June 2002

Final Report

REVISED SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT FOR THE ST. JOHNS BASIN- NEW MADRID FLOODWAY PROJECT

US Army Corps of Engineers
Memphis District

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MEMPHIS DISTRICT

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REVISED SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT FOR THE ST. JOHNS BAYOU-NEW MADRID FLOODWAY PROJECT

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 (USFWS), 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 project basin is flat Mississippi Delta terrain that was virtually cleared of bottomland hardwood forest that covered the area before the 1900s. Since the clearing occurred, the area has been used for the production of row crops, i.e., soybeans, cotton, and corn. Flooding from Mississippi River backwater in the New Madrid Floodway and headwater flooding in the St. Johns Bayou Basin results in crop losses, damage to roads and utilities, residential and commercial structures.

The Flood Control Act of 1954 authorized the closure of a 1,500-foot gap and construction of a gated outlet in the Mississippi River levee at the lower end of the New Madrid Floodway. The Water Resources Development Act of 1986 authorized channel modifications and pumping stations for the St. Johns Bayou Basin and the New Madrid Floodway.

This document describes the Memphis District plan formulation and evaluation process leading to a recommended plan of flood control for the area. This plan consists of a 1,000 cfs pumping station and 27.6 miles of channel modifications for the St. Johns Basin and a closure levee with a 1,500 cfs pumping station for the New Madrid Floodway.

A Final Supplemental EIS was filed in September 2000. Although it contained a number of avoid and minimize measures to reduce project impacts, as well as substantial land acquisition and development to mitigate remaining losses, there were concerns expressed by resource agencies and some environmental advocacy groups that environmental losses were not acceptable.

This Revised Supplemental EIS (RSEIS) documents the formulation and evaluation of additional alternatives to address those concerns. Alternative levee closure locations for the New Madrid Floodway are investigated. Also, an array of pump and gate operations are evaluated that increase connectivity of the floodway with the Mississippi River to minimize impacts on fisheries. This RSEIS also contains a proposal for significant additional avoid and minimize measures designed to benefit the aquatic and wildlife resources of the New Madrid Floodway.

The project would reduce the duration and frequency of Mississippi River backwater and St. Johns Basin headwater flooding. This reduction in flooding alleviates impacts to the area's infrastructure as well as impacts to the agriculture on which the area depends. However, associated with these benefits are impacts to the area's natural resources, primarily because of the reduction of backwater inundation. To compensate for project impacts, seasonally inundated agricultural land would be restored to bottomland hardwoods on 8,375 acres under the recommended plan. Additionally, flood easements would be purchased on herbaceous land.

This Final RSEIS evaluates the effects of each project component on the study area's significant resources. Economic costs and benefits vary with each component and alternative. Alternative 3-1.B, the National Economic Development (NED) Plan is the Recommended Plan. The estimated cost of the Recommended Plan, Alternative 3-1.B, is $80,332,000. Net annual benefits for the New Madrid levee closure and gravity outlet are estimated to be $113,000 with a benefit to cost ratio of 1.1 at the authorized interest rate (2.5 percent). Net annual benefits for the channel modifications and pumping stations are estimated to be $772,000 with a benefit-to-cost ratio of 1.2 (MRT) at an interest rate of 7.375 percent.

Comments: Please send your comments to:

District Engineer
US Army Engineer District, Memphis
Attn: Environmental Analysis Branch
167 North Main Street, B-202
Memphis, TN 38103-1894

Comments should arrive no later than or within 30 days following publication of the Notice of Availability in the Federal Register. For further information, please contact Mr. Shawn Phillips at (901)544-3321.

Note: Information contained in the Appendices as well as information contained in the September 2000 Final Supplemental Environmental Impact Statement is incorporated by reference in this Revised Supplemental Environmental Impact Statement.

SUMMARY

SUMMARY

S.1 SUMMARY OF IMPACTS

The primary impact of the project would be a reduction of backwater flooding to both basins. Of 18,120 existing wetland acres subject to backwater inundation, 6,064 acres are forested, 9,700 are cropland, 1,391 are herbaceous fields, and 965 acres are pasture, marsh, and open water.

A major concern of reviewers of the September 2000 Supplemental Environmental Impact Statement (SEIS) 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. Jurisdictional status of some agricultural wetlands could be impacted. Many wetlands that now meet the 15 consecutive days inundation criterion would have reduced inundation and may no longer be considered farmed wetland (FW). Although the project could cause a reduction in backwater inundation of these lands they would still retain wetland characteristics due to headwater flooding, and soil and groundwater conditions. 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 backwater 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 backwater inundation would be assessed by measuring mid-spring impacts on fish spawning and rearing habitat within the two-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. 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 frequently flooded cropland to BLH and acquiring spring flooding easements on herbaceous land to compensate for impacts on shorebirds and fish. Benefits to winter waterfowl habitat would be maximized by managing water levels on up to 6,400 acres. In addition to mitigation, the Corps proposes additional measures for major improvement of fishery and aquatic resources in the New Madrid Floodway.

S.2 PROJECT OVERVIEW

The authorized purpose of the project is to provide flood protection in the St. Johns Bayou Basin and New Madrid Floodway. Flood protection will provide for a reduction in flood damages incurred by the region and the nation and will allow for better utilization and greater productivity of existing agricultural lands. Additional benefits would include reductions in the physical and economic impediments that frequent flooding creates in East Prairie, Missouri, and other small communities.

The authority for closing the gap in the Mississippi River levee at the lower end of the floodway is 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.

The St. Johns Bayou and New Madrid Floodway Project was originally authorized for construction by the Water Resources Development Act (WRDA) of 1986 (PL 99-662), Section 401(a). It was based on the Report of the Chief of Engineers, dated January 4, 1983, which is part of 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 and was prepared by the Office of the Chief of Engineers in accordance with its authority to continue planning and engineering studies on viable projects awaiting authorization. Revisions contained in the Phase II GDM included non-Federal cost-sharing requirements reflected in the authorizing Act, PL 99-662.

The project authorized by WRDA 1986 was not constructed because the local sponsor could not meet cost-sharing requirements; however, the East Prairie designation as an Enterprise Community (EC) provided momentum towards implementation of the First Phase of the overall project, and the WRDA of 1996 contained provisions regarding Federal cost-sharing exceptions. As a result, U.S. Department of Agriculture (USDA) was allowed to provide funds to East Prairie in order to offset project costs incurred by the local sponsors. This reduced the non-Federal cost to five percent. In late Fiscal Year (FY) 1996, funds were reprogrammed to the project to initiate Pre-construction, Engineering and Design (PED) activities associated with this phase. In FY 1997, Congress urged completion of pre-construction activities within six months and provided new-start construction funds.

The First Phase of the St. Johns Bayou and New Madrid Floodway Project (Alternative 2, 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. The impacts of that work were evaluated in the Limited Reevaluation Report (LRR) and supporting Environmental Assessment (EA) for the First Phase of the overall project (U.S. Army Corps of Engineers 1997).

A 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 MR&T 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 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 advocacy 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. The FSEIS that was filed in September 2000 still did not address many of the concerns to the satisfaction of the resource agencies.

The Authorized 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-ft 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 channel enlargement work and both 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 local sponsor will share costs associated with impacts attributed to the St. Johns Bayou and New Madrid Floodway Project, and other features will be funded under the Mississippi River Levee Project.

The purpose of this Revised Supplemental Environmental Impact Statement is to formulate and evaluate various Avoid and Minimize alternatives (3-1, 3-2, and 3-3) that incorporate environmental features to reduce project impacts while maintaining project benefits. 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 in order to avoid high-quality woodlands; and eliminating work proposed on the upper 3.7 miles of the St. James Ditch in order to avoid the State-endangered golden topminnow. Additionally, 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 for bottomland BLH to develop. Gate operations were modified to allow fish passage between the river and the two basins, and mussels would be relocated prior to construction. A 9-foot strip of mussel habitat along one side of the Setback Levee Ditch will be avoided, and a 10-year mussel-monitoring plan would also be developed. Water levels in the lower basin and floodway can be managed to provide flooded land for winter and early spring waterfowl. Alternative levee closure locations for the New Madrid Floodway were also investigated. Finally, an array of pump and gate operations were evaluated for each of the levee closures in order to increase connectivity with the river and minimize fishery impacts

The major impact of the project is reduction of spring season 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. These acreages are based on the 300-foot National Geodetic Vertical Datum (NGVD) elevation, which is a greater than 30-year flood event. Of these, there are 6,461 acres of wetlands in the St. Johns Bayou Basin and 11,659 acres of wetlands in the New Madrid Floodway, for a total of 18,120 acres of wetlands. Approximately half of the wetlands are croplands. Total acres affected by other flood events are shown in Table S-1.

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	10,056	17,316	27,372
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

To compensate for project impacts, seasonally inundated agricultural land would be restored to bottomland hardwoods. Additionally, flood easements would be purchased on herbaceous land. Specific mitigation sites will be selected in cooperation with USFWS and MDC after the Record of Decision has been signed.

USFWS has assisted the Memphis District as a cooperating agency in preparing the Supplemental Environmental Impact Statement (SEIS) and the RSEIS by providing technical assistance on scoping comments and scopes of work for contract studies, conducting wildlife resource studies and analyses, and reviewing and commenting on studies, preliminary drafts, and final reports. USFWS analyses regarding project effects to fish and wildlife resources were incorporated into the SEIS and this document, as is their Coordination Act Report (CAR).

Since the filing of the September 2000 EIS, a major additional avoid and minimize plan has been developed for the New Madrid Floodway. It includes establishing riparian buffers on 64 miles of streams and channels. This plan would be implemented along with whatever flood control alternative is selected.

S.3 MAJOR CONCLUSIONS AND FINDINGS

S.3.1 Needs

The lower New Madrid Floodway has traditionally flooded from Mississippi River backwaters, and the St. Johns Bayou Basin undergoes headwater flooding whenever the St. Johns Bayou control gates are closed during high river stages. While other areas in the Mississippi River Valley benefit from flood control levees, the project area continues to experience difficulties due to a 1,500-ft gap in its levee system. 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, and planting has on occasion been delayed until July. Net farm income is substantially lower than optimum due to crop yield decreases and production cost increases resulting from the flooding. Additionally, floodwaters regularly damage public electric, water, and sewer utilities, and often disrupt businesses, schools, and residences. Flooded roads prevent the normal traffic flow of goods and services within the project area, resulting in economic losses, disruption, and adverse impacts to quality of life. As a result, there is widespread local public support for a project that would provide flood control and benefit environmental resources within the project area.

East Prairie, Missouri, is an area of concern 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 EC in December 1994, one of only a handful of such communities across the nation, because it met eligibility criteria regarding size, poverty, unemployment, and general distress. The town specifically chose the St. Johns Bayou and New Madrid Floodway Project as the most beneficial plan to improve quality of life and living conditions for its residents. Pinhook and several other small communities would also benefit socially and economically from the protection that would be provided by a flood control project.

The area's natural resources have been impacted by other flood control work associated with the Mississippi River and Tributaries project. Because of flood control projects at other locations along the Mississippi River, floods in the New Madrid area often occur at higher stages than in the past.

Although the primary purpose of closures and gates would be to protect infrastructure and agricultural lands, the project does afford the capability to protect significant areas from extreme flood events or hold/pulse additional water within channels or in low lying areas for prolonged periods when advantageous to the resource.

S.3.2 Alternative Plans

Nine alternatives were considered during the development of the Supplemental Environmental Impact Statement dated September 2000. These alternatives included Without-Project, the Authorized Project, Avoid and Minimize, Ring Levee Around East Prairie, St. Johns Bayou Basin Only, Wildlife Refuge, New Floodway Levee Closure Locations, Silviculture, and Non-Structural. Of these alternatives, the Ring Levee, St. Johns Bayou Basin Only, Wildlife Refuge, additional New Madrid Closure Levee Locations, Silviculture, and the Non-Structural alternatives were eliminated from consideration. The rationale for the eliminated alternatives ranged from not meeting the project purpose to infeasible economic output. A more thorough discussion is provided in Section 2.4.

The Authorized, Avoid and Minimize, and Without-Project alternatives were carried forward to detailed analysis. The Without-Project alternative is required for comparison purposes. In response to a 26 March 2001 directive from the Assistant Secretary of the Army for Civil Works and in response to USFWS and U.S. Environmental Protection Agency (EPA) concerns, this RSEIS has been expanded to include evaluation of alternative floodway closures at locations that differ from those considered in the September 2000 SEIS. Four additional levee closure alignment alternatives were considered for the New Madrid Floodway with two of these alternatives being carried through for further analysis. These alternatives were based on Alternative 3-1, the Avoid and Minimize Plan. They are alternatives 3-2 and 3-3. Each of these alternatives is fully described in Section 2.3.2. For the three closure locations carried into detail analysis, varying gate operational scenarios were also analyzed.

S.3.3 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 made by USFWS, an array of nonstructural and smaller structural alternatives was investigated to address the project purpose of flood control. Most alternatives determined to be infeasible from a benefit-to-cost standpoint were not recommended for detailed analyses because of the net negative effect they would have on the nation's economy. The exceptions to this are alternatives 3-3.A, 3-3.B, and 3-3.C, which were not economically justified but were carried through detailed analysis at the request of the resource agencies.

Alternative 5, which would provide improvements to St. Johns Bayou only, was determined to be feasible from a cost-benefit standpoint. It does not address flood protection for agricultural areas in the New Madrid Floodway and thus does not adequately address the goals of the East Prairie EC. As a result, it forgoes significant economic development opportunities in the nation’s production of goods and services and is not the NED plan. Also, this alternative does not meet the purpose to reduce the duration and frequency of backwater flooding in the New Madrid Floodway. This purpose is fulfilled by closing the gap in the Mississippi River levee at the lower end of the floodway as authorized by the Flood Control Act of 1954.

Alternative 3-1.B is the NED plan. The 1,500-foot gap in the New Madrid floodway levee would be closed and improved with a 1,500 cfs pumping station and gravity outlet structure. The proposed levee would be located between setback levee mile 35 and 36 and would have a crown elevation of approximately 317 feet NGVD. Average base width would be approximately 302 feet. The footprint would cover approximately 9 wetland acres, and approximately 233,000 cy of fill would be required.

Under this alternative, gravity gate operations would include remaining open during the mid-season fish spawning and rearing season (March 1–May 15) until the Mississippi River reaches 284.4 NGVD, at which time the gates would be closed. Pumping would commence when water in the sump reached that elevation and would continue until water elevation in the sump dropped to 283.4 NGVD.

For St. Johns Bayou Basin, 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 and would discharge ponded water from the interior over the levee during high Mississippi River stages. To maximize spring fish passage into the basin, gravity gate operations would be altered to remain open until the Mississippi River reaches 282.5 NGVD. Pumping would commence when water in the sump reached that elevation and would continue until water elevation in the sump dropped to 280.0 feet NGVD.

S.3.4 Recommended Plan

The recommended plan is the NED plan, Alternative 3-1.B. It is recommended following careful review and analysis and after full consideration and input from government agencies and the public on the draft RSEIS. The Recommended plan has a total first costs, including mitigation, of $80,332 thousand with net annual benefits of $113 thousand for the closure levee (MRL feature at 2.5 percent interest rate) and $772 thousand for the Phase I features (pumping stations and St. Johns channel items at $7.375 interest rate). Both parts of the recommended plan project have a benefit to cost ration of greater than unity. The backwater inundation on project area wetlands is 950 acres greater than Alternative 3-1.A, which was recommended in the September 2000 SEIS. Over half of the area with reduced backwater inundation is cropland. The required mitigation for the recommended plan is 8,375 acres, or about 1,200 acres less than Alternative 3-1.A. The mitigation calculated on the basis of mid-season fish rearing impacts will fully compensate for nearly all project impacts. Additional shorebird easements and winter waterfowl pond is also incorporated in the recommended plan

Most resource agencies and environmental groups are either strongly opposed to any project that includes a levee closure in the New Madrid Floodway and/or strongly believe that a levee closure should be moved as far up into the floodway as possible. This belief is based on a desire to maintain maximum connectivity between the backwater area of the floodway and the Mississippi River that benefits wetlands and aquatic resources. However, moving the closure further up into the floodway has an adverse impact on both engineering and economic feasibility. As the closure is situated further away from the narrow 1,500-foot gap that is the location of the recommended plan, the distance that the levee must span is increased; thus, the cost of construction is increased. Plus, as the closure is moved further up the floodway, more agricultural lands are left unprotected from backwater flooding and that reduces the benefits. Additionally, there is little environmental impact avoidance until well up into the floodway to the north of an old oxbow area called Eagles Nest, which only the farthest alternative northward shows some environmental benefit from. Generally speaking, moving the closure away from the lower end results in increasing costs and decreasing economic benefits proportional to the distance of the closure move without any substantial reduction in environmental impacts.

An objective of the revised SEIS was to ameliorate impacts associated with loss of connectivity. Changing gate operation to allow for more connectivity provides relatively greater benefits to the aquatic environment than a closure move. Local residents do not favor the modified gate operation of the recommended plan because agricultural lands at lower elevations are not protected from springtime flooding. However, Corps analysis clearly shows that lost agricultural benefits are more than offset by a gain in environmental benefits, and this modification can be implemented without an increase in construction costs. Additional to the avoid and minimize features that have been formulated for the St Johns Bayou Basin, substantial and significant avoid and minimize measures are recommended for the floodway, the establishment of riparian buffers along as many as 64 miles of streams and channels being the most significant. Also, the recommended plan includes a commitment to implementation of water management features for MDNR's Big Oak Tree State Park. The recommended plan is described in greater detail in Section 2.6.

S.3.5 Section 404(b)(1) Findings

Project features of the proposed alternatives 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. The potential for environmental impacts of disposal activities from channel enlargement was estimated on the basis of currently available engineering design data and available physical, chemical, and biological data. Efforts were made to identify the least environmentally damaging practical alternative for disposal sites.

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 final 404(b)(1) evaluation for the recommended plan is submitted with the Final RSEIS. Comments received on this RSEIS, including the 404(b)(1) evaluation, will be forwarded to the Missouri Department of Natural Resources for their consideration relative to state water quality certification.

S.3.6 Executive Order 11988, Floodplain Management Findings

Portions of the project would be constructed in floodplains. All alternatives were designed to minimize, to the extent practical, adverse impacts to floodplains. All non-structural alternatives were eliminated during screening due to economic infeasibility. Section 5.0 *Environmental Consequences* of this report describes the beneficial and adverse impacts for each of the alternatives studied in detail and describes any expected loss of natural floodplain benefit. Views of the general public and resource agencies have been obtained at numerous meetings. The proposed alternatives are responsive to the planning objectives and are consistent with the requirements of Executive Order 11988, and 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 frequently flooded agricultural land as mitigation for floodplain habitat losses and purchasing of shorebird easements.

S.3.7 Executive Order 11990, Protection of Wetlands Findings

The proposed alternatives are consistent with the requirements of Executive Order 11990. They minimize direct construction impacts along channel enlargement reaches by avoiding high-quality areas and by reducing channel width. Additionally, mitigation proposed pursuant to the project recommends reforesting up to 8,375 acres of frequently flooded agricultural land.

Wetlands will continue to exhibit wetland characteristics because existing topography, precipitation, soil characteristics, and water table will not change as a result of the project but will continue to produce a median continuous saturation for at least five percent of the growing season. The Mississippi River will continue to influence the water table, and saturation will continue to occur during the spring and early summer when the river is at high stage and rainfall is plentiful. This determination is based on evaluations, including field verifications, performed by Corps engineers and biologists. It is supported by the fact that there are jurisdictional wetlands above the limits of backwater inundation in both basins.

S.3.8 Wetland Impact Analysis Summary

All wetland calculations are based on the impacts of backwater flooding. Some acreage subject to reductions in backwater flooding will still retain wetland characteristics due to headwater flooding and clay soil types present in both basins, which tend to retard vertical infiltration of water.

The St. Johns Bayou Basin contains approximately 6,461 acres of wetlands below 300 feet NGVD that are affected by backwater, of which 3,514 acres are farmed. The remaining 2,947 acres of these wetlands are predominantly forested, herbaceous, or open water in nature. Open water is defined as within channel banks and permanent ponds or lakes. This consists of about 126 acres below 300 feet NGVD in the St. Johns Basin. Under the Recommended Plan, approximately 1,296 acres of the agricultural land would receive reduced inundation from backwater. Of the non-agricultural 2,947 acres, about 720 acres would receive reduced inundation from backwater as a result of the Recommended Plan.

The New Madrid Floodway contains approximately 11,659 acres of wetlands below 300 feet NGVD that are affected by backwater, of which 6,186 acres are farmed. The remaining 5,473 acres of these wetlands are predominantly forested, herbaceous, or open water. Open water is defined as within channel banks and permanent ponds or lakes. This consists of about 595 acres below 300 feet NGVD in the New Madrid Floodway. Under the Recommended Plan, approximately 5,417 acres of the agricultural lands would receive reduced inundation from backwater. Of the non-agricultural 5,473 acres, about 4,822 acres would receive reduced inundation from backwater under Alternative 3-1.B.

In both basins, there is a total of 9,700 acres of wet cropland. These are primarily in soybean fields that benefit from summer irrigation. The irrigation occurs at times when there is little or no water from backwater, headwater, seepage, or direct rainfall. Therefore, this will not change regardless of project implementation.

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 wetlands meeting the hydrologic criteria are lands inundated for 15 consecutive days or 10 percent of the growing season (whichever is less).

The jurisdictional status of non-cropland (forested, herbaceous, etc.) wetlands will not change in either basin. Based on hydrologic analysis including ground truthing, it is the Corps belief that no existing forested wetlands will 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 non-agricultural wetlands will remain unchanged with or without the project. The USFWS believes that the project will induce the clearing of wooded wetlands. The USFWS's analysis is provided in Appendix E. Up to 5,417 acres of agricultural lands in the New Madrid Floodway and 1,296 acres in the St. John's Bayou Basin may no longer meet FSA criteria for farmed wetlands depending on the selected alternative. Although these lands would be saturated during much of the growing season and still provide some wetland functional value, because their inundation would in some cases be less than 15 consecutive days, their potential to be classified as farmed wetland would be impaired.

Mitigation of fishery rearing habitat impacts would compensate for impacts to other wetland functions. The proposed reforestation of frequently flooded croplands would compensate fishery habitat losses and other wildlife functions. In conjunction with the proposed mitigation, flood easements for shorebird mitigation would be purchased on herbaceous lands. With these lands, all proposed direct and indirect impacts related to fish and wildlife would be fully mitigated.

S.3.9 Cultural Resources Findings

A cultural resources survey was conducted in the project right-of-way (ROW) and was presented in the Technical Appendices, Revised December 1981, of the GDM. An additional survey documented a number of prehistoric and historic sites in the project area, including 21 previously unrecorded prehistoric and/or historic archaeological sites and seven cultural resources sites along St. Johns Bayou.

Twelve of the sites were determined not to be significant with respect to National Register of Historic Places (NRHP) criteria. Nine of the sites were determined to be significant and subjected to additional testing; two were eligible for inclusion on the NRHP. The proposed alternatives have been designed to avoid all significant and cultural resources sites. Any inadvertent discoveries during project implementation would be fully addressed in accordance with provisions of NHPA and other applicable laws

S.3.10 ER 1165-2-132; Hazardous, Toxic, and Radioactive Waste Findings

A Phase I Environmental Site Assessment (ESA) was prepared for the project area in October 1996 in accordance with U.S. Army Corps of Engineers Regulation ER 1165-2-132, *Water Resources Policies and Authorities for Hazardous, Toxic, and Radioactive Waste (HTRW) for Civil Works Projects, June 26, 1992*. No sites of potential HTRW concern appear to be located within four miles of the project area.

S.4 AREAS OF CONTROVERSY

S.4.1 Bottomland Hardwoods.

USFWS, MDC, and the Environmental Defense Fund (EDF) have questioned whether the reduction in inundation to BLH wetlands would induce clearing on privately owned tracts. The Corps has concluded that existing wetlands will remain jurisdictional wetlands due to the influence of the normally high ground water table in the aquifer underlying both basins. Because most BLH in the project area lie in depressions that retain surface water due to low topography and underlying clay soils, BLH will continue to experience inundation from high river stages and interior rainfall after project implementation. Accordingly, such areas would remain subject to Section 404 of the Clean Water Act. Privately-owned timber may be harvested at any time, however the project will not impact those private decisions.

S.4.2 Wet Cropland

USFWS, MDC, and EDF expressed concern that reducing backwater flooding on project area lands would change the hydrology and quality of wetlands and the agricultural practices for thousands of acres in the project area. The wet croplands at issue are almost entirely 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 water quality analyses indicate 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 agricultural practices.

With any of the alternatives, there would be a reduction in the amount of farmlands that meet FSA hydrological criteria for wetlands. The amount of farmed wetland that could be reduced ranges from 6,122 acres for Alternative 3-1.A to 5,114 acres for Alternative 3-3.B for the New Madrid Floodway. Furthermore, the Corps reviewed groundwater levels and patterns relative to identified wetland areas. The Corps expects that internal rainfall events and the high water table resulting from Mississippi River stages would continue to produce saturated soil conditions. The lands will retain much of their wetland functions and hydrology. The review was coordinated with NRCS, which concurred with the findings.

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. Water quality should not change significantly as a result of the proposed alternatives. Material processing (detrital import/export) will not change significantly, either. 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, or floodwater storage. Hydrologic analyses revealed very minimal changes in high Mississippi River stages and durations with the Recommended Plan. Therefore, there would be little change over existing conditions with respect to water quality.

Additional avoid and minimize measures that have been developed for the floodway since the September 2000 FSEIS, i.e., buffering 64 miles of channel, will significantly improve water quality associated with agricultural runoff.

S.4.3 Fisheries

USFWS, MDC, and EDF stated that impacts of closing the levee gap and the reduction in the duration and frequency of Mississippi River backwater flooding through the levee gap would result in a major loss of spawning and rearing habitat in local streams and to the Mississippi River fisheries. Summer, fall, and spring adult fish surveys were conducted and indicate 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. Reforesting frequently flooded agricultural lands would mitigate losses. However, based on agency concerns and uncertainties regarding acquisition of the most desirable mitigation lands, the Corps has proposed significant additional avoid and minimize measures for the floodway. These measures include improvements on 64 miles of floodway streams and channels. Also, this revised document investigates various scenarios for gate operation to minimize impact to the fishery. These alternatives are 3-1.B, 3-1.C, 3-2.B, 3-2.C, 3-3.B and 3-3.C

S.4.4 Mussels

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 USFWS and MDC to design measures that have less impact and has proposed mitigation to offset adverse mussel impacts. The resource agencies and the Corps agreed that prior to construction portions of mussel populations that are of State and Federal importance would be moved to adjacent areas. A 9-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 USFWS regarding mussels in the project area that will partially mitigate project impacts.

S.4.5 New Madrid Floodway Operation

An operations team evaluated the proposed closure alignments and determined that all alignments were operationally feasible. However, all levee alignments raise issues with the exception of alternatives 2, 3-1.A, 3-1.B, and 3-1.C. Issues such as access to the lower fuse plug, floodway operational timing, bluehole/sanding easements, and limited manpower cause each subsequent levee closure alignment north and east of the authorized location to be more problematic from a floodway operation perspective. See Appendix K for more information.

S.4.6 East Prairie Project Only

USFWS and EDF recommended that some form of flood protection be provided around the town of East Prairie, Missouri, in lieu of any major basin-wide improvements. USFWS maintains that this alternative is more consistent with executive orders 11988 and 11990 than are the proposed alternatives. Engineering design and hydraulic analyses of a ring levee around the town were

conducted and indicate that in addition to a ring levee, channel work to resolve interior drainage problems would be required in the town and that, in turn, the costs to East Prairie outweigh the benefits. Moreover, limiting construction and benefits to East Prairie would not provide flood protection to the overall area nor remove a significant impediment to the agricultural economy of the community.

S.4.7 Limiting Improvements to St. Johns Bayou Basin

USFWS and MDC recommended that the project be limited to St. Johns Bayou Basin, which would avoid most fish and wildlife impacts of the project, especially those to the New Madrid Floodway. Throughout the SEIS, impacts to both basins were evaluated separately. Limiting improvements to St. Johns Bayou Basin would preclude the most economically sound portion of the overall project and it would not completely address the economic development goals of the East Prairie Enterprise Community and the overall area.

S.4.8 Non-Structural Alternatives

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. An array of non-structural and smaller structural alternatives was investigated to address the stated project purpose of flood control. 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. Additionally, none of the non-structural or smaller structural alternatives address the goals and intentions of the East Prairie Enterprise Community.

S.4.9 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. Lands proposed under the mitigation plan would connect the Park to Wilkerson Ditch, St. Johns Diversion Ditch, and/or James Bayou, thus providing a surface water source for the second pump. 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.5 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
cy	cubic yard
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
ESA	Environmental Site Assessment
ESEI	Environmental Science and Engineering, Inc.
FSA	Food Security Act
FSEIS	Final Supplemental Environmental Impact Statement
FW	Farmed Wetlands
FY	Fiscal Year
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
NEPA	National Environmental Policy Act
NGVD	National Geodetic Vertical Datum
NRC	National Response Center
NRCS	National Resource Conservation Service
NRHP	National Register of Historic Places
PC	Prior Converted
PCA	Project Cooperation Agreement
PDF	Project Design Flood
PED	Pre-construction, Engineering, and Design
ROW	Rights-of-Way
SEIS	Supplemental Environmental Statement
SHPO	State Historic Preservation Officer
TM	Thematic Mapper
TMDL	Total Maximum Daily Load
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

S.6 RELATIONSHIP OF PLANS TO ENVIRONMENTAL REQUIREMENTS

Table S-2 presents the compliance status of the detailed alternatives with Federal environmental protection statutes and appropriate executive orders and memoranda.

Table S-2. Relationship of Plans to Environmental Protection Statutes or Other Environmental Requirements
St. Johns Bayou and New Madrid Floodway Project, First Phase
Revised Supplemental Environmental Impact Statement

Item	Compliance
Federal Statutes	
Archaeological and Historic Preservation Act	Full Compliance
Clean Air Act, as amended	Full Compliance
Clean Water Act, as amended	Full Compliance*
Coastal Zone Management Act, as amended	Not Applicable
Endangered Species Act of 1973, as amended	Full Compliance
Farmland Protection Policy Act	Full Compliance
Federal Water Project Recreation Act	Full Compliance
Fish and Wildlife Coordination Act	Full Compliance
Food Security Act of 1985	Full Compliance
Land and Water Conservation Fund Act	Full Compliance
National Historic Preservation Act	Full Compliance
National Environmental Policy Act	Full Compliance
Native American Graves Protection and Repatriation Act	Full Compliance
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

*Pending receipt of State Water Quality Certification.

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REVISED SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

1.0 PURPOSE AND NEED

1.1 PUBLIC CONCERNS

The lower New Madrid Floodway (Appendix A, Figure 1) has traditionally flooded from Mississippi River backwater, and the St. Johns Bayou Basin undergoes coincidental flooding whenever the St. Johns Bayou control gates are closed during high river stages. While other areas in the Mississippi River Valley benefit from flood control levees, the project area continues to experience difficulties due to a 1,500-foot (ft) gap in its levee system. 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, and planting has on occasion been delayed until July. Net farm income is substantially lower than optimum due to crop yield decreases and production cost increases resulting from the flooding. Additionally, floodwaters regularly damage public electric, water, and sewer utilities, and often disrupt businesses, schools, and residences. Flooded roads prevent the normal traffic flow of goods and services within the project area, resulting in economic losses, disruption, and adverse impacts to quality of life. As a result, there is widespread local public support for a project that would provide flood control and benefit environmental resources within the project area.

East Prairie, Missouri, is an area of concern 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) in December 1994, one of only a handful of such communities across the nation, 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 quality of life and living conditions for its residents. Pinhook and several other small communities would also benefit socially and economically from the protection that would be provided by a flood control project.

The need for such a project has been identified by local interests and confirmed by Congress. It would provide flood control and flood protection to the St. Johns Bayou Basin and the New Madrid Floodway. The proposed alternatives evaluated pursuant to this project are depicted in Appendix A, Figure 2 and are discussed in sections 2.1 through 2.4.6.

1.2 PROJECT AUTHORITY

The authority for closing the gap in the Mississippi River levee is 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. It will provide flood protection to part of the project area, but construction of this component of the mainline levee system was delayed because the local sponsor has not provided the necessary right-of-way (ROW).

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). It was based on the Report of the Chief of Engineers, dated January 4, 1983, which is part of 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 and was prepared by the Office of the Chief of Engineers in accordance with its authority to continue planning and engineering studies on viable projects awaiting authorization. Revisions contained in

the Phase II GDM included non-Federal cost-sharing requirements reflected in the authorizing Act, PL 99-662.

The project authorized by the Water Resources Development Act (WRDA) of 1986 was not constructed because the local sponsor could not meet cost-sharing requirements; however, East Prairie's designation as an EC provided momentum towards implementation of the First Phase of the overall project, and the WRDA of 1996 contained provisions regarding Federal cost-sharing exceptions. As a result, USDA was allowed to provide funds to East Prairie in order to offset project costs incurred by the local sponsors. This reduced the non-Federal cost to five percent. In late Fiscal Year (FY) 1996, funds were reprogrammed to the project to initiate Pre-construction, Engineering and Design (PED) activities associated with this phase. In FY 1997, Congress urged completion of pre-construction activities within six months and provided new-start construction funds.

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 of the nation's output of goods and services, and water and related land resource management plans must develop long-range goals and priorities for the study area consistent with the NED objective.

1.4 PROJECT NEED

Flooding on the Mississippi River usually occurs in the winter and spring, 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, when over 56,500 acres of agricultural land in the New Madrid Floodway were inundated. Other significant backwater flooding occurred in 1961, 1962, 1964, 1972, 1974, 1975, 1979, 1983, 1984, 1993, 1994, 1995, 1996, 1997 (Appendix A, Figure 3), 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 17,316 acres, of which 11,843 acres are agricultural land. At high Mississippi River stages, the St. Johns Bayou Basin control gates are closed, preventing interior drainage. The two-year headwater flood event under these circumstances inundates approximately 10,056 acres, of which 6,312 acres are agricultural land.

1.5 PROJECT PURPOSE

The purpose of the project is to provide flood protection in the St. Johns Bayou Basin and New Madrid Floodway. Flood protection will provide for a reduction in flood damages incurred by the region and the nation. Additional benefits would include reductions in the physical and economic impediments that frequent flooding creates in East Prairie, Pinhook, and several other communities. Project planning objectives realized through flood protection will include:

1. Reducing the duration and frequency of backwater flooding events in the New Madrid Floodway and reducing the ponded water in St. Johns Bayou Basin that results when existing gravity outlet structure gates are closed during high Mississippi River stages.

