities in the St. James Ditch would not produce the effect desired for such structures. These types of structures would not be well suited to the stream morphology in the St. Johns Bayou Basin area, and debris collection on the structure would also reduce channel conveyance and scour the banks.

Recommendation 2e: Avoiding dredging impacts to the maximum extent possible in the entire reach of the St. James Ditch that contains suitable habitat for the State-listed golden topminnow.

Response: The Avoid and Minimize Alternative eliminates 3.7 miles of channel work on St. James Ditch above Lateral No. 2. However, the channel work along the St. James Ditch up to the intersection of Lateral No. 2 is necessary to provide adequate drainage for the town of East Prairie. Therefore, extending the no-work reach downstream of Lateral No. 2 is not feasible.

Recommendation 2f: Avoiding dredging in a nine-foot strip along the right-descending side of the Setback Levee Ditch to reduce dredging impacts to mussels and possibly leave a population to recolonize the ditch. In addition, a minimum of 1,500 mussels (species composition to be determined by the Service and MDC) should be relocated from sites within the dredge path to other appropriate areas in the St. Johns Bayou Basin. A long-term monitoring plan should be developed, in coordination with the Service and MDC, to determine the success of those mitigation measures. In addition, that monitoring plan should contain a provision to evaluate the suitability of the above-mentioned dikes, weirs, and gradient control structures as mussel habitat.

Response: The Corps will avoid dredging a nine-foot strip along the right-descending side of the Setback Levee Ditch following normal construction practices if possible. If this is not possible, the channel will be widened up to an additional nine feet to ensure a nine-foot strip is left undisturbed along the right-descending bank. In the Mitigation Plan for this SEIS, the Corps recommends that a minimum of 1,500 mussels be relocated from the sites within the dredge path to other appropriate sites. In addition, the Corps also recommends a mussel monitoring plan.

Recommendation 3: Evaluate non-structural measures (e.g., flooding easements, etc.) to address agricultural flood damages in the New Madrid Floodway. If those are infeasible,

the Corps should investigate alternative levee closure locations, such as that proposed by MDC, further north in the Floodway to avoid significant adverse effects to fish and wildlife.

Response: Several separate alternatives were also studied for the New Madrid Floodway portion of the project. Included were non-structural alternatives and an alternative levee alignment as suggested. None of these alternatives were economically justified and, as such, could not be recommended for construction. These alternatives are described in Section II of the Economics and Social Analysis Appendix.

Recommendation 4: If the Corps determines there are no feasible flood control measures other than the proposed alternatives, they should incorporate the following measures as integral features of the selected plan:

Recommendation 4a: Prevent the conversion of forested wetlands in both basins due to project-related hydrologic changes. This should be done by purchasing a conservation easement or other protective measure on forested wetlands between elevations 290 and 287 feet NGVD in the St. Johns Bayou Basin and between 290 and 277 (Authorized Project) or 281 feet (A&M) NGVD in the Floodway.

Response: The Corps does not believe the jurisdictional wetland status of forested wetlands will change. Therefore, landowners would be the same under Section 404 of the Clean Water Act requirements, and protective easements would not be needed.

Recommendation 4b: Fully compensate all unavoidable losses to fish and wildlife resources. Compensation measures should include the following measures (average annual acres).

(1) Reforest cropland to compensate for forested wetlands habitat losses associated with channel enlargement, levee closure and pump operations (i.e., altered hydrology). Approximately 2,118 acres (Authorized Project) or 1,546 acres (A&M) would be needed to mitigate direct project impacts. If protective covenants have not been placed on BLH forest as described in 4(b), the Corps should reforest an additional 6,998 acres (Authorized Project) or 6,788 acres (A&M) to compensate for induced forested wetland losses because of project-related reductions in flooding.

Response: Concur. The Corps recommends mitigation of terrestrial direct habitat value losses under the Avoid and Minimize Alternative by reforesting approximately 9,557 acres of agricultural land for fishery mitigation. The Corps does not believe any induced forested wetland losses will occur.

(2) Reforest cropland to compensate for losses in spring waterfowl migration habitat. Acreage to compensate for forested wetland losses mentioned above could also meet waterfowl compensation needs, provided the sites

were reforested with at least 50 percent red oak species and flooded during late winter and early spring to depths no greater than 24 inches.

Response: Concur

(3) Reforest flooded cropland that has unimpeded access for river fish during the spawning season (i.e., March through June) to compensate fisheries spawning and rearing habitat losses on the floodplain (excluding seasonally-connected waterbodies – see below). Approximately 7,968 acres (Authorized Project) or 7,607 acres (A&M) of flooded agricultural lands would be necessary to mitigate those habitat losses.

