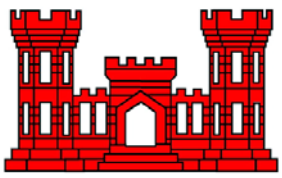
WORKING FINAL ENVIRONMENTAL IMPACT STATEMENT
for the
ST. JOHNS BAYOU
NEW MADRID FLOODWAY
PROJECT



U.S. Army Corps of Engineers
Memphis District

ST. JOHNS BAYOU AND NEW MADRID FLOODWAY WORKING FINAL ENVIRONMENTAL IMPACT STATEMENT
November 2014

Volume 1 – Environmental Impact Statement

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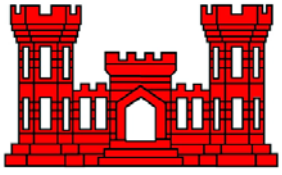

U.S. Army Corps of Engineers
Memphis District

2014 Working Final
Environmental Impact Statement
St. Johns Bayou and New Madrid Floodway Project

ABSTRACT

This Final Environmental Impact Statement (FEIS) provides information regarding the formulation and evaluation of proposed actions to reduce the risk of damage, dislocation, and disruption due to recurrent heavy flooding in portions of New Madrid, Mississippi, and Scott Counties in southeast Missouri. This would be accomplished by constructing a flood risk reduction levee, two floodwater pumping stations, ditch modifications, and other related water features in the St. Johns Bayou Basin and the adjacent New Madrid Floodway.

As built, the New Madrid Floodway is open at its southern end where an approximately 1500-foot gap exists between the frontline and setback levees, through which Mud Ditch flows. It is through this opening that the floodway drains, but it is also where flooding, known as backwater flooding, regularly occurs, when the rising Mississippi River backs up into New Madrid Floodway. The Flood Control Act of 1954 authorized construction of a levee, with an outlet structure for Mud Ditch that would close the gap, thereby effectively eliminating the backwater flooding threat. However, the New Madrid Floodway would continue to be activated in the event of catastrophic flooding. Because of concerns that closing the gap would create a flooding problem from waters impounded within the floodway, the gap-closing levee has not been built.

The St. Johns Bayou Basin is a 324,173-acre watershed situated between Commerce, Missouri, and New Madrid, Missouri, bounded by the New Madrid Floodway setback levee and frontline levee on the east, Sikeston Ridge on the west, and the Commerce Hills to the north. St. Johns Bayou, which runs to the east of East Prairie, Missouri, flows out of the basin through a gated outlet structure in the New Madrid Floodway setback levee (consisting of six 10- by 10-foot culverts) that was built in 1953 as part of a levee constructed to close a 4,200-foot gap between the setback levee and the Sikeston Ridge levee. These features prevent backwater flooding in the St. Johns Bayou Basin; but when the outlet structure is closed, St. Johns Bayou and waters from other streams and the basin's extensive system of agricultural ditches are impounded, causing or contributing to other flooding, sometimes severe, in East Prairie and elsewhere in the St. Johns Bayou Basin. The Water Resources Development Act of 1986 authorized construction of a pumping station and channel modifications to reduce the flood risk in the St. Johns Bayou Basin. In addition to flood risk reduction improvements in the St. Johns Bayou Basin, the Water Resources Development Act also authorized the construction of a pumping station in the New Madrid Floodway.

The flood pulse is the principle driving force responsible for the existence, productivity, and interactions of the major biota in river-floodplain ecosystems (Junk *et al.*, 1989). Its role in unaltered ecosystems is understood. However, the St. Johns Bayou and New

Madrid Floodway are manipulated environments with flood regimes that can be described as highly anthropogenically modified. The flood pulse provides wetland hydrology and fish and wildlife habitat while flooding destroys property and causes other damage, dislocation, and disruption. This makes flood risk reduction and environmental protection competing—but not necessarily or wholly incompatible—interests in this case, in an area that is both economically important and ecologically valuable.