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

3. Minimizing adverse impacts to wildlife and fisheries in the project area and Mississippi River and mitigating, to the maximum practicable extent possible, significant wildlife and fishery impacts.

The purpose of this study is to formulate the most environmentally and economically justified flood protection plan. Agriculture is the primary economic resource within the project area, and approximately 86 percent of land use in the two basins is devoted to agricultural production. Urban and built-up areas account for less than one percent. Impounded runoff in the lower reaches of St. Johns Bayou and headwater flooding along the upper reaches due to inadequate channel capacity result in the damaging floods that occur in St. Johns Bayou Basin. Flood damage to agricultural lands and to urban property in East Prairie, Pinhook, and other communities is also a major problem.

1.6 OTHER POTENTIAL BENEFITS

The area's natural resources have been impacted by other flood control work associated with the Mississippi River and Tributaries project. In fact, the New Madrid is a highly worked agricultural area that does not resemble the historic, forested Mississippi River floodplain in southeast Missouri. Floods often occur at higher stages than in the past. Closure and gates afford the opportunity to better manage water levels. Although the primary purpose of closures and gates would be to protect infrastructure and agricultural lands, the project does afford the capability to protect significant areas from extreme flood events or hold/pulse additional water within channels or in low lying areas for prolonged periods when advantageous to the resource.

2.0 PLAN FORMULATION

This section describes project alternatives retained for further analysis, project alternatives evaluated during the screening process, comparative impacts of the alternatives, and the NED-preferred alternative. Impacts of the project on floodway operation are discussed in Section 5.16.

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. Floodgates in the six 10-foot by 10-foot concrete box culverts remain open to pass flows from the basin through the levee to the Mississippi River when river stages allow; the conveyance has a maximum capacity of 10,000 cubic feet per second (cfs). The gates are manually closed during those periods when river stage exceeds water surface elevations in the basin. Headwater flooding in the basin is, and will continue to be, influenced by local rainfall events, and storm water runoff will continue to pond in the lower portions of the basin, inundating agricultural acreage whenever the control structure gates are closed.

Without a 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, and without channel modifications in the St. Johns Bayou Basin to improve drainage, the community of East Prairie, Missouri, and other structures in the basin would continue to experience flooding during significant rainfall events. Wetlands and permanent bodies of water in the St. Johns Bayou Basin would continue to provide substantial wildlife habitat.

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, continuing 8.1 miles along the Birds Point New Madrid Setback Levee Ditch, and ending with 10.8 miles along St. James Ditch. Selective clearing and snagging has already been completed along a 4.3-mile reach of the Setback Levee Ditch beginning at its confluence with St. James Ditch. The impacts of that work were evaluated in a Limited Reevaluation Report (LRR) and supporting Environmental Assessment (EA) for the First Phase of the project (U.S. Army Corps of Engineers 1997). The authorized project includes locating a 1,000-cfs pumping station a few hundred feet east of the existing gravity outlet at the lower end of St. Johns Bayou. The Stage Area Curve indicating farmed, wooded, and other land use acreage for the St. Johns Bayou Basin is shown in Appendix A, Figure 8.

Channel improvements designed for this alternative are based on water depths associated with flooding in a two-year frequency event. This First Phase of the project provides the same level of flood protection as the overall project, but over a smaller project area. A 25-year level of urban protection would be provided for portions of East Prairie, Missouri. No channel modifications would occur in the New Madrid Floodway.

St. Johns Bayou would be cleared and enlarged on both sides; bottom width would be increased from approximately 80 feet to 200 feet. Approximately 2,485,000 cubic yards (cy) of excavated material would be deposited along both banks, in the form of 220-feet wide embankments. The area would be allowed to vegetate naturally as part of a conservation easement.

The width of the lower 8.1 miles of the Birds Point New Madrid Setback Levee Ditch would be enlarged from approximately 40 feet to 50 feet. This work would take place from the left-descending (south) bank to the confluence with St. James Ditch, and approximately 675,000 cy of excavated

material would be placed in a 120-foot-wide embankment located along the left descending bank. The 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, and would require the removal of approximately 630,000 cy. Bottom width along the lower 3.5 miles would be enlarged from 35 feet to 45 feet. Bottom width along the remaining 7.8 miles would remain approximately 25 feet; however, the left descending bank would be widened to an average top width of 80 feet. The new embankment would be approximately 100 feet wide, and 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 and would discharge ponded interior water over the levee during high Mississippi River stages. Pumping would normally commence when water in the sump reached 279.0 feet National Geodetic Vertical Datum (NGVD) and would continue until water elevation in the sump dropped to 277.0 feet NGVD. Should river stages drop during pumping to levels below the impounded water, pumping operations would cease and the floodgates would be opened in order to allow the impounded water to flow via gravity drainage through culverts at the outlet structure. During December and January, the pumping stations would be operated to benefit waterfowl. 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 pumps are started. Once started, the pumps would pull 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 the remainder of the period. Thus, about 6,400 acres of mixed farmland and wooded acres could potentially be flooded during the waterfowl season.

The 1,500-foot levee gap in the New Madrid Floodway levee would be closed and improved with a 1,500 cfs pumping station and gravity outlet structure. The proposed levee would be located between setback levee mile 35 and 36 and would have a crown elevation of approximately 317.0-feet NGVD. Top width would be 16 feet except in the vicinity of the pump station, where it would be widened. Average base width would be approximately 302 feet. The levee would be constructed using side slopes of 4.5:1. The footprint would be approximately nine acres, and approximately 233,000 cy of fill would be required. The Stage Area Curve indicating farmed, wooded, and other land use acreage for the New Madrid Floodway under this alternative is shown in Appendix A, Figure 9.

Pumping would normally commence when water in the sump reached 278.0 feet NGVD and would continue until water elevation in the sump dropped to 275.0 feet NGVD. Should river stages drop during pumping to levels below the impounded water, pumping operations would cease and the floodgates would be opened in order to allow the impounded water to flow via gravity drainage. Unlike the improvements to St. Johns Bayou, which involve channel excavation, headwater flooding in the New Madrid Floodway will not change.

Closing the levee gap at the lower end of the New Madrid Floodway would reduce the conveyance for floodwater passage when the floodway is operated. Because of the reduced conveyance during floodway operation, water would back up in the floodway and increase the water level along a portion of the Birds Point New Madrid Setback Levee. To prevent flooding of the St. Johns Bayou Basin during operation of the floodway, the setback levee height would need to be increased. The amount of this raise has been accounted for in the first cost of this alternative.

2.3 ALTERNATIVE 3: AVOID AND MINIMIZE

The nine variations addressed under this alternative were identified by suggested operational changes to the Authorized Project to minimize adverse environmental impacts. Pumping operations and control of water surface elevations for the St. Johns Bayou Basin and the New Madrid Floodway differ from those proposed by Alternative 2.

Improvements proposed for St. Johns Bayou Basin remain constant across all of the variations, although Alternative 3 comprises nine variations, each with distinct operational variations to operations in the New Madrid Floodway.

2.3.1 St. Johns Bayou Basin

St. Johns Bayou would be excavated only from the right bank (not both), and the proposed bottom width would be decreased from 200 feet to 120 feet. Material excavated from St. Johns Bayou slated for use in constructing the levee closure and levee raises would be temporarily stored in the ROW until it is needed. The majority of the storage area is cropland that abuts the top bank of the ditch, and approximately 376,065 cubic yards of excess material would remain as an embankment in the ROW, which would be allowed to vegetate naturally and would then remain as part of a conservation easement. Channel enlargement would be conducted in phases, beginning with the lower 4.5 miles of St. Johns Bayou, with brief intervals between phases so that impacts to fish and wildlife would be lessened. The Stage Area Curve indicating farmed, wooded, and other land use acreage for the St. Johns Bayou Basin is shown in Appendix A, Figure 8.

Improvements to the 2.6-mile reach of St. James Ditch between Missouri Route 80 (Rt. 80) and Rt. 00 would be made to the right descending (west) bank instead of the left-descending bank in order to preserve woodlands that have developed along the left-descending bank. Bank stability structures would be provided in order 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, and riprap comprising these structures would serve as fishery habitat. Lateral transitions to the existing channel dimensions would be constructed at the upper limit of channel construction 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 to provide structure for benthic invertebrates and fishes.

As with Alternative 2, 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 and would discharge ponded water from the interior over the levee during high Mississippi River stages. To maximize spring fish passage into the basin, gravity gate operations would be altered to remain open until the Mississippi River reaches 282.5 NGVD. Pumping would commence when water in the sump reached that elevation and would continue until water elevation in the sump dropped to 280.0 feet NGVD, providing an additional 3.5 feet of spring inundation in the basin when compared with Alternative 2. Should river stages drop during pumping to levels below the impounded water, pumping operations would cease, and the floodgates would be opened in order to allow the impounded water to flow via gravity drainage at 10,000 cfs through culverts at the outlet structure. It would be possible to manage the gates to fluctuate water depth and inundation from November through May.

2.3.2 New Madrid Floodway

Three levee closure locations are addressed in this alternative. The Alternative 3-1 alignment is the same as that proposed in Alternative 2. Alignments for alternatives 3-2 and 3-3 were evaluated in accordance with Assistant Secretary of the Army (ASA) guidance that four setbacks to the Alternative 3-1 alignment be evaluated. See Appendix A, Figure 2 for the locations of alternatives 3-1, 3-2, and 3-3. Each of these closure levee alternative locations would require a source of borrow material. Borrow will also be required to provide a slight grade raise along the set back levee to the same elevation as the closure levee at the point where the closure levee ties into the set back levee. The largest area calculated would be for the longest closure levee, Alternative 3-3. Approximately 370 acres of borrow area at eight feet of depth would be required for Alternative 3-3. Alternative 3-1 requires the least amount of borrow acreage at about 200 acres. These quantities are included in the project first cost provided in Appendix B. The exact location of these borrow pits, and whether the borrow areas would fall below or above the closure levee location will be determined after a plan is selected and real estate acquisition begins. Also, the dredge materials from the St. John's Bayou channel work may reduce the amount of borrow required, if it is suitable construction material. The environmental impact may be a net gain in habitat for the fishery because of the desire to establish permanent water habitat.

The Alternative 3 locations also entail three different operational variations for each alignment. For all three operational variations, as with Alternative 2, a 1,500 cfs pumping station would discharge ponded water from the interior of the Floodway during high Mississippi River stages. Table 2-1 provides a summary of the various levee alignments and operational variations comprising this alternative.

Two additional setback proposals were determined to be unfeasible and are discussed in Section 2.4 *Alternatives Considered but Eliminated from Detailed Study*.

2.3.2.1 Alternative 3-1

As noted in Section 2.3.2 *New Madrid Floodway*, the only difference between alternatives 3-1, 3-2, and 3-3, is the location of the floodway levee closure. The closure for Alternative 3-1 is located at the authorized location, same as Alternative 2. The normal start and stop pump elevations for Alternative 3-1 are higher than the normal start and stop pump elevations for Alternative 2 in both the St. Johns Bayou and New Madrid Floodway basins. Start and stop pump elevations for all the Alternative 3 operations are the same as Alternative 2 during the Waterfowl Season as shown on tables 2-1 and 2-2. The Stage Area Curve indicating farmed, wooded, and other land use acreage for the New Madrid Floodway under this alternative is shown in Appendix A, Figure 9.

2.3.2.2 Alternative 3-2

The 6,500-foot Alternative 3-2 levee would be located just north of levee mile 34 and would have a crown elevation of approximately 306 feet NGVD except for those sections near the pumping station and the frontline levee, where the elevation would reach approximately 317 feet NGVD. Top width would be 16 feet except in the vicinity of the pump station and the frontline levee, where it would be widened. Average base width would be approximately 240 feet. The levee would be constructed using side slopes of 4.5:1. The footprint would be approximately 36 acres, and approximately 537,000 cy of fill will be required. There would be no crevasse section in the closure; however, an

Table 2-1. Alternative 2 and 3, New Madrid Floodway Levee Alignments and Operational Variations

	Spring Fishery Season **Spawn/Rearing (Mar 1- May 15)**		**Winter Waterfowl Season** **(December-January)**		**Crop Season** **(May-November)**	
Alternative[1]	**Pump Start[2]** feet NGVD	**Pump Stop[2]** feet NGVD	**Pump Start[3]** feet NGVD	**Pump Stop[3]** feet NGVD	**Pump Start feet NGVD**	**Pump Stop feet NGVD**
2	278.0	275.0	285.4	284.4	278.0	275.0
3-1.A	282.5	280.0	285.4	284.4	282.5	280.0
3-1.B	284.4	283.4	285.4	284.4	282.5	280.0
3-1.C[4]	288.0	287.0	285.4	284.4	282.5	280.0
3-2.A	282.5	280.0	285.4	284.4	282.5	280.0
3-2.B	284.4	283.4	285.4	284.4	282.5	280.0
3-2.C[4]	288.0	287.0	285.4	284.4	282.5	280.0
3-3.A	282.5	280.0	285.4	284.4	282.5	280.0
3-3.B	284.4	283.4	285.4	284.4	282.5	280.0
3-3.C[4]	288.0	287.0	285.4	284.4	282.5	280.0

[1]Refer to Figure 2 in Appendix A.
[2]Modified gate operations entail leaving gates open to allow for springtime connectivity with the river. This does not necessarily constitute ponding water above the closure levee.
[3]Waterfowl gate operation allow for water ponding and manual water fluctuations up to 285.4 for waterfowl benefit.
[4]Variation C same as Variation B for two of every three years. The 288 Pump elevations shown only operated one year in every three.

Source: G.E.C., Inc., September 2001.

**Table 2-2. Alternatives 2 and 3,
St. Johns Operational Variations**

	Spring Fishery Season Spawn/Rearing (Mar 1-May 1)		Winter Waterfowl Season (December-January)		Crop Season (May-November)	
Alternative	Pump Start (feet NGVD)	Pump Stop (feet NGVD)	Pump Start[1] (feet NGVD)	Pump Stop[1] (feet NGVD)	Pump Start (feet NGVD)	Pump Stop (feet NGVD)
2	279.0	275.0	286.0	285.0	279.0	275.0
3	282.5	280.0	286.0	285.0	282.5	280.0

[1]Waterfowl gate operation allow for water ponding and manual water fluctuations up to 285.4 for waterfowl benefit.

Source: G.E.C., Inc., September 2001.

inflow/outflow crevasse section would be established in the existing front line levee upstream of the closure tie-in. Some of the existing inflow/outflow crevasse section downstream of the tie-in would no longer be included in the operation plan. The Stage Area Curve indicating farmed, wooded, and other land use acreage for the New Madrid Floodway under this alternative is shown in Appendix A, Figure 10.

2.3.2.3 Alternative 3-3

The 18,500-foot Alternative 3-3 levee would be located just north of levee mile 33 and would have a crown elevation of approximately 306 feet NGVD except for those sections near the pump station and the frontline levee, where elevations would reach approximately 319 feet NGVD and 310 feet NGVD, respectively. Top width would be 16 feet except in the vicinity of the pumping station and the frontline levee, where it would be widened. Average base width would be approximately 260 feet. The levee would be constructed using side slopes of 4.5:1. The footprint would be approximately 100 acres, and approximately 1,316,000 cy of fill would be required. There would be no crevasse section within the closure; however, an inflow/flow crevasse section would be established in the existing front line levee upstream of the closure tie in. While an evaluation was made of establishing an inflow/outflow crevasse in the project closure levee, it was more feasible to locate a new crevasse section in the frontline levee. This would allow for an operational access lane directly from the river. The Stage Area Curve indicating farmed, wooded, and other land use acreage for the New Madrid Floodway under this alternative is shown in Appendix A, Figure 11.

Variation A mirrors pump and gate operations proposed for the St. Johns Bayou Basin by Alternative 3, where gravity gate operations would be altered to remain open until the Mississippi River reaches 282.5 NGVD. Pumping would commence when water in the sump reached that elevation and would continue until water elevation in the sump dropped to 280.0 feet NGVD, providing an additional 4.5 feet of spring inundation in the basin when compared with Alternative 2.

Variation B would alter operations during the prime fish spawning and rearing season (March 1-May 15) and require that gravity gates remain open until the Mississippi River reaches 284.4 NGVD. Pumping would commence when water in the sump reached that elevation and would continue until water elevation in the sump dropped to 283.4 NGVD.

Variation C mirrors Variation B for two of every three years. Every third year it would increase pump start and pump stop elevations to 288.0 NGVD and 287.0 NGVD, respectively, during the prime fish spawning and rearing season of March 1-May 15.

For all three variations, pumping operations would cease and the floodgates would be opened in order to allow the impounded water to flow via gravity drainage should river stages drop to levels below the impounded water. Furthermore, it would be possible to manage the gates to fluctuate water depth and inundation from November through May.

A mitigation feature that is common and beneficial to all levee closure alternatives considered is the hydrology restoration project for Big Oak Tree State Park. 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 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 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.

2.4 ALTERNATIVES CONSIDERED BUT ELIMINATED FROM DETAILED STUDY

Six other alternatives were considered but were eliminated from further detailed study.

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 basin-wide improvements. The levee would protect the city from headwater flooding in the eastern and western parts of the town 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 flood the town's industrial park. Hydraulic analysis indicates such a ring levee combined with channel improvements in town might alleviate interior drainage problems; however, drainage improvements in East Prairie are not part of this Phase I project.

Because no bottomland hardwood (BLH) or wetlands are within the proposed project footprint, no impacts to these or associated wildlife would occur. All affected land would either be urban or cropland that are not regularly inundated by Mississippi River backwater and therefore not significant waterfowl, shorebird, 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. Virtually the entire community would be provided protection from the 25-year flood, and improvements to St. James ditch would provide the industrial park, as well as some other areas, protection from the 100-year flood. However, economic analysis of the proposed alternative indicates the costs to East Prairie, in any combination of improvements, outweigh the benefits that would accrue since no agricultural economic benefit would be derived. The alternative has a benefit-to-cost ratio of less than 0.5 and thus is not economically feasible. Limiting benefits to East Prairie would not provide flood protection for agricultural areas in the basin, the primary focus of the originally authorized project. Additionally, the alternative does not address the city's access problems, and during flooding the city would still be isolated from necessary services until floodwaters recede.

This alternative does not meet the purpose to reduce the duration and frequency of backwater flooding in the New Madrid Floodway. This purpose is fulfilled by closing the gap in the Mississippi River levee at the lower end of the floodway as authorized by the Flood Control Act of 1954.

2.4.2 Alternative 5: St. Johns Bayou Basin Only

The alternative comprises channel improvements and a pumping station for St. Johns Bayou Basin. It excludes the levee closure and pumping station in the New Madrid Floodway. It is economically viable; however, it was not recommended for detailed analysis because it does not address flood protection for agricultural areas in the New Madrid Floodway. As a result, it is not the NED plan and forgoes significant economic development opportunities in the nation’s production of goods and services. The alternative does not adequately address the goals of the East Prairie EC because it fails to provide flood protection in the New Madrid Floodway. Even though East Prairie is physically located in the St. Johns Bayou Basin, because of the close proximity of the Floodway to the city (only two miles east) this area has as much or more influence on the city’s agricultural economic base. Missouri Highway 80, which dissects East Prairie, is the primary east-west farm to market road for the Floodway. It connects the Floodway to East Prairie and to Interstate 55. The omission of the New Madrid Floodway from Alternative 5 fails to address the 40 to more than 70 percent of the flooded farmland in the area served by East Prairie workers and businesses. Consequently, this plan severely limits the potential to improve that community’s quality of life and new economic development. Finally, this alternative does not meet the purpose to reduce the duration and frequency of backwater flooding in the New Madrid Floodway. This purpose is fulfilled by closing the gap in the Mississippi River levee at the lower end of the floodway as authorized by the Flood Control Act of 1954.

2.4.3 Alternative 6: Wildlife Refuge

This alternative requires the purchase of the lower portions of both basins for use as a wildlife refuge. The area would be developed into high-quality wildlife and fishery habitat through reforestation and continue to be subject to backwater flooding. The alternative was studied in detail in a 1993 USFWS EIS and was determined to be technically feasible. However, the local community did not support the proposal and was thought unlikely to provide the necessary lands for the project. Consequently, the proposal was considered unachievable by USFWS and was eliminated from further consideration.

2.4.4 Alternative 7: New Floodway Levee Locations

In addition to the setback levees presented in Section 2.3 *Alternative Three: Avoid and Minimize*, three others were considered but eventually eliminated from detailed study. Although impacts to fish and wildlife habitat are minimized as setback levees are moved northeast into the New Madrid Floodway flood control benefits decrease and, accordingly, benefit to cost ratios fall. Furthermore, and because of the reduced benefit, local communities do not support such alignments.

2.4.4.1 Alternative 7-1 MDC Setback Levee: MDC proposed Alternative 7-1, locating the New Madrid Floodway closure along a setback alignment farther north in the New Madrid Floodway. The proposed alignment would be more than 8 miles long and would begin at Tenmile Pond and extend along St. James Bayou before tying in to the Mississippi River levee northeast of Big Oak Tree State Park. The alignment and a range of pumping station sizes were studied in detail in the St. Johns Bayou and New Madrid Floodway, Missouri, Phase I GDM dated July 1980, and were 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. Although a range of pump sizes was analyzed, none were large enough to handle the impounded rainfall.

2.4.4.2 Alternative 7-2: The 15,840-foot levee proposed for Alternative 7-2 would be located just north of levee mile 32 and would have a crown elevation of approximately 306 feet NGVD except for those reaches near the pumping station, the crevasse section, and the frontline levee, where elevations would reach approximately 320 feet NGVD, 308 feet NGVD, and 315 feet NGVD, respectively. Top width would be 16 feet except in the vicinity of the pump station and the frontline levee, where it would be widened. Average base width would be approximately 234 feet. The levee would be constructed using sideslopes of 4.5:1. The footprint would be approximately 85 acres, and approximately 1,000,000 cy of fill would be required.

This proposed alignment results in a cost-benefit ratio of 0.6 due to a significant loss of economic benefit and because mitigation requirements are only reduced slightly. When compared to Alternative 3-3.A, approximately 4,167 fewer agricultural acres below 300 feet NGVD would be protected. The decrease in mitigation acreage would only be 995 acres. Additionally, Alternative 7-2 actually requires more mitigation acreage than alternatives 3-3.B and 3-3.C.

Successful operation of the floodway under this alternative also induces risks not associated with floodway operation under alternatives 2 and 3. Under this alternative the required crevasse section for the inflow/outflow crevasse #2 would be located in the closure levee section rather than in the frontline levee. This would require the barge-based operation to access the closure levee during a Project Design Flood (PDF) through the existing 1,500-foot gap. The additional travel time for this alternative, when compared to existing floodway operations, is approximately 1.1 hours. Furthermore, five acres of forested land would need to be cleared and almost 230,000 cy of soil would have to be excavated from the required access channel.

Finally, there is no local sponsor support for this alternative.

2.4.4.3 Alternative 7-3: The 15,000-foot levee proposed for Alternative 7-3 would be located between levee miles 27 and 28 and would have a crown elevation of approximately 306 feet NGVD except for those reaches near the pump station, the crevasse section, and the frontline levee, where elevations would reach approximately 321 feet NGVD, 308 feet NGVD, and 316 feet NGVD,

respectively. Top width would be 16 feet except in the vicinity of the pump station and the frontline levee, where it would be widened. Average base width would be approximately 233 feet. The levee would be constructed using sideslopes of 4.5:1. The footprint would be approximately 80 acres, and approximately 950,000 cy of fill will be required.

This proposed alignment results in a cost-benefit ratio of 0.3 due to a significant loss of economic benefit. A substantial decrease in mitigation requirements is possible; however, the decrease is small when compared to the loss in agricultural benefit. When compared to alternatives 3 through 3.A, approximately 10,159 fewer agricultural acres below 300 feet NGVD would be protected. The decrease in mitigation acreage would be 2,304 acres, but this amount diminishes when compared to alternatives 3-3.B and 3-3.C.

Successful operation of the floodway under this alternative also induces the greatest risk when compared to the other proposals. Under this alternative the required crevasse section for the inflow/outflow crevasse #2 would be located in the closure levee section rather than in the frontline levee. This would also require the barge-based operation to access the closure levee during a PDF through the existing 1,500-foot gap. The additional travel time for this alternative, when compared to existing floodway operations, is approximately 1.4 hours. Furthermore, five acres of forested land would need to be cleared and almost 282,000 cy of soil would have to be excavated from the required access channel.

Finally, there is no local sponsor support for this alternative.

2.4.5 Alternative 8: Convert Agricultural Land to Silviculture

This alternative would convert frequently flooded agricultural land in the two basins to silviculture and would require changing several thousand acres from agricultural production to forest through the Wetland Reserve Program (WRP) or other similar mechanisms. It reduces flood damages by changing existing land use but provides no flood protection. Such changes in land use were considered unlikely. While the WRP has been available to landowners for many years, few have chosen to participate.

2.4.6 Alternative 9: Non-Structural

This alternative comprises a combination of non-structural measures, including 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. Such measures were grouped into two broad categories for analysis; urban measures (East Prairie) and rural measures (East Prairie Vicinity). Also, this alternative does not meet the purpose to reduce the duration and frequency of backwater flooding in the New Madrid Floodway. This purpose is fulfilled by closing the gap in the Mississippi River levee at the lower end of the floodway as authorized by the Flood Control Act of 1954.

2.4.6.1 Urban Measures:

- Floodplain Evacuation: Analysis conducted pursuant to the Phase I GDM indicated this alternative was economically unfeasible. DSEIS analysis indicated the measure impractical and unachievable from the standpoint of geography. East Prairie sits atop some of the highest ground

in the area and during large floods becomes an island. For evacuation to be practical, a higher, less flood-prone location would have to be available for East Prairie and the other floodway communities to relocate to.

- Flood Proofing for Residences and Businesses: This alternative would reduce potential flood damages by making residential and commercial structures resistant to the effects of flooding. Because it does not address access to the community during flooding, provide flood protection to the industrial park, nor protect municipal water and sewer systems, the alternative was not evaluated for implementation by itself.

- Restrictions on Future Development: Such restrictions would not help existing flood problems, and East Prairie already places significant restrictions on future development. It complies with Federal Emergency Management Agency (FEMA) guidelines requiring future development to be at or above the 100-year flood elevation. Accordingly, the alternative was considered as having little potential with respect to project goals.

2.4.6.2 Rural Measures:

- Flood Easements: Flood easements were investigated as alternatives to structural measures and were proposed with a goal of compensating landowners for the effects of frequent flooding. Because no reduction in flood damage would result, no economic benefit or contribution to the national economy would occur, and it was determined that flood easements are not economically feasible because they produce no economic benefit.

- Restrictive Easements: Restrictive easements could potentially produce benefits to the national economy if growers were to shift to crops that are less susceptible to flood damage or to crops with shorter growing seasons. Such crops might avoid the spring or fall flood seasons. Area farmers already grow soybeans in flood prone areas because that crop is least susceptible to flood damage, primarily because of a short growing season. Because no better alternative crops are available, the alternative was eliminated from detailed evaluation.

- Land Use Changes: This alternative is similar to the alternative of converting agricultural lands to silviculture. Forested land is more tolerant to flooding than most agricultural crops, and conservation easements requiring the conversion of agricultural lands to woodlands could reduce flood damages. The alternative considered the use of incentives other than those provided for under the WRP; however, as in the case of the WRP, such land use changes were considered unlikely. While the WRP and similar programs have been available to landowners for many years, few have chosen to participate and it is likely that few will participate in the future. The RSEIS used a traditional land valuation approach to assess the possible benefits of this alternative and found that it was not economically justified. Accordingly, and because of apparent lack of interest in such programs on the part of local landowners, the alternative is not considered viable.

- Non-Structural Alternatives under Sections 214 and 222 of WRDA 1999: Section 214 of the Flood Mitigation and Riverine Restoration Pilot Program provides for a reduction in flood damages through the restoration of a river's natural riverine functions. Such 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 project costs and benefits.

Section 222 allows for the estimating flood control benefits using methods similar to those used for structural projects. Traditionally benefits of non-structural alternatives were estimated using land valuation methodologies. Under Section 222 benefits can include avoided flood losses and damages. As a result, the Alternative 9 Rural Measures – Land Use Changes proposal was analyzed with respect to a purchase of the three-year floodplain in the New Madrid Floodway.

Two scenarios were used. 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. Alternative 9 was not justified using such a scenario. The analysis indicated annual economic benefits and costs of $735,000 and $1,993,000, respectively, with a benefit-to-cost ratio of 0.37.

The second scenario treated the woodland benefits and costs as economic benefits and costs and included them in the economic analysis. Alternative 9 was not justified using this scenario either. It indicated annual economic benefits of $1,190,000 and annual costs of $3,085,000, with a benefit-to-cost ratio of 0.39. 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.

2.5 COMPARATIVE IMPACTS OF ALTERNATIVES

Table 2-3 compares the without-project conditions with impacts of each of the alternative actions. Significant resources are described in Section 4.0 *Significant Resources*, and the impacts of each alternative are presented in Section 5.0 *Environmental Consequences*

2.6 PREFERRED PLAN

The recommended plan is this NED plan, Alternative 3-1.B. Primary features of this plan are a 1,000 cfs pumping station and 27.6 miles of channel modifications for the St Johns Basin and a closure levee with a 1,500 cfs pumping station for the New Madrid Floodway. St Johns Basin channel work and pump/gate operation is described in Section 2.3.1. The closure levee in the floodway would be constructed in the 1,500-foot gap at the lower end of the floodway and is described in Section 2.3.2. This work would reduce headwater and backwater flooding on up to 130,000 acres in both basins for a major (approximately 30-year) flood event and prevent substantial damages from occurring to infrastructure and the agricultural economy.

The Recommended Plan has total first cost of $80.3 million including the costs for the mitigation plan. The net annual benefit for the floodway closure levee (MRL) feature is about $113 thousand, for a benefit to cost ratio of 1.1 to 1, at the authorized interest rate of 2.5 percent. The net annual benefit for the Phase I items (two pumping stations and the St. Johns channel work) is about $772 thousand, for a benefit to cost ratio of 1.2 to 1, at the evaluated interest rate of 7.375 percent. Benefits are generally derived from flood damage reduction, agricultural intensification, streets and roads, advanced replacements, and betterments while costs are derived from the construction costs, operations and maintenance, and mitigation.

Table 2-3. Comparative Impacts of Alternatives

Resource/Condition	Units	Alt 1	Alt 2	Alt 3-1.A	Alt 3-1.B	Alt 3-1.C	Alt 3-2.A	Alt 3-2.B	Alt 3-2.C	Alt 3-3.A	Alt3-3.B	Alt 3-3.C
Agricultural Lands Directly Impacted	Acres	NA	9.0	9.0	9.0	9.0	9.8	9.8	9.8	16.8	16.8	16.8
Woodlands Directly Impacted	Acres	NA	113.8	84.8	84.8	84.8	87.8	87.8	87.8	88.4	88.4	88.4
Backwater Inundation Reduction-Farmed Wetlands	Acres	NA	7,493	7,418	6,713	6,713	7,307	6,598	6,598	7,120	6,410	6,410
Backwater Inundation Reduction-Non-Agri. Wetlands	Acres	NA	6,192	5,787	5,542	5,542	5,670	5,423	5,423	4,873	4,634	4,634
Wildlife Habitat Lost	AAHUs	NA	734.3	718.7	Similar to 3-1.A	Similar to 3-1.A	693.7	Similar to 3-2.A	Similar to 3-2.A	696.7	Similar to 3-3.A	Similar to 3-3.A
Waterfowl Habitat Net Gain[1]	DUDs	NA	515,046	599,230	>599,230	>599,230	>599,230	>599,230	>599,230	>599,230	>599,230	>599,230
Fisheries Floodplain Rearing Habitat Lost	Hus	NA	2,924.1	2,720.4	2,329.4	1,851.1	2,649.4	2,258.4	1,780.1	2,432.5	2,041.5	1,563.2
Fisheries Permanent Waterbodies Lost	Acres	NA	60.5	36.2	36.2	36.2	36.2	36.2	36.2	36.2	36.2	36.2
Mussel Adverse Impacts Avoided/Minimized	Yes/No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Endangered Species Impacts	A,B,N	N	N	N	N	N	N	N	N	N	N	N
Water Quality Impacts	A,B,N	N	N	N	N	N	N	N	N	N	N	N
Effects on/Recreation	A,B,N	N	B	B	B	B	B	B	B	B	B	B
Effects on Cultural Resources	A,B,N	N	N	N	N	N	N	N	N	N	N	N
Effects on Section 122 Items	A,B,N	N	N	N	N	N	N	N	N	N	N	N
Effects on Socioeconomics	A,B,N	A	B	B	B	B	B	B	B	B	B	B
HTRW Impacts	A,B,N	N	N	N	N	N	N	N	N	N	N	N
Floodway Emergency Operation Impacts	A,B,N	NA	N	N	N	N	N	N	N	N	N	N
Total First Cost	($000)	NA	86,941	83,089	80,332	78,979	85,980	83,278	81,773	89,598	86,865	85,349
Net Annual Benefits MRL 2.5%	($000)	NA	113	113	113	113	(30)	(30)	(30)	(434)	(434)	(434)
Benefit/Cost Ratio MRL	Ratio	NA	1.1	1.1	1.1	1.1	0.98	0.98	0.98	0.7	0.7	0.7
Net Annual Benefits First Phase 7.375%	($000)	NA	731	726	772	411	734	824	494	799	981	754
Benefit/Cost Ratio First Phase	Ratio	NA	1.2	1.2	1.2	1.1	1.2	1.2	1.1	1.2	1.3	1.2

Notes: A = Adverse Impacts; B = Beneficial Impacts; DUDs = Duck Use Days; HUs = Habitat Units; N = No Impact; NA = Not Available; AAHUs = Average Annual Habitat Units

[1]Waterfowl impacts as calculated in DUD's have a net annual gain with all alternatives. However, there are habitat losses during February and March, as detailed in Table 5-9.