Response: Concur.

(4) To the maximum extent possible, mitigate in-kind (i.e., similar habitat) for fisheries habitat losses of permanent waterbodies. This could include improving existing permanent waterbodies, or reconnecting old chutes, sloughs, and oxbows with the Mississippi River. If in-kind mitigation is infeasible, reforest an additional 2,343 acres (Authorized Project) or 1,950 acres (A&M) of flooded cropland to compensate for those losses. Those sites must be easily accessible to river and floodplain fishes during the spawning season (i.e., March through June). The Corps should ensure public access to those sites through fee-title purchase or easements.

Response: Concur.

(5) Provide shallow flooded (i.e., $\leq$ 18 inches) land in April and May to compensate for project-related losses in shorebird migration habitat. (Such area could also partially compensate for losses to fisheries and waterfowl habitat). Approximately 1,583 acres (Authorized Project) or 1,523 acres (A&M) of cropland would be necessary to compensate shorebird habitat losses. Constructing moist soil areas to mitigate those losses would roughly halve the necessary acreage.

Response: The Corps agrees with the USFWS compensation measure and recommends to mitigate shorebird losses under the Avoid and Minimize Alternative by leasing (or purchasing) and flooding 765 acres of herbaceous land.

(6) Acquisition of mitigation lands, reforestation, and shorebird management measures should be accomplished concurrently with project construction and should be in place prior to project operation.

Response: Concur. The Corps will work with the USFWS and other local interests to insure that mitigation is implemented concurrently with project construction.

Additional USFWS Comments: The Service and Corps have strived to develop measures that fully address project-related impacts to Federal trust resources. However, providing the appropriate cover types (i.e., BLH, moist soil, borrow pits) only partially meets the needs of fish and wildlife. To fully compensate for project-related impacts, habitat functions must also be maintained. While the proposed mitigation plan would potentially compensate fish and wildlife habitat losses that can be quantified with current methods for estimating wildlife effects of water development projects, it would not sustain all the important ecological functions of the floodplain-river ecosystem in the project area.

Corps Response: The Corps appreciates the assistance of the USFWS in developing a mitigation plan that mitigates significant fish and wildlife losses and will continue to coordinate closely with the USFWS in mitigation site selection and development.

7.4 CORPS RESPONSE TO USGS REVIEW OF THE SEIS HYDRAULIC/HYDROLOGIC INFORMATION FOR USFWS

The USFWS requested the U.S. Geological Survey (USGS) to review the Corps Hydraulic and Hydrologic Appendix and analysis. The USGS provided a letter to the USFWS that outlined information obtained from their review (letter is contained in Appendix C, USFWS Coordination Act Report). This section responds to the comments provided.

The analysis results presented in the hydraulics appendix of the SEIS are based on previous hydraulic and hydrologic analyses documented in the St. Johns Bayou and New Madrid Floodway, Missouri, Phase II General Design Memorandum 101, Volumes 1 and 2, August, 1986. Volume 1, Section V - Hydrology, Hydraulics, and Sedimentation describes the design analysis. Volume 2 contains plates that present analysis results in graphical form, including frequency curves. The majority of hydraulic/hydrologic comments in the December 4, 1998, USGS review letter has been substantially addressed in the GDM.

In addition, the 1997 St. Johns and New Madrid Floodway, Missouri First Phase Limited Reevaluation Report (LRR) confirmed that the hydraulic/hydrologic information in the 1986 GDM is satisfactory and addressed risk and uncertainty regarding flowline elevations and stage-frequency relationships.

Moreover, additional explanations of the project and SEIS analysis have been provided during numerous meetings and in correspondence with resource agencies over a period of approximately two years.

The methodology used to determine the two-year frequency elevation for the Floodway was addressed in previous correspondence faxed to USFWS in November 1998.

The 1943-1974 period used for continuous simulation includes floods and droughts. The rainfall depths and Mississippi River stages are representative and suitable for characterization of existing conditions and project performance over design life.

In summary, the SEIS hydraulic/hydrologic results represent the best estimate of long-term daily water surface elevations in St. Johns Bayou and the Floodway. Rainfall and

Mississippi River stage are the dominant independent variables determining daily water surface elevations in both St. Johns Bayou and the Floodway. Daily data for these two dominant variables are available, and the hydrologic response to the data can be reliably calculated. Therefore, the modeled daily elevations are an accurate representation of existing and project hydrology.