Approximately 2,400,000 cubic yards of material will be needed for construction of the New Madrid levee closure and a 12-mile grade raise on the setback levee. This grade raise will begin at the intersection of the floodway closure and the setback levee and extend upstream to the vicinity Missouri Highway 102. Suitable material from the enlargement of St. Johns Bayou and the Birds Point New Madrid Levee Ditch will be used for the closure and grade raise construction. Approximately 2,700,000 cubic yards will be excavated from these reaches. Of this amount, it is anticipated that more than 50 percent will be suitable for use in the construction of the closure and grade raise. The remainder will be obtained from borrow pits along the setback levee. Up to 80 acres of new borrow area may be needed. The borrow site(s) will be located in cleared, non-wetlands areas. The amount of new borrow area will be decreased if more of the material from channel excavation than anticipated is suitable for levee construction. The amount of new borrow area may also be decreased if suitable material is available in existing borrow pits along the setback levee and if removal of sediment from existing borrow pits is desirable for fish and wildlife habitat.

Direct construction impacts will affect 102 acres of land, of which 9 acres are agricultural and 78 acres are woodlands. The remaining land types are either open water, herbaceous vegetation, scrub, shrub, marsh, or sandbar.

Gate operation in the New Madrid Floodway has been modified as part of Alternative 3-1.B to allow annual springtime flooding up to elevation 284.4 until May 15 to allow for increased river connectivity and benefit rearing and spawning habitat for fish. This increased connectivity allows water to move into about 2,000 acres of low elevation habitat known as Eagle's Nest. Eagle's Nest provides some of the best fishery habitat in the floodway. Although this method of gate operation results in some losses to agriculture, this loss is more than compensated by the environmental benefits, as reflected by reduced mitigation costs.

One of the features that the project provides is the ability to impound water during the December and January time frame to benefit winter waterfowl. About 6,400 acres could be flooded in both basins for waterfowl, although flexibility in gate operation to allow flooding and or connectivity over fewer acres would be possible and desirable. Based on Waterfowl Assessment Methodology conducted by the USFWS, the project, although causing losses in springtime habitat for waterfowl, would result in a substantial overall gain for waterfowl (approximately 600,000 duck-use days).

The resource that would incur the greatest project induced impact would be fish rearing habitat. Most of the losses are associated with croplands that periodically flood during the spring and would no longer be available for fish rearing with a closure. Analyses conducted by an interagency team indicated that the most effective means of mitigating project induced fishery losses would be through acquisition and reforestation of frequently flooded croplands. Altogether, 8,375 acres would be required to mitigate these losses (7,058 floodway and 1,317 St Johns). An additional 765 acres would be acquired and or leased and managed specifically for shorebirds. Significant mussel habitat in the St Johns Basin would be mitigated first through avoidance of quality habitat and by relocation of mussels from selected sites. A monitoring program would also be implemented to document mussel recovery. This mitigation plan results in a substantial over-compensation for terrestrial wildlife resources. The U.S. Fish and Wildlife Service (USFWS) has expressed concern that the project will induce clearing of wooded wetlands in the area. The Corps concluded that post-project hydrology, as well as regulatory laws, will discourage such clearing. In fact, the regulatory process would mandate substantial mitigation from any landowner that opted to clear these woodlands. However, it is important to note that the mitigation plan, which results in a doubling of project area

woodlands, would more than compensate such terrestrial losses should they, however unlikely, occur.

Impacts to project area wetlands due to backwater flooding (both direct inundation and impounded interior runoff) are a reduction in inundation on 12,255 acres of wetlands, of which 6,713 acres are agricultural and 5,542 acres are non-agricultural. All non-agricultural wetlands will remain jurisdictional wetlands while some farmed wetland may lose jurisdictional status, if a future determination were to be made by the NRCS on those lands. However, these farmed wetlands will continue to exhibit some wetland characteristics due to factors other than backwater flooding.

During the reformulation of this project and as documented in the revised SEIS, the Corps has developed a substantial additional avoid and minimize plan for the New Madrid Floodway. It is important to note that this plan is recommended for implementation without a decrease in mitigation, and it will result in major improvements in aquatic and terrestrial habitat in the floodway. This plan, described in Appendix L, includes: up to 64 miles of riparian buffer ranging in width from 25 feet to 100 feet per channel side; 20 artificial structures to improve fish habitat; and a four-mile-long wildlife corridor, 300 feet wide per channel side, to connect Ten Mile Pond Conservation Area with Big Oak Tree State Park. This plan will result in a substantial change in the landscape of the floodway and should have marked improvement in water quality and natural resources over existing conditions.

The project also involves the commitment of the Corps to assist in design and implementation of the MDNR plan to improve water management for Big Oak Tree State Park. The plan, also discussed in an attachment to the mitigation appendix, will involve relief wells, pump wells, pumps and control structures for surface water management, and ditch and levee work to mimic natural fluctuations of the Mississippi River prior to construction of the mainline Mississippi River Levee system.

3.0 AFFECTED ENVIRONMENT

3.1 LOCATION

The St. Johns Bayou Basin and New Madrid Floodway Project area is located in Mississippi and New Madrid counties in southeastern Missouri in the floodplain on the right descending bank of the Mississippi River. The project area encompasses portions of two drainage basins separated by the Birds Point-New Madrid Setback Levee.

The St. Johns Bayou Basin drains approximately 500 square miles. The area directly affected by the proposed action lies immediately west of the New Madrid Floodway. Project channels begin just north of the town of East Prairie, Missouri, and proceed south, then southwest, terminating at the city of New Madrid. The area extends approximately 40 miles from north to south, with a maximum width of 25 miles. The immediate project area covers 324,173 acres, of which about 288,000 acres (450 square miles) are tributary to the St. Johns Bayou. The remaining area drains northward through the Drinkwater area. In addition to St. Johns Bayou, Birds Point New Madrid Levee Ditch, and St. James Ditch, other major watercourses in the St. Johns Bayou Basin are St. Johns Ditch, Lee Rowe Ditch, and Maple Slough Ditch. All ditches flow southerly or southwesterly and drain into St. Johns Bayou, which discharges into the Mississippi River about one-half mile upstream of New Madrid through the St. Johns Bayou outlet structure.

The New Madrid Floodway covers about 207 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. Mud Ditch, Wilkerson Ditch, St. Johns Diversion Ditch, Tenmile Pond, and St. James Bayou provide major drainage in the New Madrid Floodway. All affected drainage flows into Mud Ditch, which joins with St. Johns Bayou just before its discharge into the Mississippi River. The New Madrid Floodway, an area along with the Little River Headwater Diversion channel and a significant amount of riverside batture land, constitutes the remaining historic Mississippi River floodplain in Missouri.

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 often 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

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). 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. About 10,207 of these woodlands are classified as Federal regulatory jurisdictional wetlands. Many of these wooded wetlands are on low-lying clay soils of old silted-in oxbow river channels.

Table 3-1 lists the total acres for each landcover type in both basins and the percent distribution of each cover type as determined by recent satellite imagery, aerial photography, ground surveys, and GIS delineation.

3.4 TOPOGRAPHY

Since the retreat of the last glacier over 10,000 years ago, the Mississippi and Ohio rivers meandered 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 land on the eastern 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.

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

St. Johns Bayou Basin Total Landcover			New Madrid Floodway Total Landcover		
Land Use	**Total Acres**	**Percent Landcover**	**Land Use**	**Total Acres**	**Percent Landcover**
Forested	20,096	6%	Forested	10,368.7	7.8%
Scrub-shrub/Marsh	269.6	0.1%	Scrub-shrub/Marsh	878.2	0.7%
Cropland	280,289.8	86.5%	Cropland	113,007.3	85.2%
Pasture	1,277.4	0.3%	Pasture	922.2	0.7%
Herbaceous	21,121.0	6.5%	Herbaceous	6,624.7	5%
Open Water	944.2	0.3%	Open Water	797.3	0.6%
Sandbar	166.5	0.1%	Sandbar	6.6	0%
Urban	8.1	0%	Urban	0	0%
TOTAL	**324,172.8**	**100%**	**Total**	**132,605.1**	**100%**

3.5 HYDROLOGY

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

Over a period of several decades structures were installed to promote agriculture in the two basins. Ditch systems have increased the surface water removal rate; but due to the very small slope of the landscape, runoff hydrographs remain characterized by slow rises, low peaks, and prolonged recession. In the St. Johns Bayou Basin the installation of levees and gates has reduced the influence of the Mississippi River.

Data available for hydrologic analysis include records of local rainfall and Mississippi River stages. Rainfall records are available for Cairo, Illinois, New Madrid, Missouri, and Sikeston, Missouri. New Madrid gage data for the Mississippi River provide daily river elevations at the outlets of both basins. Only limited gage data are available to describe local runoff events for St. Johns Bayou, and no gage data are 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 C of this report.

3.6 FLOODPLAIN ECOLOGY

The St. Johns Bayou Basin and the New Madrid Floodway, although highly altered, still perform floodplain functions of use to regional fish and wildlife resources. The total two-year floodplain from Cairo, Illinois, to Caruthersville, Missouri, contains approximately 177,571 acres, of which about 17,316 acres are in the New Madrid Floodway. The Floodway represents approximately 10 percent of the total Mississippi River floodplain within a 113-mile reach. The Floodway is still largely connected to the Mississippi River, which annually inundates much of the lower study area, providing interactions between terrestrial and aquatic habitats.

Annual flood pulses have been a 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 productivity, which can be more productive than that of the river main stem (Junk *et al*. 1989, Guillory 1979). 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) noted 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 other aquatic resources of the river (Junk *et al*. 1989, Amoros 1991, Lambou 1990, and Welcomme 1979). Floodplains also provide habitat essential for spawning, foraging, and refuge. 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 floodplains as nurseries (Gallagher 1979).

In many years, rising river levels inundate portions of the New Madrid Floodway in the spring, while rising temperatures and increased photoperiod induce spawning in many fish species. Turner *et al*. (1994) collected more larval and juvenile fish from the floodplain than from the adjacent river. Unlike the main stem of the river, the floodplain is characterized by slack waters, beds of aquatic vegetation, and organically rich substrates (Guillory 1979, Rissoto and Turner *et al*. 1994), which are important for fish spawning and rearing.

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 a 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.

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. Shallow waters are generally characterized by the presence of vegetation, shade, submerged branches, or other forms of structure (Wallus *et al*. 1990; Killgore and Baker 1996). The New Madrid Floodway, which is recognized as a valuable spawning and rearing location during spring flooding, is, however, a less than optimum habitat. In most of the Floodway structure is lacking and the substrate consists of 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. Therefore, fish productivity in rivers is largely regulated by

water elevation, but also by structural complexity of inundated areas. In this regard, forested areas of the New Madrid Floodway have a greater habitat value than cleared floodplain.

Many species of animals require shallow waters for successfully reproduction. As spring floods recede, amphibians and invertebrates exploit thousands of ephemeral ponds. Periodic inundation from rainfall during late winter and early spring also creates ephemeral ponds. 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).

The project area contains more diverse habitats and natural communities than elsewhere in the Missouri Bootheel. That diversity is reflected in the number of State-listed plant, mussel, fish, amphibian, reptile, bird, and mammal species reported for the two-county area. The area also provides important breeding, migration, and overwintering habitat for numerous species. Although forested wetlands in the project area are scarce, they are important refugia for 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 recorded 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 main channel or entered the deltaic plain. Gravels were deposited first, next sand, and then finer clayey sediments on top. 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.

The U.S. Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS) classified prime and unique agricultural lands in accordance with the Farmland Protection Policy Act (PL 97-98; 7 U.S.C. 4201 *et seq*.) by reviewing soil types in each county. These classifications were based on published soil survey manuals for New Madrid and Mississippi counties. Several of the lands 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. Areas in the lower parts of the 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, few, if any, prime and unique farmlands are located within the project area.

3.10 WATER QUALITY

The Corps of Engineers performed a study of the water quality of the St. Johns Bayou and New Madrid Floodway project area in 1978. 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.

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 EPA and the State of Missouri. Only at one site was the mercury concentration slightly elevated. No unacceptable levels were observed.

In October 1977, ESEI tested for pesticides in fish flesh. A few samples contained mercury concentrations in excess of the maximum safe level for human consumption. EPA expressed concern and requested further sampling and testing. Analyses of further samples revealed mercury levels within EPA limits, which satisfied EPA concerns. Concentrations of all other parameters were found to be below the maximum limits set by the EPA.

All of the earlier water quality analyses are contained in 1981 GDM, on file with the Memphis District Corps of Engineers. Test results at that time indicated that water quality of the streams and channels within the St. Johns Bayou Basin were characteristic of an intensively farmed river delta and that there was no serious release or accumulation of toxic materials. Surface waters contain elevated levels of agrochemicals, turbidity, suspended solids, and nutrients. However, no water quality parameter was found to be at unacceptable levels. 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 is reasonable to assume that project impacts related to toxic materials would be no worse than in 1981.

However, since the early GDM, different agrochemicals 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 the National Environmental Policy Act (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 water quality analyses indicate no substantive changes in crops and cropping patterns and agrochemical use and very minimal changes in water quality both inside the basins and in the Mississippi River.

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). The 1998 list and the draft 2000 list were checked. The only listing 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. Because there will be no habitat loss in the Mississippi River, the Corps believes that Section 303(d) does not apply in this situation.

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 (1979-2029). 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 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 well being, 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. A detailed socioeconomic analysis is contained in Appendix B 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. GIS data, however, were unable to distinguish between corn

and milo. They also did not account for winter wheat because satellite imagery was obtained after wheat fields had been planted in soybeans.

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

When the St. Johns Bayou floodgates are closed, surface runoff, which occurs with severe thunderstorms or prolonged rain events, is impounded inside the basin. Agricultural damages from headwater flooding are usually limited to areas along the channels and streams when banks are overtopped. 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 (U.S. Army Corps of Engineers 1986).

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 (78 percent of the total planted acres). Corn is grown on approximately 15,508 acres (14 percent) and milo on 7,769 acres (seven percent). Approximately 25,844 acres of winter wheat are double cropped with soybeans. Less than one percent of the land is in pasture (922 acres).

Mississippi River backwater flooding 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 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 BLH forest remain in the St. Johns Bayou Basin. There are approximately 10,369 acres of forested land in the New Madrid Floodway. 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. 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 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 are approximately 34 percent of the total forested acreage. Commercial forest products that could be derived from these wooded lands include lumber, veneer, wood pulp, and firewood. However, many of these stands are too small to be harvested efficiently (Yorder 1976).

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 a 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, and/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

Title 33, Part 323 CFR, *Regulatory Program of the Corps of Engineers*, states "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."

Because of the large drainage basins, cost and time constraints prohibited mapping of wetlands to the same accuracy and precision as would be routinely done for evaluations of individual Section 404 permits. Geographic Information Systems (GIS) data compiled by the U.S. Army Corps of Engineers indicates there are approximately 18,120 acres of wetlands in both basins below 300-feet NGVD (Appendix A, Figure 4). These wetlands consist of cropland (53 percent), forestlands (33 percent), and open water, herbaceous, and pasture areas (14 percent). Refer to Appendix D for details of the wetlands analyses.

4.3.1 Wetlands Delineation

For both basins, land located at elevation 300 feet NGVD and below was considered to be the area that would be potentially impacted by the proposed alternatives. It constitutes the maximum practical extent of flooding due to backwater events (refer to Appendix A, Figure 5 for existing two-year flooding). 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 in the New Madrid Floodway. Regarding wetland area, the study employed offsite determination with limited ground-truthing using the 12-day inundation elevation for nonagricultural lands and the 15-day inundation elevation for agricultural lands as hydrology indicators.

Determination of wetland hydrology was determined using GIS topographic data and an inundation analysis. This was verified with the use of aerial identification of wetlands based on satellite imagery and field inspection. Through the subsequent analysis, the wetlands acreage was established. Calculations of sump elevations meeting the requisite wetland hydrology in the St. Johns Bayou Basin and the New 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. 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 is comparable with the inundation calculation of 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.

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 (Appendix A, Figure 6) for analysis. The project area was further classified into wetland and nonwetland areas.

As presented in Table 4-1, the Corps' delineation indicates 6,461acres of wetlands in the St. John Bayou Basin.

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

Land Use	Existing Wetlands below 300 ft NGVD*	Alternative 2				Alternative 3			
		Acres	% Total Directly Impacted	Acres Inundation Reduced	% Total Backwater Inundation Reduced	Acres	Percent Total Acres	Acres Inundation Reduced	% Total Backwater Inundation Reduced
Forested	2,210	107	4.8%	549	25%	78	3.5%	554	25%
Scrub/Shrub/ Marsh	0	0	0.0%	0	0%	0	0.0%	0	0%
Cropland	3,514	6	0.2%	1,341	38%	6	0.2%	1,296	37%
Pasture	60	0	0.0%	8	13%	1	1.7%	6	10%
Herbaceous	551	5	0.9%	161	29%	5	0.9%	156	28%
Open Water	126	3	2.4%	1	1%	0	0.0%	4	3%
Sandbar	-	-	0.0%	-	0%	-	0.0%	-	0%
Urban	-	-	0.0%	-	0%	-	0.0%	-	0%
Total	6,461	121	1.9%	2,060	32%	90	1.4%	2,016	31%

*Subject to inundation from backwater flooding. Wetlands due to backwater inundation were calculated on an inundation duration basis in accordance with Corps and NRCS criteria (inundated in 50% of years for a certain length of time). The duration criterion for Corps jurisdictional wetlands in different than for NRCS farmed wetlands (see appendices C and D).

Source: G.E.C., Inc., September 2001.

As presented in Table 4-2, the Corps' delineation indicates 11,659 acres of wetlands in the New Madrid Floodway at or below 300-feet NGVD.

There are a total of approximately 6,064 acres of forested wetlands in both basins that are below 300 feet NVGD. Most of these are BLH and are located along the lower reaches of St. Johns Ditch, in Big Oak Tree State Park, and adjacent to the Tenmile Pond Conservation. BLH forests are subject to regular periodic seasonal flooding most years. The MDC has identified several significant examples of this scarce 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

Table 4-2. New Madrid Floodway Wetland Acres

Land Use	Existing Wetlands below 300 ft NGVD[1]	Authorized Project				Avoid and Minimize Alternatives													
		Alternative 2				Alternative 3-1.A				Alternatives 3-1.B and 3-1.C[2]				Alternative 3-2.A				Alternatives 3-2.B and 3-2.C[2]			
		Acres Directly Impacted	% Total Directly Impacted	Acres Inundation Reduced	% Total Backwater Inundation Reduced	Acres Directly Impacted	% Total Directly Impacted	Acres Inundation Reduced	% Total Backwater Inundation Reduced	Acres Directly Impacted	% Total Directly Impacted	Acres Inundation Reduced	% Total Backwater Inundation Reduced	Acres Directly Impacted	% Total Directly Impacted	Acres Inundation Reduced	% Total Backwater Inundation Reduced	Acres Directly Impacted	% Total Directly Impacted	Acres Inundation Reduced	% Total Backwater Inundation Reduced
Forested	3,854	6.8	0.12%	3,561	92%	6.8	0.12%	3,562	92%	6.8	0.12%	3,426	89%	9.8	0.25%	3,476	90%	9.8	0.25%	3,343	86%
Scrub/Shrub/ Marsh	82	-	0.00%	80	98%	-	0.00%	80	98%	-	0.00%	77	94%	-	0.00%	80	98%	-	0.00%	77	94%
Cropland	6,186	3	0.01%	6,152	99%	3	0.01%	6,122	99%	3	0.01%	5,417	88%	3.8	0.01%	6,011	97%	3.8	0.01%	5,302	86%
Pasture	102	-	0.00%	95	93%	-	0.00%	95	93%	-	0.00%	94	92%	0.3	0.15%	84	82%	0.3	0.15%	82	80%
Herbaceous	840	2.2	0.11%	805	96%	2.2	0.11%	805	96%	2.2	0.11%	769	92%	0.7	0.04%	793	94%	0.7	0.04%	753	90%
Open Water	595	0.1	0.02%	525	76%	0.1	0.02%	525	76%	0.1	0.02%	456	77%	-	0.00%	517	74%	-	0.00%	448	75%
Sandbar	0	-	0.00%	0	0%	-	0.00%	0	0%	-	0.00%	0	0%	-	0.00%	0	0%	-	0.00%	0	0%
Urban	-	-	0.00%	-	0%	-	0.00%	-	0%	-	0.00%	0	0%	-	0.00%	-	0%	-	0.00%		0%
Total	11,659	12.2	0.03%	11,218	95%	12.2	0.03%	11,189	95%	12.2	0.03%	10,239	88%	14.6	0.13%	10,961	93%	14.6	0.13%	10,005	86%

Land Use	Existing Wetlands below 300 ft NGVD*	Avoid and Minimize Alternatives								Additional Levee Alignments							
		Alternative 3-3.A				Alternative 3-3.B/3-3.C[2]				Alternative 7-2				Alternative 7-3			
		Acres Directly Impacted	% Total Directly Impacted	Acres Inundation Reduced	% Total Backwater Inundation Reduced	Acres Directly Impacted	% Total Directly Impacted	Acres Inundation Reduced	% Total Backwater Inundation Reduced	Acres Directly Impacted	% Total Directly Impacted	Acres Inundation Reduced	% Total Backwater Inundation Reduced	Acres Directly Impacted	% Total Directly Impacted	Acres Inundation Reduced	% Total Backwater Inundation Reduced
Forested	3,854	10.4	0.27%	2,763	72%	10.4	0.27%	2,637	68%	9.4	0.24%	2,484	64%	1.0	0.03%	2,194	57%
Scrub/Shrub/ Marsh	82	-	0.00%	80	98%	-	0.00%	77	68%	-	0.00%	80	95%	-	0.00%	78	95%
Cropland	6,186	10.8	0.04%	5,824	94%	10.8	0.04%	5,114	83%	22.6	0.08%	5,227	84%	21.6	0.08%	2,282	37%
Pasture	102	1.2	0.58%	67	66%	1.2	0.58%	65	64%	5.2	5.1%	23	23%	-	0.00%	3	3%
Herbaceous	840	6.1	0.31%	738	88%	6.1	0.31%	700	83%	2.5	0.30%	468	56%	0.2	0.01%	314	37%
Open Water	595	0.5	0.06%	505	73%	0.5	0.06%	435	73%	1.0	0.17%	450	65%	-	0.00%	355	51%
Sandbar	0	-	0.00%	0	0%	-	0.00%	0	0%	-	0.00%	0	0%	-	0.00%	0	0%
Urban	-	-	0.00%	-	0%	-	0.00%		0%	-	0.00%	-	0%	-	0.00%	-	0%
Total	11,659	29	0.25%	9,977	85%	29	0.25%	9,028	77%	40.7	0.35%	8,732	74%	22.8	0.20%	5,226	44%

[1]Subject to inundation from backwater flooding. Wetlands due to backwater inundation were calculated on an inundation duration basis in accordance with Corps and NRCS criteria (inundated in 50% of years for a certain length of time). The duration criterion for Corps jurisdictional wetlands in different than for NRCS farmed wetlands (see appendices C and D).

[2]Impacts to backwater inundation from modified gate operations to wetlands are expected to be the same for both the 284.4 annual gate operation and the 284.4 annual/288 every third year operation. That is due to the infrequent occurrence of water up to 288. The Corps believes the 288 inundation level will not aid the inundation of wetlands in any appreciable manner beyond what the 284.4 annual level would.

greenbriar, poison ivy, trumpet creeper, Virginia creeper, blackberry, and various herbaceous species. (Refer to the USFWS CAR presented in Appendix E).

The remaining forested wetlands in the project area include riparian forest and swamp. Riparian forests exhibit 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 located 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 the 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 scarce community that occur in the project area, including Big Oak Tree State Park and Tenmile Pond (MDC 1997) (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 1,391 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 NRCS, 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 wetlands 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 (NRCS 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. 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. 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.

However, because of concerns by resource agencies that farmed wetlands in the project area may be understated, the Corps performed an analysis to determine the acres that meet the FSA criterion of 15 continuous days of inundation during the growing season. A maximum of 9,700 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 6,186 acres are in the New Madrid Floodway below 288.3 feet NGVD.

4.4 WILDLIFE

In southeastern Missouri, the past conversion of woodlands and swamps to cropland has eliminated or severely reduced the abundance of species dependent upon extensive forest or swamp ecosystems. However, the diversity and abundance of wildlife 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, 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 habitats of the project area support 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 Mississippi kite 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 particularly those that require large, mature forested tracts to reproduce successfully (e.g., white-eyed vireo, northern parula, cerulean warbler), (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 of their priority species require BLH forests for breeding (USFWS CAR).

Johnson (1997) noted 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, Illinois chorus frog, and the eastern spadefoot toad. Reptiles found in sloughs, swamps, ditches, oxbows, and ponds in the project area include Mississippi mud turtle, stinkpot, southern painted turtle, western chicken turtle, red-eared slider, eastern spiny softshell, broadhead skink, black rat snake, dusky hognose snake, speckled king snake, water snakes, western ribbon snake, eastern garter snake, and rough green snake (USFWS CAR).

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.

Fall migration of waterfowl begins in mid-August, when the first flocks of blue-wing teal arrive, and continues through late December and 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 USFWS Waterfowl Assessment Model (USFWS CAR), 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. During spring migration from February through mid-March, high Mississippi River backwater in the lower basin often inundates much of the area. This not only provides resting habitat, but also feeding areas that supply important invertebrate protein food sources required for proper pre-egg laying conditioning.

Waterfowl populations depend on a variety of habitat types. Wetlands of the project area, particularly BLH, are important to wintering waterfowl. Forested wetlands provide nutritious food for waterfowl, secure roosting areas, cover during inclement weather, loafing sites, protection from predators, and isolation for pair formation.

4.6 FISHERIES

The USFWS reports that 114 species representing 22 families have been collected from the project area and surrounding drainages including the Mississippi River (USFWS CAR). Of these species, 93 have been collected from ditches and bayous in the project area drainage (Sheehan *et al*., 1998, MDC 1997). The remaining 21 species have been collected from the Mississippi River proper (U.S.G.S. 1991-1996, MDC 1997). In all, approximately 70 species were collected in St. John's Basin and 45 species were collected in the New Madrid Floodway (Sheehan, 1998). These fish represented 43 genera in 18 families. Species diversity values were also higher in the St. Johns watershed compared to the New Madrid Floodway. The numerically dominant species in St. Johns Bayou included the ironcolor, ribbon, blacktail, and mimic shiners, which are usually indicative of good habitat quality. However, almost 60 percent of the numerically dominant fishes in the New Madrid Floodway are comprised of three ubiquitous species: mosquitofish, gizzard shad, and common carp.

Of the species collected from the project area, 10 are considered endangered, rare, or on the watch list in the State of Missouri. Of these 10 species, eight were found in St. Johns Bayou and two were found in the New Madrid Floodway. 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 uncommon and diverse aquatic habitats in the project area and especially the St. Johns Bayou.

Annual flooding in the Floodway plays an important role in the natural cycle of the Mississippi River. Backwater flooding from the river and headwater flooding due to impoundment of local runoff provide spawning, nursery and foraging habitat. This enhances fish stocks and helps maintain fish diversity in the Mississippi River and its floodplain. Most of the species that have been collected in the project area use the area 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. This was not the case with respect to the small ponds and lakes on the New Madrid Floodway as compared to the more diverse small ponds and lakes in the St. Johns Bayou (Sheehan, 1998). 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 St. Johns Bayou (Sheehan *et al*. 1998). The bluntnose darter was also found in the New Madrid Floodway.

The fish fauna has been greatly altered by drainage of the original swamps and backwater areas. Wetland species characteristic of standing waters have decreased in abundance, while generalists and species adapted to flowing water have become more widespread. The species that predominate are adapted to poor water quality and lack of cover. ESEI collected 12 fish species and 442 individuals in Tenmile Pond and St. James Bayou in 1978. The collection was primarily carp (39 percent), gizzard shad (36 percent), gar (five percent), and buffalo (three 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. Later surveys by MDC from the St. Johns Bayou Basin revealed a more diverse community 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 (six percent), freshwater drum (five percent), shortnose gar (three percent), channel catfish (three percent), and smallmouth buffalo (two percent).

Sampling in 1997 and 1998 indicated a diverse assemblage. Gizzard shad, buffalo, shortnose gar, freshwater drum, and carp were recorded in both basins, with gizzard shad dominating. White bass were collected in the New Madrid Floodway during their spring spawning run and were the fourth most abundant species. Sampling during high water levels in St. Johns Bayou Basin ditches revealed an adult composition of unidentified minnows (42 percent), gizzard shad (12 percent), mosquitofish (18 percent), and smallmouth buffalo (eight percent). The young-of-the-year (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 adult composition was gizzard shad (38 percent), mosquitofish (24 percent), shortnose gar (10 percent), carp (seven percent), white bass (five percent), bigmouth buffalo (three percent), freshwater drum (three percent), threadfin shad (two percent), and smallmouth buffalo (two percent). The YOY were comprised of gizzard shad (76 percent), carp (six percent), temperate bass (six percent), inland silverside (six percent), and freshwater drum (one percent). Nearly all the fishes were characteristic of drainage ditches in the southeastern Missouri lowlands (Pflieger 1997).

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 YOY. Those collections were made as backwaters drained to the Mississippi River (John Tibbs, Texas Wildlife and Parks, pers. comm.). The YOY represented 27 and 17 species in 1993 and 1994, respectively. Similar results were reported by Sheehan *et al*. (1998) during a time 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. Examinations of adults showed that spawning occurred during the flood event. The majority of fish reported by Tibbs (1995) and Sheehan *et al*. (1998) were 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 principal prey species.

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, 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 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. 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).

Dominant species in all the collections cited above are commonly found in the Mississippi River channel and throughout the entire river floodplain.

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

provide productive 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 apparently 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 have been collected in the project area, which represents one-third of the species known to occur in Missouri. The highest species diversity and greatest abundance of individuals occurs 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 in the St. Johns Bayou Basin were not found in the Floodway. One species, *Obliquaria reflexa*, was found in the Floodway but not in the St. Johns Bayou Basin.

The presence of mature trees on the banks in the Setback Levee Ditch appears to correlate with the presence of relatively abundant and diverse unionids. Older individuals and greater diversities 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 that recruitment occurred following maintenance; however, the rate of recruitment is unknown. 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 State-listed (rare) species were found in this survey (Barnhart 1998): 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 near the edge of its range. Of these species, the rock pocketbook and flat floater are among the most rare unionids in Missouri (Oesch 1995). The ditches of the project area 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.

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, the 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 sandbar 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 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 rivers. Pallid sturgeon are opportunistic feeders that eat insects, crustaceans, mollusks, annelids, fish, and eggs of other fish. Little information exists on the range and habitat preferences of pallid sturgeon in 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 recovered sufficiently to be listed as threatened. The eagle is opportunistic, with fish comprising the major portion of its diet. Waterfowl and turtles are also occasionally eaten. 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. Nesting may begin in January with nests built less than two miles from water in large baldcypress or cottonwood trees. Three nests, one that is active, are reported within the project area near the lower part of the New Madrid Floodway, in the Hubbard Lake area. Eagles have also nested 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.

The project area is within the range of another species of note; the Federally endangered fat pocketbook mussel (*Potamilus capax*). 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 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 (USFWS 1989, Cummings *et al*. 1990). Many of the ditches in the project area may be suitable habitat (Brian Obermeyer, Kansas Wildlife and Parks, pers. comm.) (USFWS CAR). A 1978 survey reported the species in the project area from Fish Lake Ditch at Highway 80, just northeast of the Tenmile Pond Conservation Area (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*, 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). It is concluded that this project will not adversely impact *P. capax*.

Species protected by the State of Missouri that are found in Mississippi and New Madrid counties are listed in Table 4-3.

4.9 BIG OAK TREE STATE PARK AND OTHER STATE CONSERVATION AREAS

Big Oak Tree State Park is managed by MDNR. It is the only 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. 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 the Missouri portion

of the Mississippi River floodplain. This part of the park is designated a National Natural Landmark by the U.S. Department of Interior.

Table 4-3. State-Listed Rare and Endangered Species in New Madrid and Mississippi Counties

Species	Mississippi	New Madrid
Plants		
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

Species	Mississippi	New Madrid
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*) colony	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	

Status Codes: E = Endangered SU = Species Undetermined
R = Rare WL = Missouri Watch List

Sources: USFWS CAR (Appendix E); MDC (1997a and b); and Carter and Bryson (1991).

Besides being a National Natural Landmark, Big Oak Tree State Park is a unique and significant natural heritage site that 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 reportedly winter in the park.

MDNR is concerned that the park is drying from drainage of the surrounding cropland. The character of the park is slowly changing from wet-mesic BLH to a drier forest type. Several large oaks have fallen due to old age, and little or no oak regeneration is taking place. Currently, the park is unable to capture backwater due to a notch in the rim of the existing sump. To preserve the park, MDNR is planning to construct a $1.2 million water retention project around the park to capture rainfall and maintain an optimal hydrologic regime. Water retention will inhibit invading, competing

understory species and promote regeneration of the existing dominant forest species. A water management plan for the area is included in the mitigation plan.

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 Conservation Area also provides opportunities for fishing, small and big game hunting, and waterfowl hunting. The Donaldson Point Conservation Area, which lies on either side of the frontline levee along the Floodway, covers approximately 5,785 acres of largely BLH forest where bald eagles have been known to nest.

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 indicates that water quality of the streams and channels in the St. Johns Bayou Basin is characteristic of an intensively farmed river delta. Surface waters contain elevated levels of agrichemicals, turbidity, suspended solids, and nutrients. No parameter was measured at unacceptable levels with respect to human health or the environment. Updated water quality analyses were conducted pursuant to this study and indicate only minimal changes in water quality inside the basins and in the Mississippi River. This updated water quality analysis is provided in Appendix I.

The State of Missouri will make a determination as to whether or not a National Pollutant Discharge Elimination System (NPDES) permit is required after reviewing Section 404(b)(1) analysis prepared pursuant to this project and once a request for water quality certification has been made.

Finally, the project will not discharge pollutants to the waters of the United States after construction of the proposed alternatives. Water quality analyses indicate post project conditions will be similar to existing conditions.

4.11 RECREATION

Recreation resources for the overall project, discussed in the 1981 GDM, noted that outdoor recreational opportunities were limited in the study area, but there is some type of consumptive and nonconsumptive activity available throughout the year. 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. 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. Furbearers are harvested during winter in the riparian habitat. 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 and channelization. However, the project area still supports a diverse sport fishery. Recreational fisheries provided by these waters are important because there is a lack of other fishable waters in the Missouri Bootheel. Fishing is generally poor in the smaller drainage ditches, but fishing success is considered fair to good in the chutes, Setback Levee Ditch, Mud Ditch, St. Johns Bayou, borrow pits, and blue holes.

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 also are used for fishing. The blue holes, which may provide the best fishing in southeastern Missouri, reflect to a large extent the 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. Fishes commonly caught from blue holes are largemouth bass, channel catfish, sunfishes, bullheads, and several commercial fish (USFWS 1979).

Nonconsumptive outdoor recreation activities, such as bicycling, hiking, tennis, swimming, birding, nature walking, picnicking, and tent camping, are also pursued, although facilities are limited. A few wintering bald eagles arrive in November and December and stay to March, offering bird watching opportunities. Additional bird watching includes waterfowl, which can be abundant in marshes and along the margins of permanent water bodies, and shorebirds, whose migration peaks in April and May.

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 circa 15,000 B.C. and ending circa A.D. 1500. The historical period began in 1673 with exploration by the Europeans Marquette and Joliet. Colonization 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 altered markedly. This activity resulted in the need for archaeological investigations.

A Birds Point-New Madrid Floodway Cultural Resources survey and testing project was conducted to survey previously determined high probability areas in the New Madrid Floodway and to test the discovered resources for National Register of Historic Places (NRHP) significance. The purpose of the survey was to identify sites significant in terms of the National Register of Historic Places criteria (36 CFR 60) as required by the Archeological Resource Protection Act (Public Law 96-95) and Army regulations (AR420-20). The 10,280 acres were surveyed on four major landforms: Rush Ridge, O'Bryan Ridge, Barnes Ridge, and Sugar Tree Ridge. Two hundred and thirty-nine sites were discovered or relocated during the survey and subsequently tested.

Field work for the project began in March, 1989 with the survey of 1,920 acres of the area adjacent to Tom Bird Blue Hole. In April 1989, 2,800 acres of high probability areas on O'Bryan Ridge and north to the levee were surveyed, as were 750 acres of low probability areas, in order to test the validity of the predictive model. Also included was a survey of 1,710 acres on Sugar Tree Ridge and Barnes Ridge, in the south part of the project area. A records search was conducted for the entire project area. Surveying continued through the fall of 1989, and the last 200 acres were completed in spring 1990. The 10,280-acre survey identified 224 archeological sites and 24 isolated finds in the project area.

From July 1989 through April 1993 a total of 223 sites were tested for significance. Work was concentrated on the high scour areas of O'Bryan, Barnes, and Sugar Tree ridges, and all cultural resource sites in these areas were tested. Numerous sites on different landforms in the northern part of the floodway were also tested. Seventy-four of the 223 sites tested had intact deposits, and were considered significant in terms of National Register of Historic Places criterion D. An additional 51 mainly small sites were considered to have partially intact features that were temporally clean and could contribute to knowledge of the past in a way that larger sites could not. It was determined that these sites were significant as a class.

The Missouri State Historic Preservation Officer (SHPO) concurred with these findings, and consultation with SHPO resulted in a proposed plan to conduct data recovery (mitigation) on 25 of the significant sites. A Programmatic Agreement (PA) for mitigation was developed and signed by the Memphis District, the Missouri SHPO, and the Advisory Council on Historic Preservation. Mitigation of sites began in 1997 and as of September 2001, four sites remain to be mitigated.

5.0 ENVIRONMENTAL CONSEQUENCES

5.1 AGRICULTURAL LAND

5.1.1 Alternative 1: Without-Project

Existing conditions in both basins are expected to remain the same under the Without-Project Alternative. No changes in agricultural patterns are expected. Existing monthly mean elevations and two-year flood elevations for the St. Johns Bayou Basin and New Madrid Floodway are provided in tables 5-1 through 5-4.

5.1.2 Alternative 2: Authorized Project

Channel enlargement and the pumping station in the St. Johns Bayou Basin would reduce flooding on 44,545 acres of agricultural land below 300 feet NGVD. Backwater flooding from interior drainage during 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. 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. Only a small amount of prime and unique farmland is located in the project ROW and its loss is considered insignificant. Monthly mean elevations and two-year flood elevations for the authorized project for the St. Johns Bayou Basin and New Madrid Floodway are provided in tables 5-1 through 5-4.

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

Monthly Mean Elevation and Acreage								
Month	**Monthly Mean Elevation**	**Acres**	**Authorized Mean Elevation**	**Acres**	**Change***	**Alt. 3 Mean 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

Table 5-2. St. Johns Bayou Basin Mean Two Year Frequency Flood Elevations (1943-1974) and Agriculture Acres Flooded

	Existing Elevation	**Acres Impact**	**Authorized Elevation**	**Acres Impact**	**Change***	**Alt. 3 Elevation**	**Acres Impact**	**Change***
2YR FREQ	291.8	8,764	290.2	6,047	-2,717	290.3	6,047	-2,717

*Represents change in acres flooded under project conditions.

Table 5-3. New Madrid Mean Monthly Sump Elevations (1943-1974) and Agriculture Acres Flooded

Monthly Mean Elevation and Acreage								
Month	Monthly Mean Elevation	Acres	Authorized Mean Elevation	Acres	Change*	Alt. 3-1.A Mean 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	265.9	1	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	277.6	33	4	277.6	32	25
Mean	272.8	14	271.7	16	-2	272.6	14	0

Table 5-4. New Madrid Mean Two Year Frequency Flood Elevations (1943-1974) and Agriculture Acres Flooded

	Existing Elevation	Acres Impact	Authorized Elevation	Acres Impact	Change*	Alt. 3-1.A Elevation	Acres Impact	Change*
2YR FREQ	290	11,837	284.8	1,518	-10,319	284.9	1,518	-10,319

*Represents change in acres flooded under project conditions

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 300 feet NGVD. The pumping station would evacuate rainfall runoff and keep the interior ponding to a minimum, except during controlled impoundments for waterfowl during the winter. Because of this reduction in inundation, local farmers would be able to till earlier and might be able to increase lands devoted to combined winter wheat and soybean production. 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.

Material excavated for the setback levee raise would cover existing grassland that is used for pasture along some sections of the levee and berm. This land would be taken out of production until after project completion, when new grasses would be established.

5.1.3 Alternative 3-1.A

Impacts from this alternative would be nearly identical to Alternative 2 except for the higher start and stop pump elevations of 282.5 feet NGVD and 280 feet NGVD. The St. Johns Bayou Basin channel construction would require about 38 fewer cropland acres as a result of the reduction in channel width from 200 feet to 120 feet along that reach between Missouri Rt. 80 and Missouri Rt. 00, but shifting the St. James Ditch work bank from left to right for a 2.6-mile reach through high-quality woodland habitat would require 50 additional cropland acres. Because the upper 3.7 miles of St. James Ditch would be eliminated from the project about 25 acres along this reach would no longer be required. Finally, there would be no significant impacts to prime farmland.

In the St. Johns Bayou Basin, the two-year frequency flood would reduce damages on approximately 2,717 acres, or about 31 percent of the cropland. 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. Monthly mean elevations and two-year flood elevations for Alternative 3-1.A for the St. Johns Bayou Basin and New Madrid Floodway are provided in tables 5-1 through 5-4.

5.1.4 Alternative 3-1.B (Recommended Plan)

This alternative involves allowing the backwater flooding from the Mississippi River into the New Madrid Floodway to rise to an elevation of 284.4 before the floodgates would be closed and pumping initiated. These operations would generally be in effect from March 1 until May 15 of each year. Operations in the St. Johns Bayou Basin would be as described in Alternative 3-1.A. Effects of this alternative on the St. Johns Bayou Basin would the same as those described for Alternative 3-1.A.

The floodgates would remain open to allow flooding on 2,002 acres compared to 1,034 acres with Alternative 3-1.A. Increased inundation would occur primarily in the low areas not normally planted in early season crops. Land adjacent to the 284.4 pool could become saturated, thereby inhibiting farming until after May 15 when the pool would be pumped down to the 280.0 stop pump elevation. The estimated time required to pump from 284.4 to 280.0 is 1.5 days plus 3.3 days for each inch of runoff. Thus, in a year when water is impounded in the floodway at elevation 284.4 on May 15, the ponded water would not be pumped off until May 20 if there is a coincidental rainfall sufficient to produce an average of 1 inch of runoff over the entire floodway.

5.1.5 Alternative 3-1.C

This alternative differs from Alternative 3-1.B in that every three years water levels would be allowed to rise to 288 feet between March 1 and May 15. Such backwater flooding would allow inundation on 8,195 acres compared to 2,002 acres and 1,034 acres for alternatives 3-1.B and 3-1.A respectively.

Much of the area inundated between 284.4 and 288.0 would be planted in early season soybeans in an average year with Alternative 3-1.A. Land adjacent to the 288.0 pool could become saturated, thereby inhibiting farming until after May 15 when the pool would be pumped down to the 280.0

stop pump elevation. The estimated time required to pump from 288.0 to 280.0 is 6.5 days plus 3.3 days for each inch of runoff. Thus, in a year when water is impounded in the floodway at elevation 288.0 on May 15, the ponded water would not be pumped off until May 25 if there is a coincidental rainfall sufficient to produce an average of one inch of runoff over the entire floodway.

5.1.6 Alternative 3-2.A

This alternative involves the relocation of the closure levee farther up in the New Madrid Floodway and allowing water levels to rise to 282.5 feet prior to pumping. Although this alternative would fail to protect 471 acres farmland, the overall effects are similar to those of Alternative 3-1.A.

5.1.7 Alternative 3-2.B

This alternative incorporates the levee location of Alternative 3-2.A and the gate and pumping operations of Alternative 3-1.B. Although this alternative would fail to protect 471 acres of farmlands, the overall effects are similar to those of Alternative 3-1.B.

5.1.8 Alternative 3-2.C

This alternative incorporates the levee location of Alternative 3-2.A and the gate and pumping operations of Alternative 3-1.C. Although this alternative would fail to protect 471 acres of farmlands, the overall effects for the area protected are similar to those of Alternative 3-1.C.

5.1.9 Alternative 3-3.A

This alternative involves the location of the closure levee farther up in the floodway and allowing maximum water levels of 282.5 feet prior to pumping. Although this alternative would fail to protect 1,506 acres farmlands, the overall effects are similar to those of Alternative 3-1.A.

5.1.10 Alternative 3-3.B

This alternative incorporates the levee location of Alternative 3-3.A and the gate and pumping operations of alternatives 3-1.B and 3-2.B. Although this alternative would fail to protect 1,506 acres of farmlands, the overall effects are similar to those of Alternative 3-1.B.

5.1.11 Alternative 3-3.C

This alternative differs from Alternative 3-2.B in that every three years the water level would be allowed to rise to an elevation of 288 feet until May 15. There would be a greater amount of agricultural land inundated than that inundated under Alternative 3-2.B, but the amount flooded is a relatively small part of the project area.

This alternative incorporates the levee location of Alternative 3-3.A and the gate and pumping operations of Alternative 3-1.C. Although this alternative would fail to protect 1,506 acres of farmlands, the overall effects for the area protected are similar to those of Alternative 3-1.C.

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 near 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 is not expected to be practical and is not foreseen even if agricultural prices increase. This trend is indicated in MDC 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.

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, this levee could prevent intermediate flood stages from reaching the park if the local interests should decide to maintain the levee and repair problems that have already occurred. 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 in Big Oak Tree State Park 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., baldcypress 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. 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, 6.8 acres of forested wetlands would be cleared to construct the levee closure and pumping station. About 2.2 acres would then be permitted to revegetate. No wooded lands would be cleared to raise the Setback Levee. No channel enlargement work would be performed in the New Madrid Floodway.

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 floodwaters. 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.

The USFWS states that indirect impacts would be caused by project related hydrologic changes. 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 forested tracts. 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.).

Most 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 (clay) and topography (lower land elevations). They would

continue to experience inundation during interior rainfall events resulting in headwater, 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. 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 will be evaluated on a case-by-case basis with on-site determinations made regarding specific wetland impacts.

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 government has little control over actions that landowners may take until those actions fall under Section 404 jurisdiction or Section 10 of the Rivers and Harbors Act

To fully mitigate BLH losses agricultural land would be purchased in fee title and reforested in BLH. All direct and indirect woodland impacts would be fully compensated under the fishery mitigation recommendation.

5.2.3 Alternative 3-1.A

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 ditch bank 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 compared to 747 acres under Alternative 2.

BLH losses would be compensated under the fishery mitigation recommendation, which includes purchasing in fee title and reforesting frequently flooded agricultural lands.

5.2.4 Alternative 3-1.B (Recommended Plan)

For Alternative 3-1.B the placement of the closure levee and pump stations would be the same as in Alternative 3-1.A. However, the operation of the control structures within the New Madrid Floodway would allow the floodwaters to reach an elevation of 284.4 feet between January and May, as described in Section 5.1.4. At that time the floodwaters would be pumped out of the floodway to maintain an elevation of 282.5 feet or below for the remaining portion of the year. These operations will lessen the impact to the forested habitats within the floodway. Forested tracts of land would continue to provide habitat for a variety of wildlife species. The only clearing associated with this option would be the 6.8 forested wetland acres cleared for the construction of the levee closure and pump station as stated in Alternative 2. Approximately 2.2 acres of these 6.8 acres would be allowed to revegetate into bottomland hardwoods (BLH).

5.2.5 Alternative 3-1.C

The levee closure and pump station construction and location for this option would be the same as Alternative 3-1.A. However, the floodwaters would be allowed to reach 284.4 feet between January and May of each year, as described in Section 5.1.5. Every third year between January and May, the floodwaters would be allowed to rise to 288 feet. Impacts associated with this alternative would be the same as Alternative 3 1B. The construction of the levee closure and pump station would initially impact approximately 6.8 forested wetlands acres of BLH habitat. After construction, approximately 2.2 acres of the 6.8 would revegetate to BLH. There would be no other direct impacts to forested habitats associated with this alternative. The increased floodwaters would not have an adverse affect on the forested habitats within the floodway.

5.2.6 Alternative 3-2.A

Under Alternative 3-2.A, the levee closure and pump station would be relocated to a position north of the Alternative 3-1.A levee location. Operation of the pump station would only allow the floodwater elevation to reach 282.5 feet. This would greatly reduce the amount of backwater flooding received from the Mississippi River above the closure levee. This reduction in amount of floodwaters above the closure levee would have no adverse affects to the forested habitat above the closure levee. These habitats would continue to provide habitat for a variety of wildlife species. The construction of the levee would directly impact approximately 9.8 acres of forested wetland habitat. With this closure location, 148 acres of woodlands would remain outside the protected area and subject to unconstrained backwater flooding from the river.

5.2.7 Alternative 3-2.B

Alternative 3-2.B would utilize the same levee closure alignment and pump station design as proposed for Alternative 3-2.A. The difference would be the floodwater elevations at which the pumps would begin and stop operation. Floodwaters would be allowed to reach elevation 284.4 between January and May but would be maintained at 282.5 for the remaining portion of the year. The direct construction impacts would be 9.8 acres of BLH habitat. The increased floodwater elevations from Alternative 3-2.A would have no adverse impact to the BLH habitat within the floodway above the levee. The forested habitats below the levee closure would provide the same amount of wildlife habitat as it currently provides under existing conditions.

5.2.8 Alternative 3-2.C

The pump operation under Alternative 3-2.C would allow floodwaters to reach 284.4 feet between January and May of each year with an increase to 288 every third year. The levee alignment and pump station for this option would be the same as Alternative 3-2.A. Therefore, the impacts to forested habitats would remain the same as under Alternative 3-2.A. Impacts would include approximately 9.8 acres of forested habitat lost by the construction of the levee and pump station. There are no indirect impacts to forested habitats associated with the implementation of this alternative.

5.2.9 Alternative 3-3.A

Alternative 3-3.A proposes to construct an 18,500-foot levee north of the location of Alternative 3-1.A. The operation of the pump station would only allow floodwaters to reach 282.5 feet within the floodway above the levee. The only impacts to forested habitats anticipated for this alternative would be direct impacts from the construction of the levee and pump station. There would be approximately 10.4 acres of forested habitat cleared during the construction phase. The operation of this alternative would have no adverse impacts on forested habitats within the levee closure. Forested lands (about 1,000 forested acres) below the levee closure would remain in their current state as under existing conditions.

5.2.10 Alternative 3-3.B

The levee alignment and pump station locations for this alternative would be the same as Alternative 3-3.A. This alternative would allow more floodwaters into the floodway before floodgates are closed and pumping begins. Between March and May, the floodwater elevations would be maintained at 284.4 feet. The remaining portion of the year, floodwaters would be maintained at 282.5 feet. Direct impacts to forested habitats associated with this alternative would include clearing of 10.4 acres of forested habitat during the construction of the option levee and pump station. Variations in the operational criteria of this alternative would have no adverse impacts on forested habitats within the floodway above the levee. Forested habitats occurring below the levee would continue to provide the same amount of habitat as is provided under the No-Action Alternative.

5.2.11 Alternative 3-3.C

Alternative 3-3.C would utilize the same levee alignment and pump station location as proposed for Alternative 3-3.B with an operational difference in the pump station. Floodwaters would be allowed to reach 284.4 feet above the levee each year. The operational variation would be to allow floodwaters to reach 288 feet every third year. Impacts occurring from implementation of this alternative would include the clearing of 10.4 acres of forested habitat during the construction of the levee and pump station. The variations in pump operations would have no adverse affects to forested habitats.

5.3 WETLANDS

Wetlands analyses are presented in Appendix D. Section 404(b)1 analyses are presented in Appendix F.

5.3.1 Alternative 1: Without-Project

A total of 18,120 acres of wetlands of all types were delineated in the project area at or below 300 feet NGVD. These wetland acres were determined through an inundation analysis depending upon the land use per rationale detailed in Section 4.3.1. Of the total acres, 6,461 acres are located in the St. Johns Bayou Basin (Table 4-1) and approximately 11,659 acres are located in the New Madrid Floodway (Table 4-2). Approximately 53 percent of total wetlands are cropland, and 33 percent are forested. Herbaceous vegetation and open water comprise the remaining 14 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 as well as experience interior/headwater flooding.

All the forested wetlands that can reasonably 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 and advocates reduced water control, i.e., reliance on natural water level fluctuations and river connectivity to benefit stressed forest wetlands.

5.3.2 Alternative 2: Authorized Project

As presented in Table 4-1, the GIS land cover information revealed that only 121 acres of wetlands in the St. Johns Bayou Basin would be impacted directly through ditch enlargement. The 121 acres of wetlands are composed of 107 acres of forested, six acres of cropland, five acres of herbaceous vegetation, and less than three acres of open water and pasture, as outlined in further detail in Appendix D. Other impacts of this alternative to the St. Johns Bayou Basin would be similar to the 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 forested, 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.

Alternative 2 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 2,060 wetland acres below 300 feet NGVD. This figure is based on the GIS coverage and verification with the satellite image of April 22, 1993 that also includes saturated acres. In the New Madrid Floodway, periodic inundation would be reduced on about 11,218 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, non-agricultural wetlands within both basins would 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, high clay content in the topsoil, and the high groundwater table in the 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 (Lucky, 1985), regardless of backwater. 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 satellite image of April 22, 1993. The Landsat photograph of the 1997 flood also illustrates this. This hydrology helps explain the source of existing wetlands located above the five percent continuous inundation elevation due to backwater flooding.

It is likely that farmed wetlands would be impacted with this alternative. Although NRCS has made very few FW determinations in the project area, Corps hydrological analysis has determined that 15 consecutive day inundation, which is one aspect of farmed wetland NRCS classification, would be reduced. Up to 1,341 acres of potential FW in the St Johns Basin and 6,152 acres of potential FW in

the New Madrid Floodway would receive reduced inundation from backwater flooding. Although some of these areas may still experience this degree of inundation because they are in low areas that tend to retain water and also because they will still be subject to headwater flooding, there will still be a reduction in inundation. Although these farmed wetlands would still retain some wetland characteristics, their jurisdictional status as a farmed wetland could be lost in the event that NRCS was called upon to perform a Food Security Act (FSA) determination.

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) and the impacts to wetlands are fully mitigated under the plan.

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 rainfall even under project conditions, thus 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.

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) should provide years in which 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 that overtops red oak species during the dormant season could lead to high mortality and 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. This trend is indicated by MDC 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 B).

A mitigation plan has been designed to compensate for project related habitat losses. Changes to wetland habitat will be mitigated through reforesting frequently flooded cropland for fishery mitigation. In addition, the plan includes purchasing flood easements on fallow land. The mitigation plan will result in significant gains in terms of wetland functional values and detrital export.

The USFWS believes that there would be a substantial project induced loss of wooded wetlands. Their concerns are addressed in the wildlife impacts section of the SEIS, Appendix E, Appendix M (Service comments and responses), and elsewhere.

5.3.3 Avoid and Minimize Alternatives

St. Johns Bayou Basin: 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 less than one acre of pasture and open water) to the project rights-of-way. 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.

Approximately 2,016 acres of wetlands below the 300-foot NGVD elevation in the St. Johns Bayou Basin would experience a reduction in inundation. As shown in Table 4-1, backwater flooding would be reduced on up to 34 percent of the land the Corps evaluated as wetlands in the St. Johns Bayou Basin. As discussed in the previous sections and in Alternative 2, no wetlands associated with the project will be drained. However, up to 1,296 acres of potential farmed wetlands would be subject to reduced inundation; therefore, their potential for being classified as a jurisdictional farmed wetland may also be impaired. Approximately 554 acres of forested wetlands will experience reduced inundation (Table 4-1). However, as a the result of normal rainfall, high clay content in the topsoil, and the high groundwater table in the aquifer underlying both basins during high Mississippi River stages, there would be no wooded wetland loss related to this project. Impacts to existing borrow pits would be the same as under Alternative 2.

New Madrid Floodway: Within the New Madrid Floodway, five options have been suggested as avoid and minimize alternatives. Two of these were not considered for detailed analysis (Section 2.4.4). The remaining three alignment locations (Section 2.3) have each been evaluated under a "greatest wetland impact approach." The supplemental start/stop pump approaches are discussed qualitatively.

5.3.3.1 Alternative 3-1.A: In the New Madrid Floodway, construction would directly impact approximately 12 acres of wetlands within the levee closure ROW. Impacts due to direct construction would be similar to Alternative 2.

Approximately 11,189 acres of wetlands below the 300-foot NGVD elevation in the New Madrid Floodway would experience reductions in inundation due to backwater. Approximately 3,562 acres of forested wetland and 6,122 acres of wet cropland (farmed wetland) will experience reduced inundation (Table 4-2). The remaining wetland areas receiving less inundation are herbaceous, scrub/shrub, marsh, and open water lands. As shown in Table 4-2, backwater flooding would be reduced on up to 95 percent of the land the Corps evaluated as wetlands in the New Madrid Floodway at or below 300 feet NGVD. Impacts to existing borrow pits would be the same as under Alternative 2.

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. The Corps will assist MDNR in the development and implementation of water management measures beneficial to the park. 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 could be included to direct sediment-laden surface runoff water to the park, especially if mitigation lands adjacent to the park provide direct access with one or more of several ditches surrounding the park.

5.3.3.2 Alternative 3-1.B (Recommended Plan): This alternative differs from Alternative 3-1.A in that the gates will be allowed to remain open from March 1 until Mississippi River backwater flooding reaches 284.4 feet through May 15. This will increase the depth and area of backwater flooding, thereby reducing the impacts described for Alternative 3-1.A.

The gate operation allows the backwater connectivity to increase from 282.5 to 284.4 feet NGVD and will increase the inundated farmed and non-farmed wetland acres. Approximately 3,426 acres of forested wetland and 5,417 acres of wet cropland (farmed wetland) will experience reduced inundation. These decreases in reduced inundated acres are actually a measure of the reduction in project wetland impacts.

Other impacts are similar to Alternative 3-1.A.

5.3.3.3 Alternative 3-1.C: This alternative is similar to Alternative 3-1.B except that every third year the gates would be allowed to remain open from March 1 through May 15 allowing backwater connectivity to an elevation of 288 feet and this will not appreciably decrease the wetland impacts. The frequency that the wetlands would receive a higher level of inundation due to this modification to the gate operations would be at most once every three years and would not benefit the wetlands in any sustainable measure. Therefore, the reduction in wetlands impact will not be different from Alternative 3-1.B.

5.3.3.4 Alternative 3-2.A: In the New Madrid Floodway, direct construction would impact approximately 15 acres of wetlands within the levee closure ROW. Approximately 3,476 acres of forested wetland and 6,011 acres of wet cropland (FW) will experience reduced inundation due to backwater (Table 4-2). The remaining wetland areas receiving less inundation are herbaceous, scrub/shrub, marsh, and open water lands.

Approximately 10,961 acres of wetlands below the 300-foot NGVD elevation in the New Madrid Floodway would experience reductions in inundation. As shown in Table 4-2, backwater flooding would be reduced on up to 93 percent of the land the Corps evaluated as wetlands in the New Madrid Floodway. 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.

5.3.3.5 Alternative 3-2.B: This alternative differs from Alternative 3-2.A in that the gates will be allowed to remain open until Mississippi River backwater flooding reaches 284.4 feet from March 1 through May 15 of each year. This will increase the depth and area of backwater flooding, thereby reducing the impacts described for Alternative 3-1.A.

The gate opening increase from 282.5 to 284.4 feet NGVD will increase the inundated farmed and non-farmed wetland acres. Approximately 10,005 acres of wetlands below the 300-foot NGVD elevation in the New Madrid Floodway would experience reductions in inundation. Of this total, approximately 3,343 acres of forested wetland and 5,302 acres of wet cropland (farmed wetland) will experience reduced inundation. The remaining acres are scrub, shrub, marsh, open water, and herbaceous lands. These decreases in reduced inundated acres are actually a measure of the reduction in project's wetland impacts.

All other impacts will be similar to Alternative 3-2.B.

5.3.3.6 Alternative 3-2.C: This alternative is similar to Alternative 3-2.B except that every third year the gates would be allowed to remain open from March 1 through May 15 allowing backwater connectivity to an elevation of 288 and this will not appreciably decrease the wetland impacts. The frequency that the wetlands would receive a higher level of inundation due to this modification to the gate operations would be at most once every three years and would not benefit the wetlands in any sustainable measure. Therefore, the reduction in wetlands impact will not be different than Alternative 3-2.B.

5.3.3.7 Alternative 3-3.A: Construction would directly impact approximately 29 acres of wetlands within the levee closure ROW. Approximately 9,977 acres of wetlands below the 300-foot NGVD elevation in the New Madrid Floodway would experience reductions in inundation. Of these, approximately 2,763 acres of forested wetland and 5,824 acres of wet cropland (FW) will experience reduced inundation from backwater (Table 4-2). The remaining wetland areas receiving less inundation are herbaceous, scrub/shrub, marsh, and open water lands. As shown in Table 4-2, backwater flooding would be reduced on up to 85 percent of the land the Corps evaluated as wetlands in the New Madrid Floodway. 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.

5.3.3.8 Alternative 3-3.B: This alternative differs from Alternative 3-3.A in that the gates will be allowed to remain open from March 1 through May 15 until Mississippi River backwater flooding reaches 284.4 feet through May 15. This will increase the depth and area of backwater flooding, thereby reducing the impacts described for Alternative 3-1.A.

The gate opening increase from 282.5 to 284.4 feet NGVD will increase the inundated farmed and non-farmed wetland acres. Approximately 9,028 acres of wetlands below the 300-foot NGVD elevation in the New Madrid Floodway would experience reductions in inundation. Of these, approximately 2,637 acres of forested wetland and 5,114 acres of wet cropland (farmed wetland) will experience reduced inundation. These decreases in reduced inundated acres are actually a measure of the reduction in project's wetland impacts.

All other impacts will be similar to Alternative 3-3.A.

5.3.3.9 Alternative 3-3.C: This alternative is similar to Alternative 3-3.B except that every third year the gates would be allowed to remain open from March 1 through May 15 allowing backwater connectivity to a water elevation of 288 and this will not appreciably decrease the wetland impacts. The frequency that the wetlands would receive a higher level of inundation due to this modification to the gate operations would be at most once every three years and would not benefit the wetlands in any sustainable measure. Therefore, the reduction in wetlands impact will not be any more than Alternative 3-3.B.

All other impacts will be similar to Alternative 3-3.B.

5.4 WILDLIFE

A terrestrial HEP was used to evaluate the impacts of the St. Johns Bayou Basin and New Madrid Floodway Project on the wildlife habitat of forested wetlands and scrub-shrub/marsh. An interagency team composed of biologists from the USFWS, the MDC, the Corps, and a private consulting firm, G.E.C., 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 performed 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 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 USFWS CAR, located in Appendix E 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 refuge 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 979 acres within St. Johns Bayou ROW. Larger, mobile wildlife could move to the other areas during project construction. More sedentary and smaller species could be buried with excavated material. Wildlife populations would recover over time once vegetation has matured on the 585 acres of conservation easements. Table 5-5 outlines the acres impacted by each alternative in the St. Johns Bayou Basin.

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

Habitat	Without-Project	Alternative 2	Alternative 3
Bottomland Hardwood Forest	0	747	536
Scrub/Shrub Swamp and Marsh	0	0	0
Cropland	0	232	244

Conservation easements on new embankment areas would permit their use as deposition sites. These easements would prohibit farming to the channel edge. Excavated material would be fertilized and seeded with a mixture of Korean lespedeza, switchgrass, or some other 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 material. Wherever channel maintenance is not required or is not performed for any length of time, the adjacent ROW habitat would mature naturally.

The terrestrial HEP (Appendix E) 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 after providing value by restrictive easements

within much of the project ROW, there would still be a net loss of 2,754 AAHUs in the St. Johns Bayou Basin (Table 5-6).

Table 5-6. Average Annual Habitat Units Lost by Each Alternative in the St. Johns Bayou Basin Due to Construction (Direct Impacts)

Habitat	Without-Project	Alternative 2	Alternative 3
Bottomland Hardwood Forest	0	-2,754	-1,993
Scrub/Shrub Swamp and Marsh	NA	NA	NA
Cropland	0	-119	-104

There would be a loss of 6.8 wooded acres due to construction of the New Madrid Floodway levee closure (Table 5-7). This amounts to 66 AAHUs for the five evaluation species (Table 5-8). 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.

5-7. Wildlife Habitat Acres Impacted by Each Alternative in the New Madrid Floodway Due to Construction (Direct Impacts)

	Habitat	Without - Project	Alt. 2 (acres)	Alt. 3-1 (acres)	Alt. 3-2 (acres)	Alt. 3-3 (acres)
Direct Impacts	Scrub/Shrub Swamp and Marsh	0	0	0	0	0
	Bottomland Hardwood Forest	0	6.8	6.8	9.8	10.4
	Cropland	0	3	3	3.8	10.8

Table 5-8. Average Annual Habitat Units Impacted by Each Alternative in the New Madrid Floodway Due to Construction (Direct Impacts)

Habitat	Without - Project	Alt. 2	Alt. 3-1	Alt. 3-2	Alt. 3-3
Bottomland Hardwood Forest	0	-66	-66	-41	-43.5
Scrub/Shrub Swamp and Marsh	0	+4	+4	0	0
Cropland	0	0	0	0	0

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.

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 not be significant.

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 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 in both basins. 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 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 herbaceous land as discussed in Appendix E.

The USFWS believes that impacts would be greater than shown in the preceeding tables because they believe the project would lead to induced clearing of woodlands. Their rationale is contained in their CAR.. As previously stated, the Corps and USFWS disagree concerning this matter. In the interest

of full disclosure, the following is excerpted from Appendix C of the Draft CAR (Appendix E). The full text and referenced tables are contained in the CAR.

> *The interagency team oversaw all HEP analyses and developed assumptions for existing, future with-project, and future without-project conditions to quantify habitat changes. Under the future without-project alternative, the team assumed that habitat quality and quantity would remain essentially unchanged from existing conditions. Under the future with-project alternatives, the team initially agreed that 90 percent of existing privately owned forested wetlands that will be dewatered during the growing season due to the levee closure and pump operations would be converted to agriculture over the 50-year life of the project (excluding timber company land, lands in the WRP program and mitigation land). Since then, the Corps has reviewed soil surveys and Mississippi River seepage information and concluded there would be no induced development of forested wetlands because of the project. They maintain that forested wetlands will remain wet and therefore protected under existing wetlands regulations. Neither the Service nor MDC has seen any information to change their initial assumptions. Therefore, the HEP analyses quantified direct and indirect habitat impacts separately. Based on information from the Corps, the team assumed that habitat in the project footprint (i.e., construction and staging areas) would be cleared completely in the first year of construction, while habitat along channel rights-of-way will be cleared at a rate of 20 percent per year over the five years of construction. Other assumptions concerning future land use were adopted from project design specifications which include conservation easements over the channel rights-of-way to allow natural revegetation. Using the GIS-generated area figures and the guidance and assumptions of the HEP team, acreage figures for each project area under each alternative were calculated. The mink analysis was run separately since suitable habitat for the mink (adjacent to permanent water) was not found uniformly in the stands sampled for BLH.*

Regarding mitigation required for the project, USFWS wrote:

> *The Service and MDC believe there will be significant indirect, project-related effects to forested wetlands because of hydrologic changes (i.e., eliminating seasonal inundation). As previously mentioned, we believe conversion of forested wetlands to other land uses (primarily agriculture) would result in a loss of approximately 2,823 AAHUs in the St. Johns basin, and 6,496 AAHUs for the Authorized Project or 6,217 AAHUs for the A&M alternatives in the New Madrid Floodway. We recommend that the Corps purchase in fee-title, sufficient croplands to fully compensate habitat losses from induced development of those wetlands. Using the same reforestation methods described above, approximately 2,120 acres would be necessary to compensate for project-related habitat losses in the St. Johns Bayou basin. In the New Madrid Floodway, 4,787 acres (Authorized Project) or 4,669 acres (A&M) would be required to compensate for forested wetland habitat losses from the levee closure and pump operations under the Authorized Project and A&M alternatives, respectively (Table C-5).*

The preceding was presented in the interest of full disclosure regarding potential project impacts. According to the USFWS, a total of 6,907 acres of mitigation lands would be required to compensate project induced wildlife losses for the authorized alternative. It should be noted that the Corps

mitigation plan for this alternative includes acquisition and reforestation of 10,312 acres-substantially more than required to offset losses based on Service analysis and recommendations.

5.4.3 Alternative 3-1.A

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.

In the St. Johns Bayou Basin, the terrestrial HEP indicated that 1,993 AAHUs would be lost due to direct construction impacts (Table 5-6). 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.

Wildlife in the Big Oak Tree State Park would be preserved with implementation of a water management plan. 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 HEP indicated a shorebird habitat loss of 104 AAHUs in St. Johns Bayou Basin. This amounts to about a 27 percent habitat reduction. The New Madrid Floodway would lose 657 AAHU for a 68 percent shorebird habitat reduction. Shorebird habitat losses in both basins would be fully compensated with easements acquired on 765 acres of herbaceous lands.