8.0 LIST OF PREPARERS/CONTRIBUTORS

Name	Discipline	Experience	Role
Mr. Miguel Nuevo Alarcon	Research Assistant Fisheries	1 yr. Coop. Fisheries Southern Illinois University	Fishery Field Work
Mr. Barry Allen	Biologist	3 yrs. Missouri Department of Conservation, 6 yrs. Kansas Wildlife and Parks	HEP, waterfowl, Shorebird team. Mitigation recommendations
Mr. Jacques Bagur	Editor/Technical Writer	G.E.C., Inc.	Editor
Dr. Chris Barnhart	Associate Professor Biology	9 yrs. Southwest Missouri State University	Mussel sampling and survey report
Mr. Eddie Belk, P.E.	Project Manager	15 yrs. practicing engineer, 12 yrs. of those with COE	Project Manager, responsible for SEIS schedule, funding, and coordination
Mr. Mark Boone	Fishery Biologist	13 yrs. Missouri Department of Conservation	Fishery HEP Team
Mr. Barry Bruchman	Hydraulic Engineer	14 yrs. Army COE	Hydrological & Hydraulic Investigations lead engineer & prepared Hydraulic Appendix, assist, with wetland appendix
Ms. Kelly Burks	Biologist	2 yrs. Waterways Experiment Station COE; 4.5 yrs. Environmental Br., Walla Walla District COE	Technical support for HEP analysis and supervised application of EXHEP software
Mr. Randy Clark	Biologist	11 yrs. Regulatory Branch, and 5 yrs. Environmental Analysis, Memphis District COE	Wetland delineations appendix
Mr. Gary Christoff	Biologist	22 yrs. Missouri Department of Conservation	SEIS team and reviewer
Mr. Darrell Coad	Cartographic Technician, Cert. Photogrammetrist (ASPRS)	24 yrs. Survey Engineering & Mapping, Memphis District COE	Base mapping & GIS
Ms. Molly Devine	Student Aide	1 yr. Memphis District COE	Computer and clerical support for public comment section
Mr. Adrian Farmer	Biologist	U.S. Fish and Wildlife Service	Shorebird model

LIST OF PREPARERS/CONTRIBUTORS (continued)

Name	Discipline	Experience	Role
Mr. Gary Frazer	Biologist	U.S. Fish and Wildlife Service	SEIS team member for all analyses; Co-preparer of Shorebird model
Mr. Andy Gaines, P.E.	Hydraulic Engineer	12 yrs. Hydaulics & Hydrolgy Br., Memphis District COE	Classified landcover & wetlands, Conducted waterfowl & fishery analysis
Mr. Darren Gant	Biologist	Natural Resources Conservation Service, USDA (New Madrid County, MO)	Reviewed wetland mapping
Mr. Robert Green	Civil Engineer	25 yrs. Memphis District COE	Engineering Design
Dr. Roy Heidinger	Professor	32 yrs. in fisheries Southern Illinois University	Fishery Sampling and survey report
Mr. Richard Hite	Forester/Wildlife Biologist	15 yrs. St. Louis District COE 12 yrs. Memphis District COE	Technical Support in preparation of Mitigation Plan
Dr. Jan Hoover	Fishery Biologist	Waterways Experiment Station, 10 years	Fishery Analysis and Mitigation Recommendations
Dr. Robert Hunt	Hydraulic Engineer	Corps of Engineers, 3 yrs.	Hyraulic analysis and appendix
Mr. Tracy James	Hydraulic Engineer	14 yrs. Hydraulic and Hydrology Br., Memphis District COE	Water quality appendix
Dr. Jack Killgore	Fishery Biologist	17 yrs., Waterways Experiment Station, COE, ecology of freshwater fishes, impact assessment	Fishery Analysis & Mitigation Recommendations
Mr. Scott Knaus	Biologist	G.E.C., Inc	HEP fieldwork and analysis
Mr. Edward P. Lambert	Wildlife Biologist/ Ecology	10 yrs. Environmental Br., Memphis District COE; 2.5 yrs. Tennessee Wildlife Resources Agency	Technical Support in report analysis and preparation
Mr. Mike LeValley	Biologist	U.S Fish and Wildlife Service	SEIS preparation team; CAR analysis and report

LIST OF PREPARERS/CONTRIBUTORS (continued)