The complete HEP is contained in Appendix E of this report and presents a detailed analysis of the wildlife impacts for each basin. The Mitigation Plan (Appendix L) outlines actions required to mitigate terrestrial habitat value impacts. According to USFWS and based upon their projections regarding induced woodland clearing, 6,789 acres of reforested agricultural lands would be required to compensate 9,040 average annual habitat unit losses. Proposed mitigation for this alternative (9,557 acres) would fully compensate for the loss.

5.4.4 Alternative 3-1.B (Recommended Plan)

The implementation of this alternative would directly impact 6.8 acres of forested habitat with the construction of the levee closure. This is a loss of approximately 66 AAHUs previously available to wildlife species utilizing this habitat. The slight increase in floodwater elevations allowed between March and May would have no adverse impacts on the wildlife common to the forested habitats. In fact, these elevations are still lower than the elevations reach under the existing conditions. Therefore, the terrestrial wildlife would continue to benefit under this alternative, since less acres would be flooded and fewer numbers of terrestrial wildlife would be displaced from their habitat.

According to the HEP, the species utilizing the scrub/shrub/marsh habitat would gain approximately 4.09 AAHUs over the existing conditions with implementation of this alternative. This would be due to an increase in the quality of the habitat over the economic life of the project. Most of the areas containing this habitat is located within borrow pits. It was assumed that these areas would receive enough rainfall and runoff to maintain the growth of hydrophytic vegetation, which defines this habitat.

Shorebird habitat would be similar to 3-1.A; however, with the change in floodwater elevations between March and May, impacts to shorebirds would be reduced under Alternative 3-1.B. Thus, mitigation that was formulated to fully compensate fishery impacts (8,375 acres of reforested cropland) would fully compensate shorebird and wildlife impacts.

5.4.5 Alternative 3-1.C

Impacts to terrestrial wildlife, which utilizes forested habitats, would be the same as Alternative 3-1.B. These impacts are from the clearing of 6.8 acres of forested habitat within the levee closure right-of-way. By increasing the floodwater elevation between March and May from 284.4 feet to 288 feet every third year, there would be no adverse impacts to the wildlife populations occurring within the forested habitats. This alternative would be beneficial to terrestrial wildlife by decreasing the amount of habitat that would be flooded and the number of individuals displaced.

Scrub/shrub/marsh habitats occurring within the project area would provide an increased amount of AAHUs under this alternative just as in Alternative 3-1.B. The increased floodwaters every third year would help revitalize these habitats by replenishing the nutrients and food source utilized by the terrestrial wildlife common to these habitats. As a result, shorebird habitat losses in both basins would be fully compensated with easements acquired on 765 acres of herbaceous lands.

During the years in which the floodwater elevations are maintained at 284.4, the shorebird habitat would be the same as in Alternative 3-1.B. However, every third year when the floodwater elevation would reach 288 feet, the amount of habitat available to the shorebird would increase slightly.

Wildlife losses would be fully compensated by the reforestation of 6,926 acres of cropland.

5.4.6 Alternative 3-2.A

This alternative proposes to relocate the levee closure further into the floodway. The construction of the levee would require clearing 9.8 acres of forested habitat. This would amounts to a loss of 41 AAHUs available to terrestrial wildlife that utilizes this habitat from that of existing conditions. The portion of the floodway below the levee closure would continue to flood every year as it presently floods. Terrestrial wildlife in this area would continue to seek refuge from the flood by moving to surrounding areas as it does under the existing conditions. Above the levee closure, terrestrial wildlife would have some protection from the flooding. The levee would decrease the number of acres flooded each year thereby decreasing the amount of wildlife displaced during flooding.

Wildlife utilizing the scrub/shrub/marsh habitat would not realize an adverse impact from implementation of this alternative. Affects from the decreased flooding would be the same as those discussed under Alternative 3-1.A.

Shorebird habitat would decrease from 961 AAHUs under the No-Action Alternative to 314 AAHUs under this alternative. There would be a slight increase over Alternative 3-1.A due to the acres of shorebird habitat below the levee being calculated using existing condition elevations. The construction of the levee would have no adverse impacts to shorebird habitat. Under this alternative, impacts to shorebird habitat in St. Johns Bayou Basin would be the same as those under

Alternative 3-1.A. As a result, shorebird habitat losses in both basins would be fully compensated with easements acquired on 751 acres of herbaceous lands during implementation of this alternative.

Wildlife losses would be fully compensated by the reforestation of 9,345 acres of cropland.

5.4.7 Alternative 3-2.B

Impacts to terrestrial wildlife under this alternative would be the same as discussed in Alternative 3-2.A. The increased floodwaters allowed within the levee closure under this alternative would inundate more terrestrial wildlife habitat and displace more wildlife than under Alternative 3-2.A.

There would be no adverse impacts to the wildlife that utilizes the scrub/shrub/marsh habitats. These areas would function under the same capacity as under the existing conditions.

With the increase in floodwater elevations above the levee closure, the shorebird habitat would also increase slightly when compared to Alternative 3-2.A The acres of habitat below the levee would be the same as discussed under Alternative 3-2.A. Construction activities would have no adverse affects to the shorebirds. Accordingly, the shorebird habitat losses in both basins would be fully compensated with easements acquired on 751 acres of herbaceous lands included in Alternative 3-2.B

Wildlife losses would be fully compensated by the reforestation of 8,160 acres of cropland.

5.4.8 Alternative 3-2.C

During the years in which the floodwater elevations are the same as under Alternative 3-2.B, there would be no additional impacts foreseen for this alternative. However, by increasing the floodwater elevation to 288 feet every third year, there would be an increase in the amount of terrestrial habitat inundated during the spring. This would displace a larger amount of wildlife above the levee closure during every third year. Other impacts associated with this alternative would be the clearing of terrestrial habitat for the construction of the levee. Approximately 9.8 acres of forested land (41 AAHUs) would be lost to these activities. The terrestrial wildlife below the levee closure would continue to be displaced from their habitats during the spring floods each year as they are currently.

All scrub/shrub/marsh habitat occurring within the floodway is located above the levee closure for this alternative. These areas would continue to receive rainfall and runoff, which would maintain the hydrology of this habitat type. Therefore, wildlife common to the scrub/shrub/marsh habitats would not be adversely affected by this alternative.

Amounts of available shorebird habitat above the levee would remain the same as Alternative 3-2.B except during the third year when the floodwater elevations would increase to 288 feet. This increase in floodwaters would increase slightly the amount of shorebird habitat available above the levee for that particular spring. Below the levee the available shorebird habitat would be the same as described in Alternative 3-2.B. Accordingly, shorebird habitat losses in both basins would be fully compensated with easements acquired on 751 acres of herbaceous lands included in Alternative 3-2.C

Wildlife losses would be fully compensated by the reforestation of 6,711 acres of cropland.

5.4.9 Alternative 3-3.A

This alternative calls for the levee to be located further up the floodway than in Alternative 3-2.A. The direct impacts expected from this alternative are the clearing of approximately 10.4 acres of forested habitat for the construction of the levee. These 10.4 acres amount to approximately 43.5 AAHUs lost to direct impacts by the implementation of the alternative. Floodwaters would be maintained at 282.5 feet by the use of floodgates and pumps. This elevation is considerably lower than the elevations reached under the Without-Project Alternative. Therefore, the impact to wildlife above the levee would be significantly reduced. Less wildlife habitat would be flooded each year and less wildlife would be displaced by the floodwaters. Wildlife below the levee would continue to be displaced by the high floodwaters as under the existing conditions.

There would be no expected adverse impacts to wildlife, which occur within scrub/shrub/marsh habitats. This habitat type would remain in its current condition. Rainfall and runoff from surrounding areas would provide the hydrology necessary to maintain the habitat.

By relocating the levee further up the floodway, the impact on shorebird habitat was reduced from the previous alternative. This was due to an increase in acres of available habitat below the levee. This alternative would result in approximately 355 AAHUs available for shorebirds, an increase in 41 AAHUs from habitat available under Alternative 3-2.A. Under this alternative, impacts to shorebird habitat in St. Johns Bayou Basin would be the same as those under Alternative 3-1.A. As a result, shorebird habitat losses in both basins would be fully compensated with easements acquired on 710 acres of herbaceous lands with the implementation of this alternative.

Wildlife losses would be fully compensated by the reforestation of 8,688 acres of cropland.

5.4.10 Alternative 3-3.B

The direct impacts to wildlife caused by the construction of the levee for this alternative would be the same as discussed for Alternative 3-3.A. Under this alternative, the floodwaters would be allowed to reach 284.4 instead of 282.5. The increased area of floodwaters above the levee would displace more wildlife from their habitats. It is assumed that once floodwaters recede, the wildlife would return to their natural habitats. Impacts to wildlife below the levee would remain the same as under existing conditions.

Construction activities associated with this alternative would have no adverse impact on wildlife species associated with the scrub/shrub/marsh habitat. Hydrology needs of these wildlife species would be provided through the slight increase in floodwaters under this alternative along with rainfall and runoff from surrounding areas. Therefore, there should be no adverse impacts to wildlife commonly found in the scrub/shrub/marsh habitat under this alternative.

Under this alternative, the shorebird habitat above the levee should show a slight increase with the increased amount of floodwaters allowed through the floodgates. Available habitat for the shorebirds below the levee would be the same as previously discussed under Alternative 3-3.A. Accordingly, with Alternative 3-3.B shorebird habitat losses in both basins would be fully compensated with easements acquired on 710 acres of herbaceous lands.

Wildlife losses would be fully compensated by the reforestation of 7,503 acres of cropland.

5.4.11 Alternative 3-3.C

The levee construction would have the same impacts on wildlife as the previous alternative. There would be no other impacts expected, due to the clearing of habitat under this alternative. The proposed operation under this alternative would maintain floodwaters at 284.4 feet each year and every third year the floodwaters would be allowed to reach 288 feet before the gates are closed. During the years in which floodwaters are maintained at 284.4 feet the impacts to wildlife would be the same as in Alternative 3-3.B. Every third year when the floodwaters reach 288 feet, there would be an increase in the amount of wildlife habitat inundated and an increase in the amount of wildlife displaced from their habitat.

There would be no impacts to wildlife species, which inhabit the scrub/shrub/marsh habitat. These areas would be maintained at its current conditions through rainfall and runoff from surrounding areas along with the increased floodwaters every third year.

Shorebirds would realize a slight increase in habitat above the levee during the years that the floodwaters reach 288 feet. The other years would continue to provide the same amount of habitat as under Alternative 3-3.B. Below the levee, shorebird habitat would remain the same as in Alternative 3-3.B. Accordingly, shorebird habitat losses in both basins would be fully compensated with easements acquired on 710 acres of herbaceous lands with Alternative 3-3.C.

Wildlife losses would be fully compensated by the reforestation of 6,054 acres of cropland.

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 quantify 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 land cover 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 E.

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 are 333,160 DUDs.

Under the without-project scenario, no change in available DUDs is expected. The area would continue to receive 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. Recent improved estimates indicate that about 6,400 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 adverse 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 lower, reducing habitat that provides food for 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 5-9). 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. Originally under this alternative, 4,900 acres of bottomland hardwoods and croplands in the sump area were to be flooded annually for extended periods. The water was to be maintained at a constant elevation throughout the entire season. However, such inundation is detrimental to BLH (Fredrickson and Batema 1992) and could impact 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.

Table 5-9. Change in Duck-Use-Days in the St. Johns Bayou Basin and New Madrid Floodway

Mitigation Option	Authorized Alternative	Alternative 3-1.A
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
Change in Total DUDs		
St. Johns Bayou Basin	+464,906	+545,856
New Madrid Floodway	+ 50,140	+ 53,374

NOTE: 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.

This alternative would reduce periodic flooding on up to 13,278 acres of wetlands in both basins. In the St. Johns Bayou Basin, about 549 forested and 161 herbaceous land acres would be affected (Table 4-1). The New Madrid Floodway would see a reduction in inundation on 3,561 forested acres and 805 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.

Reestablishing forested wetlands (with a mix of 70 percent red oak species) to compensate for fishery habitat losses would also compensate waterfowl habitat loss, provided the flooding regime was appropriate.

5.5.3 Alternative 3-1.A

Implementation of this alternative would alter the habitat available for wintering and migrating waterfowl. In the St. Johns Bayou Basin, Alternative 3-1.A may increase total DUDs by 545,856 primarily because of increased moist soil and soybean acreage (Table 5-9). Alternative 3-1.A would also provide important forested wetland habitat during spring migration. In the New Madrid Floodway, Alternative 3-1.A 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.

Increased DUDs 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 could be permitted to flow on and off the land as it currently does. Approximately 6,400 acres could be flooded with this alternative.

If river stages are low, the gates would be shut to permit interior flooding up to the ponding elevations. The gates could 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. Maximum flexibility to manage water levels for waterfowl will be provided.

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 operation plan would thus avoid some important waterfowl losses during spring migration.

Inundated BLH is the highest-quality waterfowl habitat. 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 frequently flooded agricultural land for fishery mitigation would fully mitigate project impacts to waterfowl.

5.5.4 Alternative 3-1.B (Recommended Plan)

Effects of this alternative would be similar to Alternative 3-1.A except for gate operational changes in the floodway. Allowing the gate to remain open and flood lands up to elevation 284.4 until May 15 would provide more habitat for migratory waterfowl even though most springtime migration is over by mid-March. Total DUDs would increase and springtime losses would be slightly reduced. With this alternative, an additional 2,000 acres of floodway would be allowed to flood during the March, April and mid-May time frame. Over 90 percent of the lands below elevation 284.4 are in the Eagle's Nest area; the majority of lands flooded would be croplands. Over 500 acres would be woodlands, and these would be considered prime waterfowl habitat.

5.5.5 Alternative 3-1.C

Same as Alternative 3-1.B, except every third year when gates are allowed to remain open to elevation 288. If flooding occurred at this time, approximately 8,200 acres would be allowed to inundate above the closure. The majority of lands inundated would be cropland, but slightly over 2,000 acres below elevation 288 are wooded. Total DUDs would increase and most springtime waterfowl losses would not occur during this third year event.

5.5.6 Alternative 3-2.A

Similar to Alternative 3-1.A. Overall impacts to the floodway would not change with the project exhibiting a substantial increase in wintertime duck use but a loss in springtime habitat. The movement of the closure to this location would leave 637 acres below the closure. Most of the area below the closure is above elevation 284 and all but about 200 acres is above elevation 288; however, most of the area is below the approximate two-year flood event of elevation 290, so would be available to waterfowl during such a flood event.

5.5.7 Alternative 3-2.B

Similar to Alternative 3-1.B except for the 637 acres left unprotected and subject to flooding at elevation 290.

5.5.8 Alternative 3-2.C

Similar to Alternative 3-1.C except for the 637 acres left unprotected and subject to flooding at elevation 290.

5.5.9 Alternative 3-3.A

Impacts above the closure would be similar to Alternative 3-1.A; however, this alternative would leave 2,739 acres below this closure and allow for unconstrained connectivity with these lands and the river during flood events. Over half of this area is wooded and most of the 2,739 acres would be flooded at a two-year event.

5.5.10 Alternative 3-3.B

Similar to Alternative 3-1.B except 2,739 acres would remain below this closure location. About 1,900 acres (mostly croplands) would be above the closure that would be allowed to flood to 284.4 during the March, April, and mid-May time frame. Effects of gate operation would be very similar to Alternative 3-1.B because most of the land that is below elevation 284.4 is in the Eagle's Nest area and above this closure location.

5.5.11 Alternative 3-3.C

Similar to Alternative 3-1.C except for 2,739 acres left below the closure. As with Alternative 3-3.B, about 1,900 acres above the closure would be allowed to flood annually. Every third year up to 7,683 acres would be allowed to flood up to elevation 288. As can be seen, this is very similar in effect to Alternative 3-1.C and indicative that most lands below 288 are above this location. This would be the best alternative for waterfowl because most springtime losses would not occur on a three year cycle and because lands outside of the closure that are mostly woodlands would have unconstrained flooding at a two-year flood event.

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 reductions of floodplain and in-stream habitats affect reproductive success. Details regarding fisheries analyses are presented in Appendix G.

HSI values were multiplied by area (acres of floodplain or in-stream habitats) to obtain habitat units (HUs) available for each project alternative. 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.

Without the project, existing conditions would continue. No major changes to the streams or stream bank 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 because 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 would vary each 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 MDC (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.

Because 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 cy of excavated material. The channel dimensions would be widened and lowered as indicated:

	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.

It has been reported that water temperatures are affected by decreased riparian shading, decreased current, and expanded surface water (Ebert 1993). 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. 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. No ambient water flows would be changed in any tributaries, especially in their upper reaches.

Construction is expected only to temporarily displace the local fishery. Fishes 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.

The golden topminnow, a State-endangered species, has been recently found in the upper reaches of the St. James Ditch (Sheehan *et al*. 1998) among aquatic vegetation. Alternative 2 would remove vegetation during clearing operations, possibly affecting the presence of individuals in the area.

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. That, in turn, would reduce 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 G). 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 5,503 to 110 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 2,924 HUs of rearing habitat and 1,704 HUs of spawning habitat for all species combined.

USFWS has expressed concern that riverine fishes such as white bass would lose most, if not all, of the extensive spawning, rearing, and foraging habitat provided by the floodway. They also believe that the project area's hydrologic, topographic, and vegetative characteristics result in a flora and fauna unlike any other in the state. Although they cannot model these characteristics, they are considered extremely important to fish that use the backwater, especially during high river stages. 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). A variety of other studies has shown that a loss of floodplain habitat has been associated with reductions in abundance, diversity, and productivity in river systems. However, most of the fishes 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 only approximately 3.1 percent of the Mississippi River two-year floodplain from the Ohio River (at Cairo, Illinois) to the White River. 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.

Project implementation would reduce flooding during the spring spawning season, including potential spawning and rearing habitat in the two-year floodplain. The habitat flooded 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 2,924 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 affected 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 that fish movement occurs through the box culverts. It also suggests that fish spawning has been successful in the St. Johns Bayou Basin even though the gates are closed during high Mississippi River stages. The New Madrid Floodway structure would

operate similarly, and adult and young-of-the-year fish movements through these culverts are expected.

The levee closure in the New Madrid Floodway would prevent or reduce access to permanent waterbodies by Mississippi River fishes. 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 it 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 they 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 of the Mississippi River. However, the fish community is likely to represent more lake-dominated species because recruitment from river species will be partially eliminated. The permanent waterbodies will provide expanded recreational fishery opportunities.

Reforestation of 10,315 acres of frequently flooded cropland would mitigate project induced fishery impacts.

5.6.3 Alternative 3-1.A

This alternative 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. 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 concluded that several rock dikes should be used to replace 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 than the 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 HUs.

Riprap bank protection would be placed at the confluence of Setback Levee Ditch and St. Johns Bayou and at the confluence of St. James Ditch and the Setback Levee Ditch to maintain bank stability at these locations. This would also provide additional fishery and benthic invertebrate habitat. Along with natural revegetation of the ditch bank, adding 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 from the St. Johns Bayou Basin. In the New Madrid Floodway, floodplain-rearing HUs would be reduced by approximately 2,720 HUs

To increase fish access during the spawning period from that available under Alternative 2, the gravity outlets for both basins would allow water surface elevations up to 282.5 feet NGVD behind the levee. The average number of days that the river is less than or equal this elevation is 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. 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.

Alternative 3-1.A would increase the available floodplain habitat over Alternative 2. However, the difference in spawning habitat between this alternative and the Alternative 2 is only approximately six percent (Killgore and Hoover 1998).

Table 5-10 provides a comparison of New Madrid Floodway floodplain acres and fishery rearing habitat among alternatives.

Table 5-10. Mid-Season Floodplain Acres and Habitat Units (HUs) for Rearing Fishes in the New Madrid Floodway for Each Alternative

Alternative	Acres Flooded*	HUs Provided
1 (No-Action)	5,613.0	2,998.6
2	109.7	74.5
3-1.A	349.6	278.2
3-1.B	1,036.3	669.2
3-1.C	1891.4	1,147.5
3-2.A	492.4	349.2
3-2.B	1,179.1	740.2
3-2.C	2,034.2	1,218.5
3-3.A	870.1	566.1
3-3.B	1,556.8	957.1
3-3.C	2,411.9	1,435.4

*Average daily acreage flooded during mid-season.

Source: J. Killgore.

Fishery mitigation described in appendices G and L fully compensates for project induced habitat losses. In addition to 9,557 reforested acres of mitigation, the project includes substantial avoid and

minimize measures. These measures, which include arboreal buffer strips along channels, a wildlife corridor, and in-stream habitat dikes, should substantially improve water quality and fish habitat in the New Madrid Floodway. They are described in detail in Appendix L.

5.6.4 Alternative 3-1.B (Recommended Plan)

This alternative is similar to Alternative 3-1.A except for New Madrid Floodway gate operations. Under this alternative backwater flooding from the Mississippi River would be allowed to rise until an elevation of 284.4 feet is reached, at which time the gates would be closed and pumping would begin. This alternative would increase the area inundated and, therefore, the available spawning/rearing habitat and ecological connectivity between the River and the Floodway. A comparison of acres flooded and fishery rearing habitat is provided in Table 5-10. All other impacts would be as described for Alternative 3-1.A. Reforestation of 8,375 acres of frequently flooded lands would mitigate fishery losses.

5.6.5 Alternative 3-1.C

Alternative 3-1.C would further modify New Madrid Floodway gate operations. Under this alternative every third year the water level in the floodway would be allowed to increase until a depth of 288.0 feet is reached. This would provide additional flooded area and fishery habitat. After May 15, the water level would be managed at an elevation of 282.5 feet. All other impacts would be as described for Alternative 3-1.A. Table 5-10 compares the fishery rearing habitat and acres flooded for each alternative. Reforestation of 6,926 acres of frequently flooded lands would mitigate fishery losses.

5.6.6 Alternative 3-2.A

This alternative differs from Alternative 3-1.A in the location of the New Madrid Floodway closure levee, which would be relocated up farther in the Floodway. This action would enable area at the riverside of the levee to experience natural inundation from the Mississippi River. The flooded area and the fishery-rearing habitat would be greater than that of Alternative 3-1.A (Table 5-10). All other impacts would be as described for Alternative 3-1.A. Reforestation of 9,345 acres of frequently flooded lands would mitigate fishery losses.

5.6.7 Alternative 3-2.B

This alternative is similar to Alternative 3-2.A except for New Madrid Floodway gate operations. Under this alternative backwater flooding from the Mississippi River would be allowed to rise until an elevation of 284.4 feet is reached, at which time the gates would be closed and pumping would begin. This alternative would provide an increase over the area inundated by Alternative 3-2.A and in the habitat available for spawning and rearing (Table 5-10). All other impacts would be as those described for Alternative 3-1.A. Reforestation of 8,160 acres of frequently flooded lands would mitigate fishery losses

5.6.8 Alternative 3-2.C

Alternative 3-2.C would modify Floodway gate operations described for Alternative 3-2.B. Every third year the water level in the floodway would be allowed to increase to a depth of 288.0 feet. After May 15, water levels would be managed at an elevation of 282.5 feet. This would provide

additional flooded area and fishery habitat. All other impacts would be as those described for Alternative 3-1.A. Table 5-10 compares the fishery rearing habitat and acres flooded for each alternative. Reforestation of 6,711 acres of frequently flooded lands would mitigate fishery losses.

5.6.9 Alternative 3-3.A

This alternative differs from Alternative 3-2.A in the location of the New Madrid Floodway closure levee, which would be relocated up farther in the Floodway. This action would enable area at the riverside of the levee to experience natural inundation from the Mississippi River. The flooded area and the fishery-rearing habitat would be greater than that of Alternative 3-2.A (Table 5-10). All other impacts would be as those described for Alternative 3-1.A. Reforestation of 8,688 acres of frequently flooded lands would mitigate fishery losses.

5.6.10 Alternative 3-3.B

This alternative is similar to Alternative 3-3.A except for New Madrid Floodway gate operations. Under this alternative backwater flooding from the Mississippi River would be allowed to rise to an elevation of 284.4 feet until May 15. This alternative would provide an increase over the area inundated by Alternative 3-3.A and, therefore, in habitat available for spawning and rearing (Table 5-10). All other impacts would be as those described for Alternative 3-1.A. Reforestation of 7,503 acres of frequently flooded lands would mitigate fishery losses.

5.6.11 Alternative 3-3.C

Alternative 3-3.C would modify Floodway gate operations described for Alternative 3-3.B. Every third year the water level in the floodway would be allowed to increase until a depth of 288.0 feet is reached. After May 15, the water level would be managed at an elevation of 282.5 feet. This would provide additional flooded area and fishery habitat. All other impacts would be as described for Alternative 3-1.A. Table 5-10 compares the fishery rearing habitat and acres flooded for each alternative. Reforestation of 6,054 acres of frequently flooded lands would mitigate fishery losses.

5.7 MUSSELS

Deepening and widening existing channels in the St. Johns Bayou Basin would adversely impact local mussel fauna; the most direct effect would be the physical removal and destruction of mussels in the dredge path. Some mussels might survive the dredging. Barnhart (1998) found a number of mussels in Setback Levee Ditch that had apparently survived a previous dredging event. These were generally found along the wooded bank at sites where only one side was cleared at the time of the dredging. Because 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 dredged area contains the greatest diversity and abundance of mussels found in the project area (Barnhart 1998). Because mussels are essentially motionless, 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 include largemouth bass, white crappie, channel catfish, and freshwater drum. Those fish species are important hosts for a 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 gars. Several species appear to rely solely on freshwater drum, including *Leptodea*, *Potamilus*, and *Truncilla* species. These species are widespread and found in a wide variety of habitats, and although considered unlikely, any major reduction or loss of those fish populations could potentially reduce recruitment into, or exchange among, mussel populations throughout the project area.

According to USFWS and 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, USFWS and 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 relatively few mussel species can tolerate (Fuller 1974, Oesch 1995). Hydraulic evaluations indicate 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 3-1.A

Impacts would be similar to those described for 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 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.

A 10-year monitoring plan would be implemented after construction to evaluate mussel recolonization of the excavated channels. The monitoring plan would also determine the value of

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.

5.7.4 Alternative 3-1.B (Recommended Plan)

Impacts to mussels are restricted primarily to the St. Johns Bayou Basin. Therefore, impacts to mussels from this alternative are similar to Alternative 3-1.A.

5.7.5 Alternative 3-1.C

Impacts to mussels are restricted primarily to the St. Johns Bayou Basin. Therefore, impacts to mussels from this alternative are similar to Alternative 3-1.A.

5.7.6 Alternative 3-2.A

Impacts to mussels are restricted primarily to the St. Johns Bayou Basin. Therefore, impacts to mussels from this alternative are similar to Alternative 3-1.A.

5.7.7 Alternative 3-2.B

Impacts to mussels are restricted primarily to the St. Johns Bayou Basin. Therefore, impacts to mussels from this alternative are similar to Alternative 3-1.A.

5.7.8 Alternative 3-2.C

Impacts to mussels are restricted primarily to the St. Johns Bayou Basin. Therefore, impacts to mussels from this alternative are similar to Alternative 3-1.A.

5.7.9 Alternative 3-3.A

Impacts to mussels are restricted primarily to the St. Johns Bayou Basin. Therefore, impacts to mussels from this alternative are similar to Alternative 3-1.A.

5.7.10 Alternative 3-3.B

Impacts to mussels are restricted primarily to the St. Johns Bayou Basin. Therefore, impacts to mussels from this alternative are similar to Alternative 3-1.A.

5.7.11 Alternative 3-3.C

Impacts to mussels are restricted primarily to the St. Johns Bayou Basin. Therefore, impacts to mussels from this alternative are similar to Alternative 3-1.A.

5.8 ENDANGERED SPECIES

The Corps has maintained informal consultation with USFWS throughout the project study. Formal Section 7 consultation was requested in a December 3, 1998, letter transmitting the Biological Assessment because of the potential affect on the interior least tern and the bald eagle. The USFWS transmitted their Biological Opinion (BO) by letter dated June 11, 1999, stating that the project would not jeopardize the continued existence of the interior least tern and bald eagle. The BO from the September 2000 SEIS discusses reasonable and prudent measures/terms and conditions to minimize incidental take. The Corps has agreed to implement these measures.

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 or 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 direct construction impacts would occur.

Removing floodwaters from St. Johns Bayou Basin and preventing overbank flooding in New Madrid Floodway during much of the spring would reduce ecological connectivity between the floodplain and the Mississippi River. This would reduce fish spawning and the transport of small fish back into the river during receding floodwaters. This reduction in forage fish should have a minimal effect on 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 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, and no pallid sturgeons were collected during fishery surveys of the St. Johns Bayou area from 1977 through 1991 (Christoff 1997). The alternative should not adversely impact the pallid sturgeon.

Bald eagles are regular winter residents and recently became year-round residents in the lower part of the New Madrid Floodway, and one active nest is located in the Hubbard Lake area. The 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 might have to fly farther for food. However, spring flooding does not reach Hubbard Lake every year under existing conditions. During non-flooding years, adult eagles have probably adapted and fly farther down the floodway to forage. 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 anticipated in either basin as a result of 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, but other than earlier tillage no changes to agricultural practices are expected, and existing conditions would prevail. There is concern that earlier tillage might result in adverse impacts to the nesting eagles at Hubbard Lake when the eaglets hatch in early April. 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 or to the overall bald eagle population.

USFWS indicated that, because of the project, two eagles might be taken incidentally during the breeding season due to harassment from increased human disturbance and reduced foraging area in the vicinity of the nest. Incidental take in the form of harassment of interior least terns may also occur; however, it would be difficult to determine because least terns are wide-ranging, sometimes change nesting colonies from year to year, and because 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 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). Because left bank cover habitat would be removed during widening of the left bank channel the project would adversely impact the survival of the existing population.

5.8.3 Alternative 3-1.A

Direct construction impacts to the three Federally endangered species from channel enlargement and levee construction would be the same as those described for Alternative 2.

Impacts to the interior least tern would be similar to those described for Alternative 2 with the following changes. With modified gate operations during spring to allow water elevations to reach 282.5 feet, fish spawning and transport will continue, although size and abundance are likely to decline from present levels, and fewer young fish would continue to be carried into the river with receding floodwater. Impacts to the overall least tern population along the lower Mississippi River and the interior United States are expected to be negligible.

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 be similar to Alternative 2, with a slight reduction in potential adverse foraging impacts. Modifications to gate operations would provide forage in the spring where none would exist with Alternative 2. The impacts to the nesting eagles at Hubbard

Lake, as well as impacts to the transient and resident eagle populations in the area, are expected to be negligible. As mitigation area reforestation matures it would provide additional nesting areas.

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

USFWS included reasonable and prudent measures to minimize the amount and 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.

5.8.4 Alternative 3-1.B (Recommended Plan)

This alternative differs from Alternative 3-1.A in that the gates will be allowed to remain open until Mississippi River backwater flooding reaches 284.4 feet March 1 through May 15. This will increase the depth and area of backwater flooding, thereby reducing the impacts described for Alternative 3-1.A for the bald eagle and the least tern. Other impacts would be as described in Alternative 3-1.A.

A Biological Assessment for this alternative is provided in Appendix H. The USFWS has indicated that reasonable and prudent measures would be the same as for Alternative 3-1A and the Corps agrees to implement recommended measures.

5.8.5 Alternative 3-1.C

This alternative is similar to Alternative 3-1.B except that in every third year the gates would be allowed to remain open until a water elevation of 288 feet is reached. This alternative would further increase the depth and extent of backwater flooding, further reducing the impacts described for Alternative 3-1.A. Other impacts would be as those described for Alternative 3-1.A.

5.8.6 Alternative 3-2.A

This alternative would relocate the closure levee farther up in the New Madrid Floodway and more backwater flooding on the riverside of the floodway, thereby allowing flooding in this area to occur naturally. Water elevation in the floodway would be allowed to reach 282.5 feet. The alternative would result in decreased impacts to fishery spawning and rearing habitat when compared to Alternative 3-1.A and would lessen impacts to bald eagles and least terns. Other impacts would be as those described for Alternative 3-1.A.

5.8.7 Alternative 3-2.B

This alternative differs from Alternative 3-2.A in that the gates will be allowed to remain open until Mississippi River backwater flooding reaches 284.4 feet March 1 through May 15. This will increase the depth and area of backwater flooding, thereby further reducing the impacts described for Alternative 3-1.A for the bald eagle and the least tern. Other impacts would be as those described for Alternative 3-1.A.

5.8.8 Alternative 3-2.C

This alternative is similar to Alternative 3-2.B except that in every third year the gates would be allowed to remain open until a water elevation of 288 feet is reached. This alternative would further increase the depth and extent of backwater flooding, providing further reductions of the impacts described above. Other impacts would be as described in Alternative 3-1.A.

5.8.9 Alternative 3-3.A

This alternative would relocate the closure levee farther up in the New Madrid Floodway. This would allow natural backwater flooding on the riverside of the floodway. Water elevation in the floodway would be allowed to reach 282.5 feet. This alternative would result in further decreased impacts to fishery spawning and rearing habitat when compared to Alternative 3-1.A and would lessen impacts on bald eagles and least terns. Other impacts would be as those described for Alternative 3-1.A.

5.8.10 Alternative 3-3.B

This alternative differs from Alternative 3-3.A in that the gates will be allowed to remain open until Mississippi River backwater flooding reaches 284.4 feet March 1 through May 15. This will increase the depth and area of backwater flooding, thereby further reducing the impacts described for Alternative 3-1.A for the bald eagle and the least tern. Other impacts would be as those described for Alternative 3-1.A.

5.8.11 Alternative 3-3.C

This alternative is similar to Alternative 3-2.B except that in every third year the gates would be allowed to remain open until a water elevation of 288 feet is reached. This alternative would further increase the depth and extent of backwater flooding, providing further reductions in the impacts described above. Other impacts would be as those described for Alternative 3-1.A.

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 will continue to periodically inundate the land. However, according to MDNR, existing agricultural drainage improvements on land surrounding Big Oak Tree State Park have altered the area's hydroperiod. One example of this is the continuous embankment (levee) that was erected three 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 threaten loss of the swamp and BLH forests along with a substantial portion of the park's species diversity.

MDNR intends to construct a low levee around the park with a gate to control water levels. A pump will 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 during prolonged high-water stages and/or rainfall because of the small levee dimension and the outlet structure's small water conveyance capacity.

Tenmile Pond Conservation Area is surrounded by small levees and contains various pumps and structures to manage 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, except for MDC levees intended for waterfowl management. These levees restrict fish movement into overbank areas during highwater events of less than a 10 year frequency.

5.9.2 Alternative 2: Authorized Project

Closing the levee gap at New Madrid would reduce periodic Mississippi River backwater flooding, and Big Oak Tree State Park would no longer receive the occasional Mississippi River inundation that helps maintain the ecosystem within the park. Without its unique vegetation, the park's designation as a National Natural Landmark would be jeopardized.

The existing hydrology of 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 3-1.A

Impacts to the Big Oak Tree State Park would be similar to those described under Alternative 2. Although this alternative would reduce the incidence of flooding of the Park, 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. A water management plan for the park is included as Attachment 2 in Appendix L-Mitigation Plan.

Impacts to the Tenmile Pond Conservation Area would be similar to those discussed in Alternative 2

5.9.4 Alternative 3-1.B (Recommended Plan)

Under this alternative, the water level of the New Madrid Floodway would be allowed to rise to 284.4 feet before gate closure from March 1 until May 15. It is doubtful that this elevation would be sufficient to alter the hydrology of either Big Oak Tree State Park or the Tenmile Pond Conservation Area. However, the water management plan referred to in Alternative 3-1.A applies to the recommended plan, Alternative 3-1.B, as well.

5.9.5 Alternative 3-1.C

The operation of the New Madrid Floodway gates would be similar to Alternative 3-1.B, except that every third year the gates would be allowed to remain open until an elevation of 288 feet before gate closure. At this depth, it appears that there would be marginal flooding along Tenmile Pond Conservation Area. It is unlikely that Big Oak Tree State Park would receive any benefits from this alternative.

5.9.6 Alternative 3-2.A

Impacts to Big Oak Tree State Park and Tenmile Pond Conservation Area would be similar to those described under Alternative 2. However, the water management plan referred to in Alternative 3-1.A applies to Alternative 3-2.A, as well.

5.9.7 Alternative 3-2.B

Under this alternative, the water level of the New Madrid Floodway would be allowed to rise to 284.4 feet before gate closure March 1 until May 15. It is doubtful that this elevation would be sufficient to alter the hydrology of either Big Oak Tree State Park or the Tenmile Pond Conservation Area. However, the water management plan referred to in Alternative 3-1.A applies to Alternative 3-2.B, as well.

Impacts would be as described for Alternative 2.

5.9.8 Alternative 3-2.C

The operation of the New Madrid Floodway gates would be similar to Alternative 3-2.B, except that every third year the gates would be allowed to remain open until an elevation of 288 feet before gate closure. At this depth, it appears that there would be marginal flooding along Tenmile Pond Conservation Area. It is unlikely that Big Oak Tree State Park would receive any benefits from this alternative. However, the water management plan referred to in Alternative 3-1.A applies to Alternative 3-2.C, as well.

5.9.9 Alternative 3-3.A

Impacts to Big Oak Tree State Park and Tenmile Pond Conservation Area would be similar to those described under Alternative 2. However, the water management plan referred to in Alternative 3-1.A applies to Alternative 3-3.A, as well.

5.9.10 Alternative 3-3.B

Under this alternative, the water level of the New Madrid Floodway would be allowed to rise to 284.4 feet before gate closure from March 1 until May 15. It is doubtful that this elevation would be sufficient to alter the hydrology of either Big Oak Tree State Park or the Tenmile Pond Conservation Area. However, the water management plan referred to in Alternative 3-1.A applies to Alternative 3-3.B, as well.

5.9.11 Alternative 3-3.C

The operation of the New Madrid Floodway gates would be similar to Alternative 3-3.B, except that every third year the gates would be allowed to remain open until an elevation of 288 feet before gate closure. At this depth, it appears that there would be marginal flooding along Tenmile Pond Conservation Area. It is unlikely that Big Oak Tree State Park would receive any benefits from this alternative. However, the water management plan referred to in Alternative 3-1.A applies to Alternative 3-3.C, as well.

5.10 WATER QUALITY

5.10.1 Alternative 1: Without-Project

Water quality in both basins is expected to remain unchanged. Periodic channel maintenance in the future will increase turbidity and degrade water quality in the vicinity of the maintenance; however, the impacts would be temporary and insignificant and would not degrade overall water quality in either basin.

5.10.2 Alternative 2: Authorized Project

Impacts would be similar to those described in Section 5.10.3 *Alternative 3: Avoid and Minimize*.

5.10.3 Alternative 3-1.A

As presented in Appendix I, water quality impacts resulting from this alternative are expected to be relatively minimal with respect to the Without-Project Alternative. Headwater inundation during winter months would result in increased retention of materials (e.g., sediments, nutrients, and pesticides) that would normally be available for transport as runoff prior to the spring flooding season. This is a benefit when considering the wetland function of improving water quality in the headwaters. Potential negative impacts that might arise as a result of this alternative include increased material loading during an extended growing season.

U.S. Army Corps of Engineers analysis conducted pursuant to this Revised SEIS combined hydrologic, land cover, and water quality data and then conducted mass balances for the various alternatives. Material processing estimates were calculated using expected loadings and wetland function factors to derive a wetland function value. The net yield (load) was compared to the total available load, and the percentage either transported or retained (the watershed function) was used to compare the alternatives. 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 published values and results from detailed studies of the Cache River system, which is located near the study area. Detailed changes in mass balances for flooded upland or agricultural lands were assessed using runoff estimates in published sources. Input and rationale for material processing were developed and applied to the project area using hydrologic and land use information in order to assess material transport with respect to different hydrologic scenarios. The approach indicates a change in mass of less than 0.1 percent for selected constituents. Accordingly, no adverse impacts are expected.

Representatives from the University of Missouri's Delta Research and Extension Service in Portageville, Missouri, indicated that agricultural intensification that might result from reduced flooding in the area would likely involve a change to higher yielding soybean varieties. Economic analysis (Appendix B) indicates only approximately five percent of the currently farmed land will be impacted (i.e., subject to intensification) and that an increase in total farmed acreage is not likely. Because such soybeans utilize atmospheric nitrogen, increased applications of nitrogen fertilizers are unlikely. Additionally, because local soil types have relatively high phosphorus contents, increased applications of phosphorus are also considered unlikely.

Should corn production intensify, atrazine might become a potential concern. Those areas cultivated in corn that are located in well-drained areas near surface waters would contribute to increased atrazine concentrations; however, the amount of such lands is small with respect to the project area. Furthermore, because application effectiveness diminishes with increased precipitation and, in turn, runoff, application in such periods is not normal practice. Normal practice, combined with atrazine's relatively short-term persistence, leads many to conclude that the potential for elevated concentrations in project area surface waters is limited. Analysis of atrazine application in the project area (approximately 25 percent of the total project area planted in corn is treated) indicates that pre-emergent application rates were on the order of one to two pounds active ingredient per acre (ai/ac), less than post-emergent applications.

The analysis also indicates that the various alternatives are likely to have virtually no effect on hypoxia/anoxia in the Gulf of Mexico. Analysis indicates that the change in mass of nitrogen, phosphorus, organic carbon, and sediments in the study area as a result of the proposed project will be less than 0.1 percent of the total mass available. Hydrologic analysis indicates the amount of water associated with floodwater inundation in the project area accounts for less than one percent of the water balance, and the limited material processed by floodwaters will have no discernable effect on loadings to the Gulf of Mexico. Additionally, the conversion of cropland to bottomland hardwood forest pursuant to mitigation associated with the project will more than offset any pollutant processing that occurs as a result of backwater flooding from the Mississippi River.

The State of Missouri will make a determination as to whether or not a National Pollutant Discharge Elimination System (NPDES) permit is required after reviewing Section 404(b)(1) analysis prepared pursuant to this project and once a request for water quality certification has been made.

The project will not discharge pollutants to the waters of the United States after construction of the proposed alternatives. Water quality analyses indicate post project conditions will be similar to existing conditions.

The Corps proposes major additional avoid and minimize measures that include establishing buffer strips along 64 miles of channels in the New Madrid Floodway. Also, all channels requiring work in the St. Johns Basin would have restored riparian buffers. These measures, particularly those in the floodway, would significantly improve water quality by filtering runoff from adjacent agricultural lands.

5.10.4 Alternative 3-1.B (Recommended Plan)

Increased potential for exchange of river and upland/runoff water and material associated with operations for fish passage would increase material exchange between the Mississippi River and upland tributaries. Although this might increase the export of upland material, it would also allow

for potential treatment of Mississippi River water, and it more closely resembles current conditions than Alternative 3-1.A. Impacts from this alternative would not differ significantly from impacts modeled for Alternative 3-1.A. As a result, water quality associated with project area hydrology/hydraulics will remain essentially unchanged from current/existing conditions.

5.10.5 Alternative 3-1.C

Because gate operations associated with this alternative are identical to those of Alternative 3-1.B for two of every three years, impacts associated with this alternative are not likely to be discernable from those associated with Alternative 3-1.B.

5.10.6 Alternative 3-2.A

Qualitatively, the increase in the amount of land between this levee and the Mississippi River (when compared to the Alternative 3-1 levee alignments) would improve water quality conditions when compared to the recommended plan. However, and because water quality modeling conducted pursuant to this analysis indicates water quality in the project area will remain essentially unchanged from current conditions once the recommended plan is implemented, such improvement would be practically indiscernible and, as a result, would be insignificant.

5.10.7 Alternative 3-2.B

Increased potential for exchange of river and upland/runoff water and material associated with operations for fish passage would increase material exchange between the Mississippi River and upland tributaries. Although this might increase the export of upland material, it would also allow for potential treatment of Mississippi River water. Impacts from this alternative would not differ significantly from impacts for Alternative 3-2.A.

5.10.8 Alternative 3-2.C

Because gate operations associated with this alternative are identical to those of Alternative 3-2.B for two of every three years, impacts associated with this alternative are not likely to be discernable from those associated with Alternative 3-2.B.

5.10.9 Alternative 3-3.A

Qualitatively, the increase in the amount of land between this levee and the Mississippi River (when compared to the Alternative 3-1 levee alignments) would improve water quality conditions when compared to the recommended plan. However, and because water quality modeling conducted pursuant to this analysis indicates water quality in the project area will remain essentially unchanged from current conditions once the recommended plan is implemented, such improvement would be practically indiscernible and, as a result, would be insignificant.

5.10.10 Alternative 3-3.B

Increased potential for exchange of river and upland/runoff water and material associated with operations for fish passage would increase material exchange between the Mississippi River and upland tributaries. Although this might increase the export of upland material, it would also allow

for potential treatment of Mississippi River water. Impacts from this alternative would not differ significantly from impacts for Alternative 3-3.A.

5.10.11 Alternative 3-3.C

Because gate operations associated with this alternative are identical to those of Alternative 3-3.B for two of every three years, impacts associated with this alternative are not likely to be discernable from those associated with Alternative 3-3.B.

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. Because MDNR's water retention project will restore some of the inundation required by Big Oak Tree State Park, it has the potential to change the park's recreational use.

5.11.2 Alternative 2: Authorized Project

Recreational impacts that would occur in the St. Johns Bayou Basin 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 recreational values for these areas until revegetation occurs, and there would be some loss of BLH along the channel banks due to excavation of the ditches.

However, restrictive easements placed on the new embankments would result in the emergence of a brushy edge habitat that is presently lacking in the project area and would provide increased small game hunting and nonconsumptive recreation opportunities. Loss of terrestrial wildlife habitat would be mitigated by the purchase and reforestation of croplands. 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 some other sport fishes 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 denied access when the gates are closed. Recreational fishing along the streams would be expected to decrease proportionally. Fishing in flooded cropland would be reduced or eliminated in the St. Johns Bayou Basin with pumps evacuating interior runoff. Gate operation in the New Madrid Floodway would reduce flooding on croplands and any associated fishing as well.

Cropland in the project area is currently seldom flooded during winter months by high Mississippi River stages. With Alternative 2, runoff from both basins would be ponded for winter waterfowl and would maintain a more 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. However, and because project implementation would reduce duck-use-days during spring migration (February and March), USFWS believes any potential gains are questionable. The Eagles Nest Wetland Reserve Program tract has been annually flooded during fall and winter for hunting, but this area receives significantly fewer waterfowl in dry years than in years when the region is wet from flooding. The Corps acknowledges this spring loss and agreed to mitigate for it

by purchasing and reforesting croplands, which would provide better and more extensive waterfowl migratory and winter habitat than presently exists. Many of these lands would continue to be inundated from rainfall events and overbank flooding of the streams. It is reasonable to conclude that improved waterfowl hunting would occur on a large part of reforested acres and in the waterfowl ponding area.

Prolonged spring flooding has lasted into the month of July during the past five years. Comments obtained from local residents at the scoping meeting indicated this has significantly reduced turkey and swamp rabbit populations. Alternative 2 would reduce prolonged flooding and allow the populations of these animals to increase in both drainage basins.

Reforested croplands required for mitigation would be placed in public ownership and provide a significant increase in recreational opportunities over existing conditions.

5.11.3 Alternative 3-1.A

Impacts to wildlife recreation in the project area in the St. Johns Bayou Basin would be similar to those in Alternative 2, except that less wildlife habitat would be lost with a reduced St. Johns Bayou channel size and switching work banks on St. James Ditch. 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 offer additional fishing locations.

Fishing recreation impacts in both basins would be similar to those with Alternative 2 although 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 would be realized with Alternative 2.

The purchase and reforestation of mitigation lands would benefit turkey, swamp rabbit, waterfowl, squirrel, and deer hunting, as well as nonconsumptive recreation.

5.11.4 Alternative 3-1.B (Recommended Plan)

This alternative differs from Alternative 3-1.A by modifying New Madrid Floodway gate closure operations to allow water levels to rise in the floodplain to 284.4 feet before gate closure from March 1 until May 15.

Other than for waterfowl, hunting in the Project Area would remain essentially the same as that described for Alternative 3-1.A. Impacts on waterfowl would be less than that experienced under

Alternative 3-1.A; increased spring flooding of the Floodway would allow for more use of the floodway by migratory waterfowl.

Fishing would be impacted less by this alternative; there would be some retention of connectivity between the floodplain and the Mississippi River that would allow for sport fishes to access the floodplain for spawning.

5.11.5 Alternative 3-1.C

This alternative is similar to Alternative 3-1.B except that every third year the water level in the New Madrid Floodway would be allowed to reach a level of 288 feet from March 1 until May 15. This would further reduce impacts on fishery and waterfowl resources.

5.11.6 Alternative 3-2.A

Under this alternative the levee would be located farther up into the floodway. Water elevations would be allowed to reach a maximum of 282.5 feet. Impacts would be similar to those of Alternative 3-1.A, except that the levee relocation would allow additional acreage downstream from the levee to flood naturally, reducing the impacts to fisheries and waterfowl.

5.11.7 Alternative 3-2.B

Levee placement would be the same as in Alternative 3-2.A, but gate operations would allow water levels to reach a maximum of 284.4 feet before closing between March 1 and May 15, as per Alternative 3-1.B. Overall impacts are as described for Alternative 3-1.A, except that levee relocation and modifications to gate operations would lessen impacts to sport fisheries and wildlife.

5.11.8 Alternative 3-2.C

This alternative is similar to Alternative 3-2.B except that every third year the water level in the New Madrid Floodway would be allowed to reach a level of 288 feet from March 1 until May 15. This would further reduce impacts on fishery and waterfowl resources.

5.11.9 Alternative 3-3.A

Under this alternative there would be additional relocation of the levee into the floodway. Water elevations would be allowed to reach a maximum of 282.5 feet. Impacts would be similar to those of Alternative 3-1.A, except that the levee relocation would allow additional acreage downstream from the levee to flood naturally, reducing the impacts to fisheries and waterfowl.

5.11.10 Alternative 3-3.B

Levee placement would be the same as in Alternative 3-3.A, but gate operations would allow water levels to reach a maximum of 284.4 feet before closing from March 1 until May 15. Overall impacts are as described for Alternative 3-1.A, except that levee relocation and modifications to gate operations would further lessen impacts to sport fisheries and wildlife.

5.11.11 Alternative 3-3.C

This alternative is similar to Alternative 3-3-B except that every third year the water level in the New Madrid Floodway would be allowed to reach a level of 288 feet from March 1 until May 15. This would further reduce impacts on fishery and waterfowl resources.

5.12 CULTURAL RESOURCES

5.12.1 Alternative 1: Without-Project

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

5.12.2 Alternative 2: Authorized Project

A cultural resources survey was conducted within the project ROW and was presented in the Technical Appendices, Revised December 1981, of the GDM. An additional survey documented a number of prehistoric and historic sites in the project area (Klinger *et al.* 1988), including 21 previously unrecorded prehistoric and/or historic archaeological sites and seven cultural resources sites along St. Johns Bayou.

Twelve of the sites were determined to be insignificant with respect to National Register of Historic Places (NRHP) criteria. Nine of the sites were determined to be significant and subjected to additional testing; two were eligible for inclusion on the NRHP. The project has been designed to avoid all of the potentially significant and significant cultural resources sites.

In response to Missouri State Historic Preservation Officer (SHPO) comments regarding the SEIS, the Corps of Engineers agreed to conduct a cultural history of the entire project area and a Memorandum of Agreement (MOA) has been developed and signed in which the Memphis District has agreed to conduct the study. The study will include the history of the Mississippi River Commission as it relates to the affected areas; the history of legislation that led to the New Madrid Floodway construction and the construction itself; a history of social events related to the Floodway; an analysis of flood control and drainage systems in both basins as historic properties; and photographs, drawings, film footage, personal interviews, etc. that relate the area's history and flood control systems.

5.12.3 Alternative 3-1.A

Under this alternative the floodplain closure levee would be located in the same location as that described for Alternative 2 and all impacts related to levee construction would be the same as those previously described.

A portion of the work on St. James Ditch would be switched from the east (left) bank to the west (right) bank. Because a previous cultural resources survey was conducted only for the east bank along this reach of the project ROW, a cultural resources survey would have to be conducted for the west bank. If cultural resources were found in this area, either the resources would be tested or the ROW would be altered to avoid them. Cultural resources determined to be significant and unavoidable would be mitigated in accordance with provisions of the National Historic Preservation Act (NHPA).

All cultural resources investigations and analysis would be coordinated with SHPO and other parties, as appropriate. Any inadvertent discoveries would be fully addressed in accordance with provisions of NHPA and other applicable laws. The MOA and historic study described in Alternative 2 would also be conducted for Alternative 3. Alternatives 3-1.A, 3-1.B, and 3-1.C differ in spring water levels resulting from varying gate operations. Such variation in water surface elevations would not affect cultural resources in the project area, which are already regularly inundated by backwater flooding from the Mississippi River.

Because a cultural resources survey of this area has not been completed, it is possible that a resource exists within the footprint. However, due to elevation, it is a low probability area.

5.12.4 Alternative 3-1.B (Recommended Plan)

Impacts are the same as Alternative 3-1.A.

5.12.5 Alternative 3-1.C

Impacts are the same as Alternative 3-1.A.

5.12.6 Alternative 3-2.A

Under this alternative the floodplain closure levee would be placed farther up in the floodplain than the levee described in Alternative 3-1, and all cultural resource impacts associated with project construction would be addressed in the same manner as that described for Alternative 3-1. Alternatives 3-2.A, 3-2.B, and 3-2.C differ in spring water levels resulting from varying gate operations. These differences in water levels would not affect cultural resources in the project area, which are already regularly inundated by backwater flooding from the Mississippi River.

Because a cultural resources survey of this area has not been completed; it is possible that a cultural resource exists within the footprint of the closure. Due to elevation, it is a low probability area.

5.12.7 Alternative 3-2.B

Impacts are the same as Alternative 3-2.A.

5.12.8 Alternative 3-2.C

Impacts are the same as Alternative 3-2.A.

5.12.9 Alternative 3-3.A

Under this alternative the floodplain closure levee would be placed farther up into the floodplain than the levee of Alternative 3-2, and all cultural resource impacts associated with project construction would be addressed in the same manner as that described for Alternative 3-2. Alternatives 3-3.A, 3-3.B, and 3-3.C differ in spring water levels resulting from varying gate operations. These differences in water levels would not affect cultural resources in the project area, which are already regularly inundated by backwater flooding from the Mississippi River.

A cultural resources survey has not been completed of this area; it is possible that a cultural resource exists within the footprint of the closure. Due to elevation, it is a low probability area.

5.12.10 Alternative 3-3.B

Impacts are the same as Alternative 3-3.A.

5.12.11 Alternative 3-3.C

Impacts are the same as Alternative 3-3.A.

5.13 SECTION 122 ITEMS

Each of the alternatives carried into detailed analysis (alternatives 2, 3-1.A, 3-1.B, 3-1.C, 3-2.A, 3-2.B, 3-2.C, 3-3.A, 3-3.B, and 3-3.C) have similar if not identical effects to each of the following Section 122 items. As the MRL Feature is moved further up into the Floodway and away from alternatives 2 and 3-1 location, temporary construction effects may be slightly increased as the closure levee is lengthened. However, long-term effects from operation and maintenance will be the same. The First Phase Feature's construction and long-term operation effects of the two pumping stations and channel work will also be the same on the following Section 122 items.

5.13.1 Noise

The Noise Control Act of 1972 established the EPA's noise program, of which transportation was a major focus. The Act's goal was to promote an environment free from noise pollution and its adverse effects on public health and welfare. An outdoor noise level of 55 decibels (dB) has been identified as the noise level, below which no interference or annoyance to human hearing occur. Additionally, it is EPA guidance that a 24-hour exposure level of 70 dB or less is the environmental noise threshold, below which there is no measurable hearing loss over a lifetime. The EPA has found that the noisiest construction equipment typically ranges from 88 A-weighted decibels (dBA) to 91 dBA at a distance of 50 feet. Typical operating cycles may involve two minutes of full power, followed by three or four minutes at lower settings.

Noise would increase during channel enlargement and pumping plant construction due to equipment operation; however, the increase would be confined to the immediate area of construction/pumping, and the noise levels generated would be of the same magnitude as noise resulting from the extensive agricultural operations that already take place in the project area. Following construction, noise levels should return to normal over most of project area.

Pumping operations would elevate noise levels at the pumping stations, but the use of electric pumps would limit those at levels to acceptable ones. Because the proposed pumping stations would occupy relatively remote locations, noise impacts would be negligible. No noise mitigation measures would be required for any of the alternatives although Occupational Safety and Health Administration (OSHA) regulations might require the use of hearing protection for construction personnel.

5.13.2 Air Quality

In response to Clean Air Act Amendments (CAAA), the EPA has established National Ambient Air Quality Standards (NAAQS) for the protection of human health. NAAQS specify maximum levels

of pollutants and exposure periods, below, which no significant threat to human health or welfare exist. The Missouri Division of Environmental Quality (MDEQ) Air Pollution Control Program is responsible for statewide measurement of ambient air concentrations and emissions levels for contaminants. The nearest ambient air monitoring station is located in Iron County and has not recorded any NAAQS violations in the last four years.

Construction activity will generate regulated pollutants including ozone (O_3), carbon monoxide (CO), and coarse particulate matter (PM_{10}), and such emissions would slightly and temporarily degrade local air quality. However, all construction activity would be conducted in such a manner as to meet all applicable State and Federal air quality guidelines, and none of the proposed alternatives would significantly affect the area's air quality.

5.13.3 Aesthetic Value

Vegetative clearing and construction of a pumping station 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, and reforestation of agricultural lands as part of the proposed mitigation for this project would enhance aesthetics.

5.13.4 Displacement of People

None of the proposed alternatives would result in the displacement of people. The area's agricultural income would likely be enhanced over levels expected without the project.

5.13.5 Community Cohesion

The communities of East Prairie and Pinhook support the enhanced flood protection for the area. Farmers have also expressed support for alternatives that would permit them to increase production. Accordingly, no adverse impacts to community cohesion are anticipated.

5.13.6 Local Government Finance, Tax Revenues, and Property Values

The proposed alternatives present a potential for property values to increase. Tax revenues are likely to increase.

5.13.7 Displacement of Businesses and Farms

No businesses or farms would be displaced either directly or indirectly as a result of the proposed alternatives. However, the proposed mitigation plan requires the purchase and reforestation of 8,375 acres of cropland. Purchase of the mitigation lands could cause the displacement of a small number of 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 transportation infrastructure.

5.13.9 Community and Regional Growth

Alternatives 2 and 3 would not contribute substantially to regional growth; however, elimination of historical flooding problems might induce an increase in East Prairie commerce. This would benefit the overall income, employment, and tax base of the area.

5.13.10 Employment

The proposed alternatives would require construction that, in turn, would increase employment demand for the area.

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 agricultural 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

Alternative 2 includes a 1,500 foot levee closure and structure at the south end of the New Madrid Floodway that will prevent backwater flooding from the Mississippi River, and two pumping stations, one in the New Madrid Floodway basin and the other in the St Johns Bayou Basin. Also included are channel improvements on St Johns Bayou, Birds Point Levee Ditch, and St James Ditch designed to drain the area in the vicinity of East Prairie, Missouri. The closure is a feature of the Mississippi River Levees (MRL) project and as such has a "grandfathered" project discount rate of 2.5 percent. All other features use a discount rate of 7.375 percent and are included as the First Phase feature of the overall project.

Total annual benefits for the MRL feature of Alternative 2 are presented in Table 19 of Appendix B. Agricultural benefits account for 89 percent of the project benefits. Inundation reduction benefits comprise 63 percent of the project benefits followed by intensification at 37 percent. The benefits of the First Phase feature are presented in Table 20 of Appendix B. The agricultural benefits of this feature 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 are composed of betterment and advanced replacement benefits and are due to improving or replacing area bridges during construction.

The annual costs for the MRL feature of Alternative 2 are also presented in Table 19 of Appendix B. The annual costs for the First Phase feature are presented in Table 20 of Appendix B. Annual interest and sinking fund costs reflecting the financing costs of the project account for 96 percent of

the First Phase feature's cost. The remaining four percent is operation and maintenance primarily of the two pumping stations and associated facilities.

5.14.3 Alternative 3-1.A

The MRL feature of Alternative 3-1 is identical to that of Alternative 2. Its benefits and costs are presented in Table 19 of Appendix B. This closure location is the NED closure location. It is also the only closure location that has a benefit-to-cost ratio greater than one (1.1 to 1 at 2.5 percent discount rate). The benefit and cost data for the First Phase features of Alternative 3-1.A are presented in Table 21 of Appendix B. The benefit-to-cost ratio of the First Phase feature is 1.2 to 1 at 7.357 percent discount rate. The annual benefits are primarily agriculturally based flood control benefits. The majority of the annual costs are the interest and sinking fund costs associated with financing the project.

5.14.4 Alternative 3-1.B (Recommended Plan)

The alternative is very similar to Alternative 3-1.A. The MRL feature is identical. The First Phase feature is modified to reduce potential environmental effects. This modification slightly lowers the flood control benefits while sharply reducing the mitigation requirements. Because the costs are reduced significantly more than the benefits, this alternative becomes the NED plan. A detailed presentation of the benefit and cost information of the NED plan (Alternative 3-1.B) is presented in Table 29 of Appendix B.

5.14.5 Alternative 3-1.C

The MRL feature is the same as alternatives 3-1.A and 3-1.B. The First Phase feature is further modified to reduce potential environmental effects. This modification reduces both annual benefits and costs. The benefits are reduced significantly more than the costs. The benefit and cost data for this alternative are also presented in Table 21 of Appendix B

5.14.6 Alternative 3-2.A

The MRL feature of Alternative 3-2.A is not economically justified. Its benefit-to-cost ratio is slightly below unity. Its benefits and costs are presented in Table 19 of Appendix B. The First Phase feature of Alternative 3-2 is presented in Table 21 of Appendix B. The incremental benefit-to-cost ratio of the First Phase feature is greater than one. However, since the MRL feature is not economically justified, Alternative 3-2.A is not the NED plan.

5.14.7 Alternative 3-2.B

Alternative 3-2.B is very similar to Alternative 3-2.A. The MRL feature is identical and not economically justified. The First Phase feature is modified similar to Alternative 3-1.B. Alternative 3-2.B is also not the NED plan since the MRL feature is not economically justified.

5.14.8 Alternative 3-2.C

Alternative 3-2.C is also very similar to alternatives 3-2.A and 3-2.B. The MRL feature is identical and not economically justified. The First Phase feature is modified similar to Alternative 3-1.C. Alternative 3-2.C is also not the NED plan since the MRL feature is not economically justified.

5.14.9 Alternative 3-3.A

The MRL feature of Alternative 3-3.A is not economically justified (Table 19 of Appendix B). Its benefit-to-cost ratio is 0.7 to one. The incremental benefit-to-cost ratio of the First Phase feature is greater than one. However, since the MRL feature is not economically justified, Alternative 3-3.A is not the NED plan.

5.14.10 Alternative 3-3.B

Alternative 3-3.B is very similar to Alternative 3-3.A. The MRL feature is identical and not economically justified. The First Phase feature is modified similar to alternatives 3-1.B and 3-2.B. Alternative 3-3.B is also not the NED plan since the MRL feature is not economically justified.

5.14.11 Alternative 3-3.C

Alternative 3-3.C is also very similar to alternatives 3-3.A and 3-3.B. The MRL feature is identical and not economically justified. The First Phase feature is modified similar to alternatives 3-1.C and 3-2.C. Alternative 3-3.C is also not the NED plan since the MRL feature is not economically justified.

5.15 HAZARDOUS, TOXIC, AND RADIOACTIVE WASTE

A Phase I Environmental Site Assessment (ESA) was prepared for the project area in October 1996 in accordance with U.S. Army Corps of Engineers Regulation ER 1165-2-132, *Water Resources Policies and Authorities for Hazardous, Toxic, and Radioactive Waste (HTRW) for Civil Works Projects, June 26, 1992*.

Two illegal dumps were observed. One located in St. James Ditch approximately 1.25 miles west of the Missouri Route 102 intersection with the Birds Point New Madrid Setback Levee, consisted of household trash and a discarded water heater. The second, larger dump was noted approximately 0.70 miles upstream from the first dump, near the intersection of Missouri Route 525 and St. James Ditch. A follow-up inspection conducted in June 1998 and reviews of recent aerial photographs indicates no changes or additional activity have occurred at either dump.

A land use history of the area was prepared pursuant to the investigation, and environmental database searches for potential sites of concern were conducted in consultation with USEPA, MDC, MDNR, NRC, and various local officials. No releases or spills are known to have occurred in the project area since 1990, and there were no Resource Conservation and Recovery Act (RCRA) database sites located in the project area. According to emergency response officials East Prairie and New Madrid, there were no known hazardous waste incidents, releases, or contamination, and rail officials revealed no indication of HTRW contamination from train operations/accidents. The initial ESA concluded there was no evidence of potential HTRW in the project area.

A subsequent ESA performed in July 2001 researched appropriate Federal, state, and local databases and historical sources and interviewed pertinent personnel in order to characterize environmental conditions in the project area. No field investigations were conducted.

Historical records were reviewed, including United States Geological Survey (USGS) historical topographic quadrangle maps, in order to ascertain previous uses and occupants of the project area and surrounding areas. The original environmental database searches were updated and local emergency response and rail officials were contacted to ascertain whether or not changes had occurred in the project area. Vista Information Solutions, Inc. (Vista) conducted a supplemental environmental database search for the project area, including a one-mile water well search near the vicinity of each proposed levee location (alternatives 2, 3-1, 3-2, and 3-3).

Based on information gathered during the subsequent ESA, no sites of potential HTRW concern appear to be located within four miles of the project area. Refer to Appendix J for a list of sources consulted in the preparation of this section.

5.16 MISSISSIPPI RIVER STAGE IMPACTS AND NEW MADRID FLOODWAY OPERATIONS

5.16.1 Development History of the Floodway

The greatest flood of modern times occurred in 1927 and resulted in the loss of some 500 lives, about 700,000 people were left homeless, and 26,000 square miles (72 percent) of the Lower Mississippi River Valley was flooded. After this flood, Congress passed the Flood Control Act of 15 May 1928, which authorized the Corps of Engineers to construct the Mississippi River and Tributaries (MR&T) Flood Control Project. This is the largest flood control project in the world. By adopting House Document 90, 70th Congress, Section 8 of the 1928 Act authorized the construction and operation of the Birds Point-New Madrid Floodway. By law, the MR&T Project must pass the PDF; the Floodway is part of the system that has been designed to accomplish this task. During occurrence of the PDF, the Floodway is required to pass 550,000 cfs.

Designs for the Floodway were incorporated in the Jadwin Plan after the devastating flood of 1927. Still the flood of record on the Lower Mississippi River, the flood of 1927 motivated the nation to take a greater role in flood control. The entire Lower Mississippi Valley was studied and a comprehensive plan for flood control resulted.

Completed in 1933, the Floodway was designed to lower flood stages upstream and adjacent to the Floodway during major flood events. The 56-mile-long frontline levee had existed prior to the 1927 flood. The Jadwin Plan stated, “The serious problem begins at Cairo at the confluence of the Ohio and the Mississippi. From here to New Madrid the main levee on the west bank chokes the river unduly and should be set back sufficiently to lower the head of water at Cairo by six feet in an extreme flood. The existing riverbank levee will be retained but lowered five feet. The Floodway between the new and the old levees will be capable of cultivation at all times excepting in floods greater than that of 1922.”

A 36-mile-long setback levee was constructed to a grade equivalent to 60.0 feet on the Cairo gage as planned. The frontline levee was retained and a section of it was to be degraded to an elevation equivalent to 55.0 feet on the Cairo gage; the remainder of the frontline levee would remain at an equivalent height of 57.0 feet on the Cairo Gage. The plan of operation was one of natural overtopping of the degraded section at an equivalent stage of 55.0 feet on the Cairo gage. At the southern end of the Floodway, the frontline and setback levee were not joined, leaving the gap approximately 1,500 feet long.

As a part of the Birds Point – New Madrid Floodway project, the Corps purchased flowage easements for all lands within the Floodway above 300 feet on the NGVD, which was approximately 106 thousand acres. By purchasing flowage easements, the Federal government was essentially buying the right to flood the land within the Floodway. The purchasing of flowage easements was not completed on the remainder of the land.

Additionally, the Corps of Engineers purchased a strip of land on the west side of the levee along 11 miles of the frontline levee that was to be degraded and serve as a natural fuseplug for operation of the Floodway. The strip of land, one-half mile wide, was purchased outright, in fee title, and its purpose is to adsorb any blue hole formation and sand deposits that occur from operation.