Name	Discipline	Experience	Role
Mr. Bobby Learned	Economics & Social Analysis	14 yrs. Economics Br., Memphis District COE; 5 yrs. Economics Br., Vicksburg District COE	Economic Analysis
Ms. Jane Ledwin	Biologist	7.5 yrs. U.S. Fish and Wildlife Service, 1/2 yr. LA Coastal Management Div., 2.5 yrs. OCS Office in NC	SEIS preparation team; CAR analysis and report
Mr. Hubert Logan, P.E.	Civil Engineer	32 yrs. Design Br., Memphis District COE	Engineering Design
Ms. Gloria Markovci	Environmental Engineer	2 yrs. Environmental Br., Memphis District COE	Phase I HTRW Assessment
Mr. Robert Martin	Wildlife Biologist	4 yrs. Ark. Game & Fish Com.; 5 yrs. Environmental Br., Memphis District COE	Technical Reviewer, Contributed to Section 404(b)(1) information
Mr. Barry McCoy	Biologist	G.E.C., Inc.	HEP fieldwork and analysis
Mr. Jim McNeil	Archeologist	19 yrs. Environmental Br., Memphis District COE	Archaelogical Survey & Appendix
Mrs. Christina Mills	Biologist	2 yrs. Environmental Br., Memphis District COE	Assistant Project Biologist and SEIS coordinator, GIS and HEP analyses, incremental cost analysis, mitigation plan, wetland appendix, HTRW appendix
Mr. Norman Newman, Jr.	Geotechnical Engineer	19 yrs. Geotechnical Engineering Section, Memphis District COE	Advice on groundwater conditions and wetlands, wetland appendix
Mr. Brian Obermeyer	Researcher/Student	Southwest Missouri State University	Mussel sampling and survey report
Dr. Michael Passmore	Research Wildlife Biologist	4 yrs. Waterways Experiment Station; 15 yrs. Environmental Br., Walla Walla District COE	Technical support and consultation for the HEP analysis
Ms. Kristin Pelizza	Biologist	1 yr. Environmental Br., Memphis District COE	Section 404(b)(1) review and Mussel review

LIST OF PREPARERS/CONTRIBUTORS (continued)

Name	Discipline	Experience	Role
Mr. David Reece	Fish & Wildlife Ecology	4 yrs. Chief, Environmental Br., Memphis District COE; 5 yrs. Policy Division, HQ USACE; 12 yrs. Environmental Br., New Orleans District COE; 4 yrs. Florida Game and Fish Comm.	Environmental Review, Supervisory SEIS coordination, Responses to comments
Rochelle Renken	Biologist	10 yrs. Missouri Department of Conservation	Shorebird Model and endangered species
Mr. Andrew Roberts	Biologist	1.5 yrs. U.S. Fish and Wildlife Service, Columbia Field Office, 1 yr. Missouri Department of Conservation	Mussel Sampling and survey report; U.S. Fish and Wildlife Service CAR
Mr. Erwin Roemer	Archeologist	2 yr. Environmental Br., Memphis District COE; 8 yrs. Vicksburg District COE; 10 yrs. Private Sector	Report Reviewer
Mr. John Rumancik	Fishery and Wildlife Biologist	20 yrs. Environmental Br., Memphis District COE; 1.5 yrs. US Dept. Agr. ASCS	Project Biologist/SEIS Coordinator; Section 404; Biological Assessment; HTRW review; Public Comment Response
Mr. Michael Schmidt	Researcher I Fisheries	9 yrs. Coop. Fisheries Southern Illinois University	Fishery Fieldwork
Mr. Larry Sharpe	Project Manager	28 yrs. practicing engineer, 26 yrs. of those with COE	Project Manager, responsible for St. Francis, St. Johns Bayou & New Madrid Floodway Basin activities
Mr. Andy Simmerman	Civil Engineer	4 yrs. Geospatial Engineering Branch, Memphis District COE	GIS Mapping & Plotting
Dr. Robert Sheehan	Associate Professor	23 yrs. in fisheries Southern Illinois University	Fishery Sampling and Fisheries survey report
Ms. Maryetta Smith	Biologist	Mississippi Valley Division COE; Vicksburg District COE	Reviewer and technical assistant in analysis and mitigation
Mr. Richard Turner	Civil Engineer	5 yrs. Design Br., Memphis District COE	GIS mapping and queries
Mr. Tre' Wharton	Biologist	G.E.C., Inc.	HEP fieldwork, Review and Edit SEIS

LIST OF PREPARERS/CONTRIBUTORS (continued)

Name	Discipline	Experience	Role
Mr. Gregg Williams	Biologist	2.5 yr. Environmental Br., Memphis District, COE, 6 yrs. private sector Environmental engineer, 2.5 yrs. fishery technician for Mississippi Department of Wildlife, Fisheries, and Parks	HTRW Phase I Assessment and technical review
Mr. Kevin Williams	Civil Engineer	7 yrs, Design Br., Memphis District COE	Engineering Design and GIS
Dr. Paul Wills	Fisheries Researcher II	8 yrs., Coop. Fisheries Southern Illinois University	Fishery Sampling and survey report
Mr. Dave Wissehr	Biologist	Missouri Department of Conservation	HEP, waterfowl, shorebird team and mitigation recommendations

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