5.16.2 Authorization History of the Floodway

5.16.2.1 Flood Control Act of 1954. The Flood Control Act of 1954 amended the Birds Point – New Madrid Floodway Project by authorizing modifications to the floodway in accordance with House Document Numbered 132, Eighty-third Congress. The house document recommended the "construction of a new levee to project grade extending about 1,800 feet from the fuseplug section of the frontline levee across the existing gap therein to the setback levee, . . .and the construction of a floodgate for the release of interior drainage." (H.D. 183, 83D Congress, 1st Session). The amendment did not include plans for the construction of a pumping station; therefore, a sump area would be needed when the floodgate was closed due to high water on the Mississippi River. The sump area would have been comprised of approximately 26,000 acres of unimproved land in the backwater area. This was the majority of the land for which flowage rights had not been purchased. Because of the necessity of the large sump area, the plan did not receive local support and the closure was never constructed.

5.16.2.2 Flood Control Act of 1965. Further modification to the floodway was authorized by the Flood Control Act of 27 October 1965, substantially as recommended by the report of the Chief of Engineers published in House Document 308, 88th Congress. This document provided for raising the frontline levee to give more protection to the floodway area by, "raising the levees forming the east boundary of the Birds Point – New Madrid Floodway and modifying operation thereof to include breaching of the fuse plug levee during floods which reach 58 feet and threaten to exceed 60 feet at Cairo." Whereas the plan authorized by the 1928 Flood Control Act provided for operation of the floodway, when the river stage at Cairo reached 55 feet, by overtopping a fuse plug levee, the modified plan authorized by the 1965 Flood Control Act provided for artificial breaching of the fuse plug levee during floods which reach 58 feet and threaten to exceed 60 feet at Cairo.

As a result of the modified plan for operation, modified flowage easements (based on artificial degradation of portions of the frontline levee) were purchased over lands above 300 NGVD. Original flowage easements already were purchased for natural overtopping of the Floodway. The second purchase of flowage easements, the modified flowage easements, was necessitated by the change in operation to artificial crevassing.

5.16.3 Operational History of the Floodway

5.16.3.1 Flood of 1937 Operation. Since its construction, the floodway has been operated only once, in 1937. The flood of 1937 was the first major test of the flood control features that had been constructed as part of the MR&T project under the 1928 Flood Control Act.

By late afternoon on 23 January, the river was already at 56.0 feet on the Cairo Gage. Although the Flood Control Act of 1928 had stipulated that the sections of the frontline levee would be degraded in order to provide natural overtopping of the levee at a stage equivalent to 55.0 feet on the Cairo gage, this feature of the project was never implemented. When it became apparent that natural operation of the floodway would be too slow to keep the river at Cairo below 60 feet, the District Engineer ordered that the floodway be placed in operation by means of artificial crevasses.

Initially, personnel in the area used picks and shovels to cut ditches through the frontline levee in hopes that the scouring effect would provide adequate crevasses. When the attempts to crevasse the levee by trenching failed, the District prepared to operate the floodway by use of explosives. Operation of the floodway was assisted by using explosives to create three artificial inflow crevasses within the upper fuseplug section. Several other inflow crevasses formed naturally, and at least one occurred prior to the first artificial crevasse.

Later, physical model studies revealed that the operation of the floodway reduced the crest at Cairo by approximately 3.5 feet. Even with operation of the floodway, the river reached a stage of 59.5 feet on the Cairo gage.

During the flood of 1937, the river reached a higher stage and passed a greater volume of water than in 1927 in the reach of river between Cairo and the mouth of the Arkansas River. However, the flood of 1927 had caused more damage. The features of the MR&T had been successful.

5.16.4 Other Floodway Aspects

5.16.4.1 Increased Level of Protection. As authorized by FCA 1928, the frontline levee would have provided a 17-year level of protection to the Floodway with the fuseplug section at a height equivalent to 55.0 feet on the Cairo gage. The 1965 FCA, by authorizing the Corps to artificially breach the fuseplug section, allowed for the fuseplug section of the frontline levee to be raised to provide headwater flood protection to the area within the Floodway for floods producing stages up to 60 feet on the Cairo gage. To ensure protection for stages up to 60 feet at Cairo, the authorized grade of the fuseplug levees were set at an elevation equivalent to 60.5 feet on the Cairo gage. Likewise the setback levee, originally authorized for 60.0 feet, was raised to three feet above the authorized flowline (65.5 feet relative to the Cairo gage). The three feet was the authorized freeboard.

Over the years, changes in the physical properties of the floodway have necessitated changes in the operational plan for floodway operation. Similarly, changes in floodway operation have allowed for changes that have increased the level of protection for the floodway. Currently, based on the authorized level of flood protection, the expected frequency of floodway operation is, on the average of 1 in 80 years (60 feet on the Cairo gage).

5.16.4.2 Litigation. Following a revision of the plan of operation for the floodway in 1983, the Memphis District prepared to acquire additional real estate interest that was necessary to prepare the floodway for operation, including the right to enter upon the frontline levee. Efforts to obtain rights-of-entry to the floodway levees lead to condemnation proceedings. Locals then filed suit and received a permanent injunction against operation of the floodway. The Government appealed this decision, and the injunction was overturned in 1984.

5.16.4.3 Studies Since 1984. From the time the injunction was overturned in 1984, four studies concerning the floodway have been completed. Three of the studies directly investigated alternatives of floodway operation.

5.16.4.4 Technical Report - 1985. A technical report, completed at the request of ASA/CW, was complete in April 1985. Although the Corps was not authorized to actually place the floodway into operation until 58 feet on the Cairo gage with a forecast that exceeded 60 feet, the then current plan of operation (1983 Plan) required the use of mechanical equipment to start artificially degrading the frontline levee at the outflow crevasse locations at a stage equivalent to 51.5 feet on the Cairo gage. This report provided technical information concerning the engineering feasibility of using gated structures as an alternative for operating crevasses in the frontline levee, thus eliminating the necessity for such an early start-up period.

The study concluded that a gated structure could be constructed that would reduce the detrimental effects of operation of the floodway; however, its cost would be significantly higher that that of the then existing plan of operation. The report was prepared for technical information only; it contained no recommendations regarding the authority for implementing any of the structural alternatives investigated.

5.16.4.5 Reconnaissance Report – March 1990. Even with the development of the 1986 plan of operation (the current plan), local interests were concerned about the effects of floodway operation. Locals asked that the Corps perform a study in which the impacts expected from floodway operation would be weighed against the cost of possible alternatives to the use of the floodway. Because the Corps did not have the authority for such a study, Congressman Emerson of Missouri sponsored a resolution in 1987 to authorize a reconnaissance study to identify and determine if there was a feasible alternative to the operation of the Birds Point – New Madrid Floodway.

The study identified several alternatives to the use of the floodway that were potentially feasible from an engineering standpoint. However, none of the alternatives were economically justified. Feasibility studies were not recommended because no alternatives had proven to be economically feasible.

5.16.4.6 Engineering Review Study. Although the reconnaissance study did not identify any alternatives to floodway operation, it did identify a potential modification to the current plan for operation of the floodway. An engineering review of the potential modification was conducted to collect, develop, and analyze such data necessary to prepare a reliable cost estimate and determine engineering feasibility.

The proposed modification planned for raising the frontline levee, including the fuseplug sections to a stage equivalent to 64.5 feet on the Cairo gage. The operation would then be accomplished by natural overtopping of the fuseplug levee with no artificial crevassing of the frontline levee. The plan also involved raising and modifying existing levees and floodwalls both within the floodway and along all impacted areas on the Mississippi and Ohio Rivers. In unprotected areas impacted by increased flood levels, new flood protection measures would be provided or flowage easements would be purchased. The plan also included the addition or alteration of existing planned pumping stations.

The study concluded that the modified plan of operation was engineeringly feasible and would cost approximately $140 million (1990 cost). The Review Report was provided to the MRC in January

1992. In April 1992, the Commission passed a resolution endorsing the concepts presented in the report and calling for the Corps to furnish the report to Congressional and local interest groups. This was accomplished in July 1992. To date, Congress has not authorized any of the modification to the floodway and affected areas that were recommended in the report.

5.16.5 Alternative 1: Without-Project

The current plan of operation, adopted in 1986, was designed to delay floodway operations as long as possible and to eliminate early start-up requirements of the 1983 plan of operation. The plan involves waterborne operations utilizing the Memphis District's floating plant located at Ensley Engineer Yard in Memphis Harbor, and is centered on the presence of approximately 66,000 feet of four-inch diameter polyethylene pipe located at the three crevasse sites. A detailed presentation of features described in this section is presented in Appendix K.

Floodway operation will be assisted by pumping a binary-blasting agent into these pipes and explosively degrading the frontline levee in these locations. The inflow crevasse is located in the upper fuseplug section and is 11,099 feet long. Inflow/Outflow crevasse #2 is located in the lower fuseplug section and is 5,500 feet long. Inflow/Outflow crevasse #1, located near the southeast area of the frontline levee, is also 5,500 feet long. The crevasse sites located in fuseplug sections were raised two feet in order to provide a dry working platform during operation.

The plan and its timetable for completion are based on the PDF rate of rise on the Mississippi River, which is approximately two feet per day. This is the same flood for which the entire MR&T Project is designed and it presents the shortest time span for operation; thus providing the most conservative timetable.

The current explosive design consists of three four-inch diameter polyethylene pipes that are horizontally emplaced in the three crevasse sites. The pipes were buried seven feet below grade in order to optimize explosive effects. One pipe is located along the centerline of the levee. The other two pipes are located 18 feet on either side of the centerline, and the configuration is designed to remove the top 11-feet of the levee. The pipes are buried in roughly 1,000-feet sections and are spaced approximately 60 feet apart to prevent sympathetic detonation across the sections.

The pipes terminate in shallow access wells, four-foot diameter polyethylene pipes that provide easy access during emergencies. The access wells are covered with approximately two feet of gravel. The 275 tons of binary blasting agent is stored in two non-detonating components; sodium perchlorate solution and atomized aluminum powder. The liquid component, sodium perchlorate solution, is stored in 2,500-gallon white fiberglass tanks that weigh approximately 17 tons and are moved by cranes. The aluminum powder is stored in 55-gallon drums.

When these two components are properly mixed, a blasting agent with a cratering ability of one and a half times that of TNT is created. In order to properly mix the agent, mix-pump units (MPUs) have been specifically designed to mix and pump DBA-105P at a rate of 500 pounds per minute. If the agent is mixed and pumped into the pre-emplaced pipes and the plan is not fully implemented, the agent can be pumped back out of the pipes with virtually no damage to the levee.

The timetable of operation is based on the PDF rate of rise of approximately two feet per day. Depending on the actual flood event, preparations may have to take place at different stages. The key to the operation is the time required to have the plan operational by the time the Cairo gage

registers 60 feet. All decisions on the timeline belong to the President of the MRC; Memphis District has the responsibility for carrying out those directions. The key actions start with the departure of the pump barge tow and quartering tow from Ensley Engineer Yard. It should be noted that loading the necessary equipment and configuring the tows requires approximately 24 hours. Therefore, loading operations should be initiated just prior to a reading of 54 feet on the Cairo gage.

At 55 feet on the Cairo gage, TVA will operate Kentucky Dam without regard to the winter or summer Kentucky Reservoir elevations. The plan requires 38 hours for towing, so departure from Ensley Engineer Yard should occur just prior to 56 feet on the Cairo gage. At the same time, survey crews and access well uncovering crews will also proceed to the floodway. At approximately 57 feet on the Cairo gage, the President of the MRC may give land crews the order to begin locating and uncovering access wells at the inflow crevasse within the upper fuseplug section. Additionally, the President of the MRC will request Sheriffs of Mississippi and New Madrid Counties, Missouri to evacuate the Floodway.

At approximately 59 feet, the tows will arrive at Norfolk Landing, River Mile 949, which is located at the downstream end of the inflow crevasse. This will serve as the command post and staging area for all pumping operations at the crevasse sites. The survey and well crews will have initiated excavation, and at least six of the access wells at the inflow crevasse should be uncovered. Evacuation of the floodway should be nearing completion and access roads into the floodway should be secured.

After the tow arrives, pump crews will begin filling the buried pipes with blasting agent, and both of the pump barges will initiate mixing and pumping operations on the upper fuseplug. The dual mix-pump units will allow each pump barge to fill two 1,000-feet sections of the crevasse at one time. The timetable allows 15 hours for mixing and pumping operations at the inflow crevasse. By 60 feet on the Cairo gage, pump operations at the inflow crevasse must be completed, and the crews will immediately move to the two-inflow/outflow crevasses to begin loading at those sites. Under current conditions, with the existing 1,500-foot gap at the lower end of the Floodway, the majority of the floodway is inundated by backwater at this stage.

When the stage reaches 58.0 feet on the Cairo gage and is forecasted to exceed 60.0 feet, the President of the MRC has the authority to initiate crevassing. However, under ideal conditions, crevassing will be delayed until after the upper fuseplug begins to overtop, at approximately 60.5 feet. By 61.0 feet on the Cairo gage, the inflow crevasse is required to be opened in order for authorized levels of protection to be provided. This requirement is based upon the physical model tests that serve as the basis for the current operational plan. The crevasse will be opened in 1,000-foot lengths, and only that portion of levee as is required by current hydrologic conditions will be opened.

By the time the inflow crevasse is operated, the pump barges will have reached the two separate inflow/outflow crevasses and started mix-pump operations at those locations. Operation of inflow/outflow #2 is critical. If the barge loading inflow/outflow #2 at the lower end of the Floodway experiences a failure, the barge loading inflow/outflow #1 will move to inflow/outflow #2. In the physical model tests, operation of the inflow/outflow crevasses was not initiated until the lower fuseplug section was overtopped for approximately 12 hours. Overtopping of the lower fuseplug should initiate approximately 38 hours after the inflow section is artificially crevassed.

5.16.6 Alternative 2: Authorized Project

Typically, the Mississippi River system response to flood events can be characterized by slow rising stages with prolonged crests. A review of the Mississippi Basin Model was conducted to compare the existing conditions of the Mississippi River Levee System with those resulting from closing the existing 1,500-foot gap as proposed by Alternative 2. Results from the modeling indicate very little difference between the without-project alternative and the various with-project alternatives in stages at Mississippi River gage locations.

For Alternative 2 conditions, the only measured increases in stages, as compared to without-project conditions, occurred at Hickman, Kentucky, and H.W. 173, which were 0.1-foot and 0.3-foot higher, respectively. A 0.1-foot decrease in stage was measured at the New Madrid gage, and the maximum increase in water surface elevations at stations along the riverside of the frontline levee was 0.5-foot at levee mile 81. The modeling also indicated that the closure of the 1,500-feet gap would require raising portions of the Setback Levee to protect the St. Johns Bayou Basin from the Mississippi River flooding during the operation of the New Madrid Floodway. The grade of the Setback Levee would be raised to maintain the authorized freeboard.

The evaluation concluded that, under project conditions, the difference in response of the Mississippi River system with the 1,500-foot closure, when compared to current conditions, would be negligible in terms of stage and duration.

Closure levee location proposed by Alternative 2 would allow for the use of existing inflow/outflow #2, and no new inflow/outflow crevasse section would be necessary. No additional pipes would be required. The Corps currently has authority to operate inflow/outflow #2; therefore, no additional operational authority would be required. The Corps currently has the real estate rights to operate inflow/outflow #2; therefore, no additional real estate instruments along the levee would be required. There would be a need to purchase existing modified flowage easements over all lands not covered below 300 feet NGVD. Hydraulic operation of these alternatives would not require the purchase of any additional bluehole/sanding land. The Corps currently has all required real estate to access inflow/outflow #2; therefore no additional access lanes would be required. The existing plan of operation includes operation of inflow/outflow #2; therefore there would be no change to the operational timeline.

5.16.7 Alternative 3-1.A

Conditions and operational matters for Alternative 3-1.A would be the same as those described for Alternative 2.

5.16.8 Alternative 3-1.B (Recommended Plan)

Impacts are the same as Alternative 3-1.A.

5.16.9 Alternative 3-1.C

Impacts are the same as Alternative 3-1.A.

5.16.10 Alternative 3-2.A

Closure levee location proposed by Alternative 3-2.A would require an inflow/outflow crevasse on the frontline levee upstream of existing inflow/outflow #2, and approximately 15,600 feet of four-inch diameter polyethylene pipe would be required. The Corps currently has authority to operate inflow/outflow #2; therefore, no additional operational authority would be required. The Corps would have to acquire real estate rights to operate the proposed inflow/outflow section. Additionally, there would be a need to purchase existing modified flowage easements over all lands not covered below 300 feet NGVD. Hydraulic operation of these alternatives would not require the purchase of any additional bluehole/sanding land. The Corps would have to obtain real estate interest in the access lane leading to the proposed inflow/outflow section. Approximately 62 acres would be required. The existing plan of operation includes operation of inflow/outflow #2; therefore there would be no change to the operational timeline.

5.16.11 Alternative 3-2.B

Impacts are the same as Alternative 3-2.A.

5.16.12 Alternative 3-2.C

Impacts are the same as Alternative 3-2.A.

5.16.13 Alternative 3-3.A

The closure levee location proposed by Alternative 3-3.A would require an inflow/outflow crevasse located on the frontline levee and approximately 15,600 feet of four-inch diameter polyethylene pipe would be required. The Corps would have to obtain operational authority to artificially crevasse the proposed section. The Corps would have to acquire real estate rights to operate the proposed inflow/outflow section. Changes to flow levels above and below 300 feet NGVED would be significant enough to require a new modified flowage easement throughout the floodway above the levee. Hydraulic operation of the alternative would require the purchase of bluehold/sanding lands totaling approximately 870 acres along the majority of the closure. The Corps would have to obtain real estate interest in the access lane leading to the proposed inflow/outflow section. Approximately 62 acres would be required. There would be no increase to the current timeline.

5.16.14 Alternative 3-3.B

Impacts are the same as Alternative 3-3.A.

5.16.15 Alternative 3-3.C

Impacts are the same as Alternative 3-3.A.

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 the 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. 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 disjunctive habitat fragments. Cumulative impacts may also occur when the timing of perturbations are so close in space that their effects overlap.

5.17.1 Past

The project area stands at the top of the Central Mississippi River Valley and is part of a 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 presettlement 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 lost. 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 DeSoto entered the valley. It was at the confluence of the Mississippi and Ohio rivers that Marquette and Joliet noticed marked changes in the landscape, such as the abundance of switchcane (*Arundinaria*) and mosquitoes.

The first European settlement of importance was the site that 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. Small communities along the river supplied the steamboats with wood for fuel 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 forests 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 an underserved reputation and discouraged people from settling in the area.

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. An 1859 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. In 1858 there was a major flood on the Mississippi River. 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 a devastating 1927 flood, the MR&T 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 1910s and early 1920s, a land boom was in progress for the landowners. Families were hired to clear land for $8-12 per acre after the timber had been harvested. 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 reduced profits. Many resident 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 to 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 New Madrid Floodway and surrounding areas have a 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.

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 connected to the Mississippi River only through a gated control structure. It is operated such that Mississippi River waters do not back up into the basin during flood events.

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 additional land clearing since the mid- to late-1960s for soybean production. It is the Corps opinion that 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 as part of this project, but do not depend on the project for construction.

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 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 because 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. Several exist in the project area and none are known to be located 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 about 17,000 are in the New Madrid Floodway. Of that total acreage, 69 percent has been tentatively (not jurisdictional delineated) mapped as wetland. Within the reach of the Mississippi River from the Ohio River to the White River, 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 the *Mississippi River Mainline Levees Enlargement and Control Supplement No. 1 to the Final Environmental Impact Statement* dated July 1998. 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.

This document (the Final Revised Supplemental Environmental Impact Statement for the St. Johns Bayou-New Madrid Floodway Project) 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 project would curtail the possibility of infrequent (30+ 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 and (approximately 55,000 acres) in the St. Johns Bayou. Backwater flooding from two-year flood events would be reduced on approximately 10,239acres of wetlands (about 5,417 acres of farmed wetland and 4,822 acres of forested and non-farmed wetlands) in the New Madrid Floodway. Flooding (both headwater due to high river stage and backwater) from two-year flood events would be reduced on approximately 2,016 acres of wetlands (about 1,296 acres of farmed wetland and 720 acres of forested and non-farmed wetlands) in the St. Johns Bayou Basin. However, with the conditions that will continue to exist after project implementation, such as poor drainage, seepage, soil conditions, and interior rainfall, and the addition through the mitigation of up to 8,375 acres of previously cleared, reforested wetlands lands, there may be a incremental increase in project area wetland acres. Please refer to Section 5.3 for more information.

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 remain saturated and continue to be jurisdictional under Section 404 of the Clean Water Act and FSA.

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-feet gap in the levee will have no measurable change on Mississippi River flood stages.

The mitigation plan would result in a net gain of BLH and flood easements on herbaceous land to provide shorebird habitat. Reforestation may 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 additional proposed avoid/minimize plan, composed of restoration of approximately 64 miles of stream and channels, along with artificial structure and a special wildlife corridor, will provide a quantum improvement in the environmental quality of the area. In addition to tripling the fishery value and connecting the two significant natural areas in the New Madrid Floodway, this plan provides significant improvement to overall water quality. All buffer areas, though designed mostly with fish and aquatic restoration as the focus, will also provide significant benefits to a variety of wildlife species. The aesthetics and overall quality of the human environment will be significantly enhanced. Implementation of this plan would not only have a positive impact on the immediate project area, but would provide improved water inputs to the Mississippi River as well. These are the kind of measures that address such concerns as hypoxia in the Gulf of Mexico and TMDL issues both inside and outside the floodway. Even without the additional avoid and minimize proposal, analysis also indicates that the various alternatives are likely to have virtually no effect on hypoxia/anoxia in the Gulf of Mexico (see Section 5.10.3).

The New Madrid area floodplain is approximately 10 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 this mitigation package 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 also 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 10,239 acres of wetlands in the New Madrid Floodway, 3,426 of which are forested. All of these acres will remain wetlands, and none of the forested acres will be lost. A 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 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 a highly worked and manipulated environment. Since the original forestland has been cleared and the main Mississippi River levee has been built, high river stages do not flow freely over the forest floor as they originally did. High river stages now back up into the New Madrid Floodway and, in essence, water ponds on thousands of acres of agricultural farm land. This connection provides hydrologic exchange between mostly agricultural fields and the aquatic ecosystem of the Mississippi River. According to USFWS and MDC, lands in the project area are known to support more diverse habitats and natural communities than elsewhere in the Bootheel. However, data indicates a substantially higher level of fishery diversity in the St. Johns Bayou Basin than in the New Madrid Floodway (Sheehan *et al*. 1998). These diverse habitats were evaluated, 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 for these unavoidable losses.

Impacts to fishery, terrestrial, waterfowl, and shorebird resources were reduced by incorporating environmental design features into the alternatives discussed in this document. Alternatives were formulated to avoid and minimize impacts through project design prior to developing compensatory measures for unavoidable impacts.

Each alternative has 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 to formulate measures that:

- Offset 100 percent of the terrestrial AAHUs lost.

- Offset 100 percent of the fishery rearing HUs lost in the floodplain. In addition, formulate measures to offset losses of in-stream fishery HUs.

- Offset 100 percent of the shorebird AAHUs lost.

- Offset 100 percent of waterfowl DUDs lost during spring migration.
- Reduce detrimental affects to the freshwater mussel habitat during project implementation and for future projects.

- Compensate for as many resource categories as possible on the same real estate.

Appendix L presents amplifying information on mitigation, particularly with respect to the Recommended Plan.

6.1 ST. JOHNS BAYOU BASIN

6.1.1 Terrestrial Habitat Mitigation

Terrestrial habitat losses in both basins will be compensated by reforestation associated with mitigation for fishery losses. Enlarged channel dimensions would be reduced, and restrictive easements would be placed on the channel embankments.

6.1.2 Fisheries Floodplain Habitat Mitigation

The loss of floodplain habitat for rearing fishes will be compensated by fee title land acquisition of 1,317 acres of agricultural land that provides access for riverine fish during high water stages of the Mississippi River from March through June. This land would be reforested by planting 85 percent acorns and 15 percent RPM trees. This would also mitigate part of the terrestrial losses, the remainder of which would be compensated by New Madrid Floodway fishery mitigation. Attempts will be made to purchase mitigation lands in large tracts as close as possible to the lower end of the basin.

6.1.3 Fishery In-Stream Habitat Mitigation

In-stream losses would be mitigated by the avoidance of bottomland hardwoods within the right-of-way (66 acres), construction of bank stabilization measures (riprap at channel intersections), and the avoidance of a 9-foot strip along the right-descending bank in the Setback Levee Ditch. The upper 3.7 miles of St. James Ditch would be removed from construction to avoid adverse impacts to the State-endangered golden topminnow.

6.1.4 Waterfowl Habitat Mitigation

Waterfowl habitat losses in both basins would be compensated by reforestation associated with mitigation for fishery losses. A sufficient amount of the purchased land must be flooded to a depth of 18 to 24 inches to be accessible to most dabbling and diving ducks in the project area. The MDC would manage (fluctuate) the water levels on about 6,400 acres (both basins combined) to maximize winter waterfowl benefits.

6.1.5 Shorebird Habitat Mitigation

Shorebird habitat losses in the St. Johns Bayou Basin will be compensated through an easement (or purchase) and flooding of approximately 105 acres of 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.

6.1.6 Mussel Mitigation

Mussel mitigation involves the avoidance of a nine-foot strip along the right-descending bank of the Setback Levee Ditch, the relocation of mussels from sites within the dredge path to other locations within the project area, and the establishment of a mussel monitoring program to evaluate avoidance and relocation on the ability of the mussel population to recover from dredging actions.

6.2 NEW MADRID FLOODWAY

6.2.1 Terrestrial Habitat

Terrestrial habitat losses in the New Madrid Floodway will be compensated by reforestation associated with mitigation for fishery losses.

6.2.2 Fisheries Floodplain Habitat

The loss of floodplain habitat for rearing fishes will be compensated by fee title land acquisition of 7,059 acres (for the Recommended Plan) of agricultural land that provides access for riverine fish during high water stages of the Mississippi River from March through June. This land would be reforested by planting acorns.

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 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).

Reforested acres necessary for compensatory mitigation of rearing habitat lost in the New Madrid Floodway are:

Alternative	Reforested Acres
2	8,860.9
3-1.A	8,243.6
3-1.B	7,058.7
3-1.C	5,609.3
3-2.A	8,028.5
3-2.B	6,843.6
3-2.C	5,394.2
3-3.A	7,371.2
3-3.B	6,186.4
3-3.C	4,737.0

6.2.3 Fisheries Permanent Waterbody Habitat

Permanent waterbody habitat would be compensated through the construction of new borrow pits or enhancing existing borrow pits in mitigation tracts. The borrow pits should maintain connections to the Mississippi River to provide access for adults and young-of-the-year fishes. USFWS requested 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, and reconnect backwaters and old river channels to provide access of fishes to the Mississippi River during spring backwater flooding.

6.2.4 Waterfowl

Waterfowl habitat losses in the New Madrid Floodway will be compensated by reforestation associated with mitigation for fishery losses. A sufficient amount of the acquired mitigation land must be flooded to a depth of 18 to 24 inches to be accessible to most dabbling and diving ducks in the project area. MDC would manage (fluctuate) the water levels on about 6,400 acres (both basins combined) to maximize winter waterfowl benefits.

6.2.5 Shorebird

Shorebird habitat losses in the New Madrid Floodway will be compensated through an easement (or purchase) and flooding of approximately 660 acres of 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:

(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.

Mitigation requirements attributed to the impacts of the St. Johns Bayou Basin portion of the project will be the acquisition responsibility of the local sponsor, the St. Johns Levee and Drainage District. The remaining mitigation requirements are attributed to the impacts of the levee closure, a feature of the Mississippi River and Tributaries Project, and will be the responsibility of the Corps. The local sponsor is 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 ADDITIONAL AVOID AND MINIMIZE MEASURES

The Corps believes that all significant fish and wildlife losses will be fully mitigated with the recommended mitigation plan. However, because of uncertainties regarding acquisition of the most desirable lands, effectiveness of management of those lands, and the values placed on the lower floodway, the Corps recommends additional avoid and minimize measures for the project area. Measures include placing buffers on 64 miles of streams and channels, construction of artificial fish structures, and development of a wildlife corridor between Big Oak Tree State Park and Ten Mile Pond Conservation Area. This plan is described in an attachment to Appendix L.

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, and 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, including interested individuals, representatives from state and federal agencies and the U.S. House of Representatives, and representatives of private organizations. Additional project briefings were held between the Corps, project sponsor, local interests, and state and federal agencies during the preparation of the draft report.

The Notice of Availability of the DSEIS was published in the April 9, 1999, Federal Register, and the draft was mailed to approximately 145 individuals and public and 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 USFWS. 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, as well as individuals. Twenty-one individuals presented testimony; all speaking in favor of the project.

A total of 48 written comments were received during the comment period and 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 comments were received after the close of the comment period. They were accepted and considered during the preparation of the September 2000 Final SEIS (FSEIS).

State and Federal resource agencies expressed concern with the loss of river connectivity to the New Madrid Floodway with the potential impacts of this loss on fishery spawning and rearing habitat and wetlands. Because of the level of Department of Interior (DOI) and Environmental Protection Agency (EPA) concerns and potential referral to the Council on Environmental Quality (CEQ), the Assistant Secretary of Army for Civil Works [ASA(CW)] identified a Washington level, interagency working group to seek resolution of resource agency concerns. To facilitate this effort, the ASA(CW) extended the period for referral to CEQ indefinitely. The group identified four additional floodway closure options for consideration. Fifteen potential mitigation sites totaling more than 20,000 acres were also identified. In correspondence dated March 26, 2001, the ASA(CW) directed that the SEIS be revised to focus on alternative floodway closure locations and more detailed evaluation of potential mitigation sites.

Three meetings were held with project sponsor representatives and representatives from EPA, USFWS, MDC, and MDNR between March and September 2001 to establish the proposed Corps course of action, to obtain input, and to present findings. A preliminary revised draft SEIS was provided to each organization in September 2001 for review concurrent with Memphis District. The revised draft SEIS was filed and a 45-day public review was initiated on November 2, 2001.

The revised draft was mailed to approximately 125 individuals and public and governmental interests. Most comments from individual citizens were received by the December 17th end of the comment period. The general comment period was extended to January 2, 2002, but the comment period for DOI and EPA was not closed until February 28, 2002. On November 26, 2001, another public meeting was held at East Prairie, Missouri. Besides Corps personnel, 55 attended, including U.S. Representative Jo Ann Emerson and a member of the staff of Senator Christopher Bond, state agency representatives, officials of local agencies, and individuals. Eleven statements were made during the public comment portion of the meeting. One commenter indicated his agency was reviewing the document and would be providing written comments during the public comment period. The remaining verbal comments were in general support of the project.

In addition to the verbal comments made during the public meeting, 39 comment letters were received during the comment period, and 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 and the fishery. Another underlying concern is a loss of connectivity between the New Madrid Floodway and the Mississippi River. While most comments received in opposition to the project involve one of these basic concerns, there were many other comments questioning the validity of economic calculations or assumptions, endangered species impacts, compliance with environmental regulations, water quality impacts, floodway operations, the ability to implement the mitigation plan, and post project clearing and drainage.

Project sponsors and supporters have also voiced concerns through their comments and in discussion subsequent to the official comment period. Most project proponents share frustration due to the years of delay in implementing the project. Most project proponents have expressed concerns about

the modified gate operations incorporated in the recommended plan as well. This concern is not so much based upon the additional start pump elevation of 284.4 feet, versus the previous 282.5 feet, as it is with the lateness in the spring planting season (May 15) that the gates would be left open to the higher level. According to commenters, this impacts not only short term crop financing, but also could cause early season crop losses. Several written comments from project proponents criticized the mitigation package for excessiveness. The local sponsor has also voiced concern since the close of the public comment period regarding negative fishery resource impacts from short duration surging. It is true that in some cases, it may be counter-productive to allow water back into the area for a short duration only to pump it out soon after. For instance, if the land has been either plowed or otherwise prepared for planting, adverse impacts could occur to water quality by allowing the area to be inundated and subject to wave action for a short duration, while the fishery receives no positive impact for the short duration flood.

All written comments are provided in Appendix M. Responses to each comment are also provided in Appendix M. The comments are not separated with respect to whether the commenter is a project opponent or proponent, but rather by hierarchy and alphabetically.

7.2 COORDINATION

Numerous interagency planning meetings comprising Corps, USFWS, and MDC representatives convened throughout the study to assess environmental impact associated with the proposed project, including; wetlands, woodlands, terrestrial habitat, waterfowl, fisheries, mussels, endangered species, water quality, and mitigation issues. Throughout the study process, all scopes of work, survey data, and reports from contractors were developed and reviewed by the interagency team. Representatives from MDNR, EPA, NRCS, WES, and GEC were also involved in many of these meetings.

Subsequent to the release of the DSEIS, the EPA expressed concerns it had to the Council on Environmental Quality (CEQ), and the CEQ convened a meeting on July 13, 1999, to discuss EPA's concerns. Representatives from USFWS also attended. EPA concerns related to a number of issues, including wetland impact, alternative analysis, purpose and need, mitigation, cumulative impact, and water quality analysis. It stated a desire that a revised draft of the DSEIS be prepared. The Assistant Secretary of the Army for Civil Works [ASA(CW)] granted an extension to EPA to provide comments on the DSEIS. The Corps and EPA subsequently conducted several meetings and representatives from other agencies were often in attendance, and the Corps conducted additional water quality analysis for inclusion in the FSEIS. EPA provided a formal letter of comment on the draft SEIS dated March 20, 2000, and the Corps response to that letter is contained in Appendix M of the September 2000 SEIS. Additional studies and analyses substantiated the recommendations of the draft report and were added to the final report to clarify necessary issues and impacts.

During the development of this SEIS as directed by the ASA(CW) in the March 26, 2001 letter, there were three interagency working level scoping/working meetings. These meetings were held in Memphis on April 11, June 12, and August 10, 2001. The meetings were attended by the EPA, the Fish and Wildlife Service, MDNR, MDC, G.E.C., Inc., a representative of the project sponsor, and the Memphis District Corps team. Congresswoman Emersion (Missouri) was represented in the August 10, 2001 meeting. It was during these meetings that MDC suggested modified gate operations as a method to reduce/avoid impacts to the fishery.

Additional coordination was also conducted specifically between the Fish and Wildlife Service and the Corps under the Fish and Wildlife Coordination Act. Activities conducted under this authority include the preparation of the Coordination Act Report, which is provided in Appendix E. Specific activities were conducted in accordance with a scope of work agreed to between USFWS and the Corps in June 2001. The Draft CAR (October 16, 2001) was provided and included in the October 2001 Draft SEIS. All new aspects of the Draft CAR are limited to cursory reviews of the additional closure levee locations and modified gate operations. In most aspects, the CAR is similar to the CAR provided in June 2000 that was included in the September 2000 SEIS. The USFWS did not provide a revised waterfowl assessment for the new alternatives considered.

Additional coordination between interests in the project area, resource agencies, and the Corps occurred during the development of the project web site. The East Prairie Enterprise Community provided permission to establish a link from the Corps project information web site between the Enterprise Community web site (pers. Comm. Dr. Martha Ellen Black). Links were also provided from the project site to the EPA, Fish and Wildlife Service, Missouri Department of Conservation, and Missouri Department of Natural Resources. However, until the winter or spring of 2002, the Fish and Wildlife Service internet site was not accessible.

7.2.1 USFWS Recommendations and Corps Responses

The USFWS provided the following recommendations in their June 6, 2002, *Fish and Wildlife Coordination Act Report* (CAR). The USFWS's recommendations, taken directly from the CAR, are shown in italics and are followed by the Corps responses.

Based on the magnitude of fish and wildlife losses, value of these resources, and the inability to properly mitigate these losses due to the design, purpose and economic objectives of the project, the Service recommends that the Recommended Alternative/NED Plan (Alternative 3-1B) not proceed as formulated. Other alternatives that provide greater opportunity to minimize and compensate fish and wildlife losses, such as presented in the Department of Interior's February 26, 2002, letter, should be more fully evaluated and incorporated into a limited project.

Corps Response: The Corps disagrees with the USFWS's contention that the Recommended Plan induces losses that cannot be adequately mitigated. Please see the following responses to Service recommendations as well as Corps responses to the DOI comments on the draft RSEIS contained in Appendix M. Regarding the "other alternatives" referenced in this paragraph, their costs greatly exceed benefits and they are clearly not in the public interest. They are addressed in the RSEIS sections 2.4.4.2 and 2.4.4.3 and elsewhere, as well as in the Corps response to the last Service Statement in Section 7.2.2 that follows.

The following recommendations pertain to the Recommended Alternative/NED Plan (Alternative 3-1B). Several of these recommendations were contained in the May 2000 FWCA report and have been updated. Providing these recommendations does not change the Service's opposition to the Recommended Alternative nor indicates that implementing these recommendations will fully compensate for project-related fish and wildlife losses. The Service is aware that specific purposes and features of the project may prevent many of these recommendations from being implemented if the project is constructed (e.g., permanent change in wetland and fishery hydrology, inability to locate suitable sites with willing sellers, and effect on project economics of removing lands from agriculture production for mitigation). Furthermore, we fully expect that these recommendations will be rejected as infeasible or unjustified by the Corps and the local sponsor or reduced in scope to

the point of becoming virtually meaningless as compensation measures. These recommendations are provided by the Service to rectify and compensate for a portion of the anticipated impacts in the event that the Recommended Alternative is approved, funded, and constructed over our objections.

Corps Response: The Corps and the USFWS jointly determined, early in project planning, that reforestation of frequently flooded cropland could provide suitable mitigation for fishery losses. The Corps originally believed that losses could be adequately mitigated based on compensation of fish spawning impacts, i.e., areas where depth and duration criteria necessary for fish spawning would be impacted by reduced inundation. However, the Corps later agreed to the USFWS's request for a larger mitigation acreage based on impacts to fish rearing habitat, which has no depth or flood duration restrictions. This agreement to use the larger mitigation number was based on the USFWS's contention that there were uncertainties regarding project impacts to wetlands and some resource categories such as amphibians and reptiles. The Mississippi Valley Division Commander agreed with the Regional Director of USFWS to employ this higher acreage to alleviate some of the concerns posed by USFWS. Because of the addition of fish rearing habitat, the recommended mitigation plan results in significant over-compensation for terrestrial wildlife resources, waterfowl, and fish spawning, according to the USFWS's previous estimates of these resource impacts. It should also be pointed out that since the filing of the final SEIS in September of 2000, the revised project now includes a gate operation feature to allow increased connectivity between the Mississippi River and floodplain during the fish reproductive period, as well as significant additional avoid and minimize measures for the New Madrid Floodway. These measures include: riparian buffers/corridors on 64 miles of streams and channels; 20 in-stream fish structures; and a wildlife corridor between Big Oak Tree State Park and Ten Mile Pond Conservation Area. These environmental measures are recommended for implementation without a decrease in required project mitigation. Rather, in a good faith effort to address Service concerns, the Corps has proposed these measures as potential improvements to the wildlife and fishery habitat that will actually exceed the existing conditions in the project area. Much of the area of wetland impact is actually cropland that meets farmed wetland criteria for inundation but requires summertime irrigation in order to successfully grow a crop under existing conditions. The Corps has worked diligently with the USFWS and MDC in project impact assessment and in determining appropriate compensation measures. Based on all the evidence and after careful review and consideration, the Corps believes that the project will provide much needed flood control for the St Johns Basin and New Madrid Floodway and, with mitigation and proposed additional avoid and minimize measures, all significant fish and wildlife impacts will be more than adequately mitigated.

Recommendation 1: *Minimize dredging and channel modifications to the maximum extent possible by implementing the following conservation measures:*

Corps Response: Refer to the following responses.

Recommendation 1a: *Installing gradient control structures at the upper end of all work reaches and at the mouths of all major tributaries to prevent headcutting.*

Corps Response: Channel gradient control would not be necessary at these locations, because the bottom elevation of the ditches would be the same as existing conditions. Also, gradient control would not be necessary at the upper end of channel construction, because 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 cutting. Also, to maintain bank stability

at the confluence of St. James Ditch with Setback Levee Ditch, stabilization measures will be installed.

Recommendation 1b: *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.*

Corps Response: Nine dikes will be constructed in the St. Johns Bayou Basin, 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. It should be noted that the Setback Levee Ditch has been previously cleared and fishery habitat has reestablished to its present condition. Furthermore, recent collections by SIU indicate relatively high species diversity suggesting relatively rapid recovery from previous disturbances. The temporary loss resulting from new maintenance would return to pre-project conditions as it has in the past without additional in-stream dikes. The significant additional avoid and minimize proposal included in the Recommended Plan for the New Madrid Floodway includes in-stream transverse dikes for fishery habitat in the lower reach of Mud Ditch from just below Eagles Nest to the closure levee. There are about 20 structures over a five-mile stretch in this additional proposal.

Recommendation 1c: *Constructing a low-head weir where the Lee Rowe Ditch branches off the St. James Ditch to prevent perching that channel during base flows.*

Corps Response: Concur with maintaining the depth of base flow in Lee Rowe Ditch during low flow periods. Pre-project base flow levels can be maintained in Lee Rowe Ditch by leaving a plug in the St. James Ditch just downstream from the junction between the two ditches at approximately mile 3.7 of St. James Ditch. A weir would not be necessary because the same result can be accomplished with a plug. Also, a plug would provide pooled water to benefit aquatic habitat and rock would be placed on the downstream face of the plug to further enhance aquatic habitat and to prevent erosion of the plug.

Recommendation 1d: *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.*

Corps Response: The low velocities in the St. James Ditch would likely not produce the effect desired for vortex weirs. 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 could also reduce channel conveyance and scour the banks. However, to accommodate Service concerns, the Corps is willing to try this on a test basis on a one-mile reach of St. James Ditch.

Recommendation 1e: *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.*

Corps Response: The recommended alternative eliminates 3.7 miles of channel work on St. James Ditch above Lateral No. 2 to avoid any impacts to the golden topminnow within this reach.

Recommendation 1f: *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.*

Corps 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, 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. Therefore, as requested by the USFWS, this recommendation will be fully implemented.

Recommendation 2a: *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 284.4 (NED) NGVD in the Floodway. The Service assumes the Corps will purchase flood or similar easements up to elevation 284.4 that will include covenants to prevent the clearing of forested wetlands.*

Corps Response: The Corps does not believe, based on extensive hydrological analysis, that jurisdictional wetland status of forested wetlands will change. This opinion is further supported by the presence of forested wetlands north of the project area in locations not subject to frequent flooding regime of the lower Floodway. Therefore, land use would remain the same with the project as under existing conditions. Landowners must comply with all requirements of Section 404 of the Clean Water Act; therefore, protective easements would not be needed. Flowage easements will be purchased in the New Madrid Floodway on lands up to elevation 284.4 NGVD to allow for springtime flooding for fish management and to 285.4 NGVD to allow for winter waterfowl flooding. These easements would not contain covenants to prevent clearing; however, there is a high likelihood that these lands would be considered suitable mitigation lands, in which case there would be a substantial amount of reforestation.

Recommendation 2b: *Compensation for unavoidable losses of fish and wildlife resources should include the following measures (average annual acres).*

(1) *Reforest approximately 1,550 acres of agricultural lands and maintain appropriate hydrologic conditions on these areas to partially compensate for forested wetland habitat losses associated with channel enlargement, levee closure, and pump operations (i.e., altered hydrology). If protective covenants are not placed on forested wetlands as described in 2(a) above, the Corps should reforest an additional 6,788 acres to compensate for induced forested wetland losses.*

Corps Response: The Corps does not believe, based on extensive hydrological analysis, the jurisdictional wetland status of forested wetlands will change. Therefore, land use would remain the same with the project as under existing conditions. Landowners would have the same constraints

under Section 404 of the Clean Water Act requirements, and protective easements would not be needed. However, the recommended mitigation plan includes reforestation of 8,375 acres which would more than compensate this loss even though the Corps does not believe it would occur. It should be pointed out that the USFWS biologist concurred in the past that the recommended fishery mitigation does fully mitigate any potential loss related to induced clearing.

(2) *Reforest cropland and maintain appropriate hydrologic conditions 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.*

Corps Response: Concur. The proposed mitigation plan for reforestation fully addresses these concerns.

(3) *Reforest approximately 7,058 acres (based on information in Table 14, Appendix G in the draft RSEIS) of seasonally flooded agricultural lands that has unimpeded access for river fishes during the reproductive season (i.e., March through June) to partially compensate mid-season fisheries spawning and rearing habitat losses on the floodplain (excluding permanent water bodies in #4 below). Lands behind existing levees with impeded access for fishes (i.e., St. Johns Bayou Basin) and areas in the New Madrid Floodway after the levee gap is closed do not meet the definition of "unimpeded access". Enhancement of batture lands would also not be acceptable compensation for fisheries spawning and rearing habitat losses because it would provide little additional fish and wildlife benefit above existing conditions, and both the hydrologic and temperature regimes of these areas differ significantly from those of the Floodway.*

Corps Response: Based on this recommendation, it would be impossible to provide compensation lands in the project area, i.e., lands above the closures would have impeded access and lands below the closure are batture lands. Results of the Fisheries Survey Final Report (Sheehan, July 1998) do not support the USFWS's opinion that the Bird's Point-New Madrid Setback Levee "currently block fish movement" or meet the definition of unimpeded access. In fact, the Shannon-Weaver diversity index values reported by SIU (*Fisheries Survey Final Report*, Sheehan, July 1998, tables 22, 23, and 24) is comparable or higher for the St. Johns Bayou Basin than it is for the New Madrid Floodway, including "river species" reported in Table 22. These data, at the very least, indicate that the presence of gated outlet culverts do not necessarily restrict all fish movement at times when the gates remain open. It can also be deduced that the protected nature of the basin could provide better habitat or conditions for wetland and backwater species that otherwise are not as diverse or not present in the New Madrid Floodway. The USFWS has provided no evidence to support the contention that batture lands of the area do not meet hydrologic criteria for fish spawning. The Final RSEIS Appendix L discusses Donaldson Point and Island #8 in some detail with regard to the backwater/slackwater hydrologic characteristics desirable for a fishery nursery. These two batture areas do provide a benefit to the fishery that the Corps believes would be greatly improved under the mitigation plan. Ample documentation is available in the scientific literature to clearly indicate that forested wetlands are excellent habitats for fishes and other wetland-dependent species. Regardless, the proposed mitigation of 8,375 acres of reforested agricultural lands more than adequately compensates for all impacts. The USFWS's assertion that batture lands are unacceptable and lands inside the post closure floodway are unacceptable is without foundation. Based on analysis preformed by the Corps, the proposed mitigation plan is adequate. If the adequacy of mitigation was

restricted to areas meeting the USFWS's stated parameters, it would be necessary to move to backwater areas outside the immediate project vicinity to acquire lands. The Corps has no objection to acquisition of desirable mitigation lands in other basins, e.g., Lower Obion River. However, as stated above, the Corps does not accept the USFWS's conclusions, nor does it believe that mitigation lands far removed from the project vicinity would be acceptable to Missouri resource agencies, the local sponsor, and others.

(4) *To the maximum extent feasible, provide approximately 1,950 acres of in-kind compensation for the loss of permanent waterbodies. Compensation actions should involve restoring/reconnecting old chutes, sloughs, and oxbows with the Mississippi River and/or improving habitat values of existing permanent waterbodies. Borrow pit construction provides minimal permanent water habitat for fishes and is not considered adequate compensation. If in-kind replacement is infeasible, reforest an additional 1,950 acres of flooded cropland with unimpeded access for river fishes to compensate permanent waterbody losses. The Corps should ensure public access to these sites through fee-title purchase or easements.*

Corps Response: With the Recommended Plan, the impact on permanent water bodies is reduced due to the additional access to the floodway through the rearing mid-season. Therefore, total acres to fully mitigate fishery losses associated with permanent water bodies from backwater inundation reduction would be less than 1,950. The amount of reforested land that would adequately mitigate the impacts from the recommended plan, to include permanent water bodies, is 8,375 acres. The Corps will continue to work with the USFWS to identify opportunities to create permanent water habitat that would reduce the need for compensation acres through reforestation. Borrow pits are excellent habitats when properly constructed, and can be done by following environmental guidelines. The Corps notes that there could be a reasonable opportunity for this in batture areas such as on Donaldson Point or Island #8 that are discussed in the mitigation plan (Appendix L). -The additional purpose of providing public access is not required to mitigate losses.

(5) *Provide approximately 1,500 acres of shallow flooded (i.e., < 18 inches) agricultural lands in April and May to compensate for project-related losses in shorebird migration habitat. Depending on development and management practices, these shorebird mitigation sites could also partially compensate for waterfowl habitat losses. Constructing moist soil areas to replace these losses would reduce the area needed for mitigation to 770 acres.*

Corps Response: The Corps agrees with the USFWS compensation measure and recommends mitigating shorebird losses with restrictive flowage easements (or fee acquisition) and flooding 765 acres of herbaceous land.

(6) *Acquisition of mitigation lands (including easements under recommendation 2a), reforestation, and shorebird management measures should be accomplished concurrently with project construction and should be in place prior to project operation.*

Corps Response: Concur. The Corps will work to insure that mitigation is implemented concurrently with project construction per Section.6.3 of the final RSEIS.

Recommendation 3: *Acquire and restore (reforestation and hydrology) sufficient lands around Big Oak Tree State Park to provide a buffer and to compensate for impacts to the ecologic and biological functions and values of the Park and the federally designated National Natural Landmark. These lands would be managed by the Missouri Department of Natural Resources as a unit of the State Park.*

Corps Response: Concur. The mitigation plan specifically addresses this issue.

Recommendation 4: *Develop and implement a plan, in cooperation with the Missouri Department of Natural Resources and the National Park Service, to maintain and restore wetland hydrology in Big Oak Tree State Park and the National Natural Landmark.*

Corps Response: The Corps agrees with the MDNR and the National Park Service that restoration of the park is necessary to prevent further degradation. The Corps will work closely with MDNR to develop and implement a water management/restoration plan.

Recommendation 5: *Develop and implement a program, in cooperation with the Service and MDC, to monitor the fish and wildlife effects of the project and the performance of all mitigation measures ultimately implemented. The monitoring program should address all aspects of fish and wildlife impacts and mitigation, including hydrologic changes in wetland and fishery habitats and land use changes (e.g., conversion of wetlands to agriculture production). The monitoring program should be in place prior to operation and operational for a minimum of 25 years.*

Corps Response: The Corps welcomes this proposal and will develop a plan to measure the effectiveness of mitigation. Hydrologic and land-use changes will also be measured and reported. We would propose to measure land-use changes for a period of 10 years, which would adequately reflect any project-induced changes. The effectiveness of mitigation components could be measured over a longer period of time, i.e., 25 years. Measurements and reporting could occur at approximate five-year intervals and it is not anticipated that this would be a costly monitoring program.

Recommendation 6: *Conduct an independent, scientific review of the project to resolve the longstanding disagreement between the Corps and the Service concerning the expected environmental impacts of this project, especially relating to wetland and fishery losses.*

Corps Response: The Corps has considered and continues to consider any review and comments offered on this project. It is the Corps' responsibility under the law to evaluate impacts and report those impacts using the best scientific information reasonably available. Our analysis of wetland impacts is based on extensive hydrologic analysis along with consideration of regulatory constraints. Mitigation of fishery impacts has been, up until now, in accordance with Service recommendations. Even now, we are recommending measures that have been suggested by the USFWS, though the USFWS now contends that implementation of these measures do not adequately mitigate impacts. The Corps recognizes that the project does impact wetlands and fish, and the Corps has proposed measures to avoid, minimize and compensate for those losses based on recommendations of the USFWS and within the context of a flood control project. The Corps believes that, considering the substantial mitigation measures combined with major additional avoid and minimize measures for the project area, the project environment will not suffer unacceptable losses to fish or wetland habitat. Also, and as shown by USFWS's own analyses, the recommended mitigation plan, notwithstanding additional avoid and minimize measures, provides significant over-compensation to terrestrial wildlife and waterfowl, and fully mitigates shorebird impacts. The Corps has spent over

five years and millions of dollars to collect data and analyze project impacts, has coordinated closely with USFWS and other resource agencies, and has fully reported the results of all analyses. The Corps welcomes all comments but will not further delay a final decision in favor of additional study and review.

Recommendation 7: *Develop and implement an adaptive management program, in cooperation with the Service and MDC, that provides flexibility to add or revise fish and wildlife mitigation components based on scientific review and monitoring as addressed in recommendations 5 and 6 above. Three critical issues that will require close monitoring and have a high probability of requiring future corrective actions are: 1) the ability of fish to freely access the floodway-river through the New Madrid Floodway gates and pumps during the seasonal flooding regime proposed under the Recommended Alternative; 2) the fixed timing of gate operations in relationship to fish movements and reproductive periods; and 3) the extent of reduced wetland hydrology and its impairment of wetland ecological functions, which may be greater than the Corps has predicted.*

Corps Response: The Corps will review gate design prior to project construction to insure that the structure will accommodate maximum fish passage within the constraints of project operation. The Corps will also consider adjustments in operation of the gates regarding factors such as flooding, timing, etc. The Corps agrees that maximum flexibility should be provided managers of mitigation lands so that adjustments can be implemented, if necessary, to obtain desired outcomes.

Recommendation 8: *All project mitigation components and the monitoring and adaptive management programs should be formalized under an Environmental Operating Plan (EOP). The EOP would establish monitoring standards and criteria to assess mitigation performance and integrate information from the scientific review and monitoring program with decisions concerning future remedial actions (adaptive management). The Corps should diligently pursue the necessary authorizations and appropriations to guarantee that the EOP is a viable component of the project and is in place prior to project operation. The following three tasks should be completed concurrent with completion of the FRSEIS and Record of Decision*:

Corps Response: Please see response to Recommendation 5. The Corps will develop an operating plan for pump and gate operation and prepare an initial development and management plan for the candidate mitigation parcels. Any substantial deviation from the measures to implement the project and mitigate unavoidable losses could exceed the project authority and/or terms of the Local Cooperation Agreement executed between the Corps and the non-Federal sponsor. Activities and measures not covered by existing authorities would be the responsibility of local or State interests and their Congressional delegation.

a. *The Corps should secure Congressional authorization for an appropriate portion of the construction funds to be set aside to accomplish any remedial or mitigation actions dictated by the EOP.*

Corps Response: See the general response to Recommendation 8.

b. *Annual funding to implement the EOP should be linked directly to overall operational funds for the project. Authorization to use a proportion of annual operating funds for these purposes should be obtained in Congress.*

Corps Response: Funds are appropriated annually for Inspection of Completed Works that are maintained by local interests, i.e., the cost-shared items implemented under the St. Johns Bayou and New Madrid Floodway authority and maintained by the local non-Federal sponsor. Similarly, funds are appropriated annually for Inspection of Completed Works that are maintained jointly by the local sponsor and the Corps, i.e., the levee closure and gated outlet structure. From a mitigation success standpoint, this would be the responsibility of the designated resource agency, although the Corps would be instrumental in insuring success of developmental measures, e.g., success of reforestation, and would be responsible to correct deficiencies if mitigation components are not working as intended. Regarding additional authorization, the Corps is restricted from lobbying for additional authorities or funding, but will implement guidance as directed by Congress and in accordance with appropriated funds.

c. *In order to effectively implement the EOP and achieve any remedial measures dictated through monitoring and adaptive management, an operations committee should be authorized by Congress. This body should consist of technical personnel from the Corps, Service, MDC, Missouri Department of Natural Resources, and the local sponsor*.

Corps Response: Our limitations regarding authorization have been previously stated. The Corps will work with appropriate interests regarding monitoring effectiveness of project operation and mitigation measures and will work within our authority and funding limitations to implement remedial measures as determined to be in the overall project interest.

7.2.2 Position of the USFWS on the Recommended Alternative

The USFWS provided an additional opinion (Position Statement) in the June 6, 2002 final CAR regarding their general concerns with the Recommended Plan and their opposition to the plan. While this does not necessarily require a response, the Corps believes it is necessary to correct some statements or misrepresentations that the USFWS has made. The following Service statements and Corps responses are intended to clarify any misunderstanding on the part of the reader.

Service Statement: The goal of the U.S. Fish and Wildlife Service and Missouri Department of Conservation concerning the St. Johns Bayou and New Madrid Floodway Project is that fish and wildlife resources and the habitats upon which they depend be conserved and properly mitigated through balanced project planning, implementation and operation. This basic goal is supported by language in the Fish and Wildlife Coordination Act, which states that wildlife conservation shall receive equal consideration with other features of water resource development projects. The Fish and Wildlife Coordination Act further requires the Corps to give full consideration to the report and recommendations of the Secretary of the Interior as contained herein.

Corps Response: The Corps fully supports this goal and, as the USFWS is well aware, has coordinated extensively with them and other resource agencies to address fish and wildlife concerns. Impact analysis and mitigation planning, to include avoid and minimize measures, has been at the forefront of overall project planning since the initiation of studies in 1996. Since the filing of the SEIS in September 2000, practically all project planning and reformulation (of the revised SEIS) has been directed towards analysis of alternatives as they relate to fish and wildlife impacts. The plan recommended for implementation has been completed only after full consideration of impacts and after formulating mitigation measures to offset significant fish and wildlife losses. Modifications in project operation are included to ameliorate impacts to fish and enhance the area's value to

waterfowl. These modifications also reduced the wetlands acres that are subject to reduced inundation as a result of project implementation. As reflected in responses to Service recommendations, and in responses to Service comments contained in Appendix M, the Corps has fully considered the report and recommendations of DOI.

Service Statement: The USFWS is opposed to the Recommended Alternative/NED Plan for the St. Johns Bayou and New Madrid Floodway Project and recommend that it not go forward as formulated. Implementation of the Recommended Alternative will result in significant losses of regionally and nationally important fish and wildlife resources, which can not be adequately mitigated due to project design and economic objectives. The Recommended Alternative will significantly reduce the duration and frequency of flooding on 130,000 acres of Mississippi River floodplain, adversely impact a regionally important fishery (including an economically viable commercial fishery) by eliminating the last remaining connection of the Mississippi River with its historic floodplain in Missouri, result in the elimination or major degradation of over 18,000 acres of wetland habitat and their ecological functions, and cause further decline in the biological and ecological integrity of a federally designated National Natural Landmark. Proceeding with this project with the knowledge that there are no feasible means to minimize, compensate, or remediate these adverse environmental impacts directly conflicts with the spirit and intent of the Fish and Wildlife Coordination Act. The project, as presently formulated, provides only superficial consideration of fish and wildlife resources while maximizing the national economic benefits. This project takes the most expedient route to provide flood control and drainage of agricultural lands (for the intensification/diversification of crop production) at great cost to fish and wildlife resources and related environmental resources in Missouri and the Lower Mississippi River Basin.

Corps Response: The Corps disagrees with the USFWS contention that significant fish and wildlife losses will not be adequately mitigated for the Recommended Alternative. Mitigation was formulated based on recommendations provided by USFWS that reforestation of frequently flooded croplands could mitigate losses to fish spawning and rearing habitat caused by reduced backwater inundation. The amount of reforestation was based on losses to fish rearing habitat occurring mid-season, and this calculation of reforestation maximized the amount of mitigation lands needed. Furthermore, USFWS's own analysis indicated that providing reforestation based on fish rearing losses provides significant over-compensation for terrestrial wildlife species and waterfowl. Therefore, the USFWS's statement that significant wildlife resources cannot be mitigated is without merit, because HEP analysis, which is an evaluation approach developed by USFWS, shows the resource to be over-mitigated.

Regarding elimination of flooding on 130,000 acres, the reader is directed to Table S-1 in the RSEIS. This refers to approximately 55,000 acres in the St. Johns Basin and 78,000 acres in the floodway that would no longer be inundated with an approximate 30+-year flood event. Although the environmental benefits associated with this magnitude of flooding over primarily agricultural lands are somewhat questionable, the flood damage reduction benefits to agriculture, infrastructure, and people's lives and livelihood by eliminating such a flood event are not. The two-year floodplain in the floodway is a little over 17,000 acres, which represents about 10 percent of the available two-year floodplain along the 113-mile stretch of the Mississippi River adjacent to Missouri from Cairo, Illinois to Caruthersville, Missouri (Section 3.6, Final RSEIS). While an occasional flood event, such as the 30+-year event that leads to flooding on 130,000 acres as the USFWS references, does create a significant impact on the people in the project area, it is not the important flood event for the sustainability for the natural resources in the project area.

Regarding fishery impacts, the majority of fish that use the floodplain for spawning are species common throughout the entire Mississippi River and its floodplain, and spawning occurs in many areas of the river floodplain. Acquisition, reforestation, and management of frequently flooded cropland would significantly improve habitat for fish spawning and rearing and the Corps believes the project-induced impact of reducing backwater inundation would be mitigated. The Corps and Service disagree with the relative importance of the New Madrid Floodway with respect to the fishery. The USFWS bases much of its opinion on the work by SIU (Sheehan, July 1998). The referenced study was produced for the Corps and is an integral part of the Corps fishery analysis. The Corps utilized these data as part of the fishery impact analysis using the Habitat Evaluation Procedure agreed to by an interagency team including the USFWS. This analysis concentrated on mid-season rearing as the greatest impacted fishery season per the interagency team's direction. Table 14 from Appendix G presents these results, which in turn is the basis for the mitigation plan provided in Appendix L. However, SIU's data do not support the USFWS's opinion regarding the relative importance of the New Madrid Floodway. Shannon-Weaver diversity index values for fishes in the St. Johns Basin were similar or higher than values calculated for the New Madrid Basin. In addition, the numerically dominant fishes in the New Madrid Basin were mostly common, ubiquitous species, whereas species richness was considerably higher in the St. Johns Basin. The Corps feels strongly that the additional avoid and minimize measure presented in Attachment 1, Appendix L could improve fishery values of the New Madrid Floodway. Furthermore, the Corps believes the statements by the USFWS that the floodway is a *regionally important fishery* is misleading when the relative value of St. Johns Basin and/or the potential improvements to floodway fishery habitat is not mentioned.

Regarding wetland impacts, the amount of wetlands that could be affected by project-caused reduced inundation is shown in tables 4-1 and 4-2 for the St. Johns Basin and New Madrid Floodway, respectively. As can be seen, there are 2,016 acres of wetlands in the St. Johns Basin and 10,239 acres of wetlands in the New Madrid Floodway that would experience reduced inundation. The majority of wetlands impacted are farmed wetlands that require summertime irrigation to grow a crop successfully. The forested wetlands that would receive reduced backwater inundation are 554 acres in the St. Johns Basin and 3,426 acres in the New Madrid Floodway. Although these woodlands would not receive the backwater inundation currently received, they would still maintain wetland characteristics due to rainfall, headwater flooding, seepage, and other factors, and still provide many of the ecological benefits that they currently provide. If there was an attempt to clear any of these woodlands for agricultural production, an applicant would be subject to jurisdictional constraints under the Section 404 permitting process and would have to adequately mitigate for such losses in accordance with Federal and state guidelines. Also, with regards to wetland impacts, the primary component of the mitigation plan is reforestation of 8,375 acres of frequently flooded cropland. For the most part, this would result in the conversion of cropland to forested wetland. The Corps has performed site-specific hydraulic analysis that has been further supported by aerial identification through the use of satellite imagery and field inspection as described in final RSEIS Section 4.3.1. The USFWS bases its opinion on no site-specific Service analysis and on references as described on pages 6 and 8 of their draft CAR dated 16 October 2001. The Corps performed a review of the basis for the USFWS's opinion and it is provided in Appendix M in the response to DOI Comment #25. In summary, the basis for the USFWS's opinion is not backed by any site-specific data or analysis. Furthermore, the one reference that is directly applicable to the project area, Lucky-1985, actually supports the Corps opinion concerning there being more water available than the local aquifer can absorb, thereby maintaining wet, saturated conditions. Lucky mentions rainfall ponding in particular.

Regarding impacts to the Big Oak Tree State Park (National Natural Landmark), the Corps' recommended plan includes working with the State MDNR to develop and implement a water management plan to improve current ecological conditions of that area.

The Corps has worked within the letter, the spirit and intent of the Fish and Wildlife Coordination Act to minimize and compensate fish and wildlife resources to the greatest extent feasible. Furthermore, the Corps has proposed significant new measures to improve the ecology of the floodway that include, primarily, establishing buffer/riparian areas on 64 miles of channels and streams and channels in the floodway. These additional measures, which will result in major improvements to the area's aquatic resources, are recommended for implementation in addition to mitigation measures. The majority of reformulation that has occurred during the last year and a half has focused on providing ameliorating or mitigating effects for the environment that has resulted in a reduction in economic benefits. The overwhelming majority of economic benefits have come from flood damage reduction as opposed to intensification (Appendix B, Table 29). Lastly, there has been nothing expedited regarding plan formulation for flood control; rather, the process has been deliberate, considerate, thoughtful, and intensively coordinated.

Service Statement: Although the Service is opposed to the Recommend Alternative, we are prepared to work with the Corps, the local sponsors, and other agencies to formulate a more environmentally acceptable project. The Department of the Interior and Service recommended a solution in its February 26, 2002, comments on the draft Revised Supplemental Environmental Impact Statement that would minimize some of these environmental impacts while providing benefits from reduced flooding in the town of Pinhook and facilitate increased agricultural production in the Floodway. This solution involved selecting one of the two uppermost setback levees (alternatives 7-2 and 7-3 in the draft RSEIS) in the New Madrid Floodway. We strongly encourage the Corps to reconsider its selection of the Recommended Alternative and reformulate the project centered around one of these setback levees.

Corps Response: At the request of the Council on Environmental Quality and as directed by a Washington Level interagency team composed of ASA(CW), HQUSACE, USFWS, and EPA, following publication of the final SEIS in the fall of 2,000, the Corps has done substantial additional analysis and project reformulation. Reformulation has resulted in a modified gate operation to benefit fish and wetlands, additional information regarding potential mitigation lands, and substantial avoid and minimize measures for the New Madrid Floodway. The additional setback levees to which you refer were analyzed and determined to have very low benefit to cost ratios; 0.6 and 0.3 for alternatives 7-2 and 7-3, respectively. Benefit costs analyses considered the reduced costs of mitigation associated with these alternatives. They were clearly not in the local or Federal interest and any further reformulation around one of these setback levee alignments would not be worth pursuing.

7.3 DISTRIBUTION

This RSEIS has been distributed to the following recipients, as well as to those who provided comments on the October 2001 Draft RSEIS:

7.3.1 Federal and Tribal

Senator Christopher Bond

Senator Jean Carnahan
Congresswoman Jo Ann Emerson
Council on Environmental Quality
Environmental Protection Agency:
- NEPA Compliance Division, Washington, D.C.
- Regional Administrator, Kansas City
- NEPA Team Leader, Kansas City
- Wetlands Protection Section, Kansas City

Department of Interior:
- Denver Federal Center
- Office of Environmental Policy and Compliance, Washington, D.C.
- USFWS, Columbia, MO Field Office
- USFWS, Regional Office, Ft. Snelling

Natural Resource Conservation Service:
- District Conservationist, Benton, MO
- New Madrid Field Office
- Charleston Field Office
- State Conservationist
- State Biologist

Department of Agriculture:
- USDA/RHS, Washington, D.C.
- USDA-Rural Development, Columbia

Quapaw Tribe of Oklahoma:
Quapaw Business Committee Chair, Quapaw, OK
Quapaw Tribe of Oklahoma, NAGPRA Representative, Fayetteville, AR

7.3.2 State

Governor Bob Holden
Senator Peter Kinder
Representative Denny Merideth
Representative Lannie Black
Representative Peter Myers
Missouri Department of Conservation:
- Office of the Director
- Planning Section
- Cape Girardeau Field Office
- Duck Creek Conservation Area
- Tenmile Pond Manager

Missouri Department of Natural Resources:
- Office of the Director
- Water Pollution Control Program
- State Historic Preservation Office
- Division of State Parks

Missouri Highway and Transportation Department
Missouri Department of Social Services, Mississippi County Director
Kentucky Department of Environmental Protection

7.3.3 Local

Mayor, City of Sikeston
Mayor, Village of Pinhook
Mayor, City of New Madrid
Mayor, City of East Prairie
Mayor, City of Charleston

7.3.4 Libraries

Mississippi County Library, Charleston
Mississippi County Library, East Prairie
New Madrid County Library, New Madrid
Sikeston Public Library, Sikeston
Missouri State Library, Jefferson City
Riverside Regional Library, Benton
Colorado State University Libraries, Fort Collins, CO

7.3.5 Other Organizations and Individuals

Mr. Jack McIntosh, Superintendent, Reorganized School Dist No. 2, East Prairie
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Consolidated Drainage District No 1 of Mississippi County, Missouri, Charleston
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Mr. Jim Holsen, President, St. Louis Audubon Society, Kirkwood
Ms. Bea Covington, Executive Director, Missouri Coalition for the Environment, St. Louis
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Mr. Dale R. Ludwig, Missouri Soybean Assn, Jefferson City
Mr. James E. French, President, French Implement Co., Charleston
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