The FEIS analyzes a reasonable range of alternatives including avoid and minimize measures that result in a reduction of environmental impacts compared to the originally authorized project. Avoid and minimize measures were formulated to reduce the direct impact as well as to maintain connectivity with the Mississippi River to a significant portion of the New Madrid Floodway. These measures include, but are not limited to: conducting channel work from only one stream bank (as opposed to both), reducing proposed channel bottom widths by 80 feet in St. Johns Bayou, and allowing a floodplain connection to 289.5 feet NAVD88 during the winter period (15 November to 28/29 February) in the New Madrid Floodway.

Alternatives A3 and B3.1 is the recommended plan. It consists of closure of the New Madrid Floodway at the location of the 1,500-foot gap, construction of a 1,500-cubic foot per second (cfs) pumping station in the New Madrid Floodway, construction of a 1,000-cfs pumping station in the St. Johns Bayou Basin, modifications to 23 miles of ditches in the St. Johns Bayou Basin, waterfowl management during waterfowl season in both basins, and flood management in a manner that recognizes the benefit of the flood pulse to the remaining natural environment.

The estimated cost of the recommended plan is $170,262,000. Average annual cost of the project is $7,724,000. Average annual benefits are $20,573,000. The combined benefit to cost ratio is 2.7 (discount rate of 3.375). Benefit to cost ratio of the New Madrid Floodway closure only is 4.1 at the authorized discount rate of 2.50%.

Comments: Please send your comments regarding the FEIS to:

District Engineer
US Army Engineer District, Memphis
Attn: Project Management Branch (SJNM)
167 North Main Street, B-202
Memphis, TN 38103-1894

Comments should arrive no later than 30 days following the publication of the Notice of Availability in the Federal Register. For further information or to submit comments via email, please contact:

Mr. Joshua Koontz, NEPA Coordinator at (901)544-3975, or Joshua.m.koontz@usace.army.mil or,

Mr. Danny Ward, Project Manager at (901) 544-0709, or Daniel.d.ward@usace.army.mil.

Summary

S1. Introduction

This Final Environmental Impact Statement (FEIS) was prepared according to the National Environmental Policy Act (NEPA), NEPA regulations of the Council on Environmental Quality, and NEPA directives of the Department of the Army and of the U.S. Army Corps of Engineers (USACE). It assesses the reasonably foreseeable impact on the human environment of a proposal to alleviate flooding in portions of New Madrid, Mississippi, and Scott Counties in southeast Missouri, by constructing flood risk reduction features in the St. Johns Bayou Basin and in the adjacent New Madrid Floodway.

The major difference between the current recommended plan and previous recommended plans is the level of connectivity that will remain in the New Madrid Floodway following completion of the project. Previous plans would have resulted in the loss of connectivity to the majority of the remaining natural habitat within the New Madrid Floodway. The current recommended plan takes a watershed approach that recognizes the importance of all resources (i.e., social, economic, and environmental). The recommendations call for constructing previous authorized project features but changes the project's operation based on specific elevations and periods of the year that the flood pulse either provides an environmental benefit or a socioeconomic impact. Specifically, connectivity will be maintained up to a point in which floods overtop roads resulting in community isolation during portions of the year that do not coincide with agricultural activities. As the growing season commences, flood elevation thresholds would be gradually lowered to manage flood risks primarily to agriculture areas while reducing environmental impacts. An additional major difference between this FEIS and previous NEPA documents are the manner in which unavoidable impacts to significant resources are mitigated. Previous plans called for an overall amount of acreage (2002 RSEIS) or a non-specific amount of acreages based on impacted habitat/functions (2006 RSEIS 2). Although compensatory mitigation is based on impacts to habitat/function as defined by the ecological models, the FEIS uses a watershed approach to identify specific mitigations zones within the project area to acquire future mitigation tracts. Specific zones were defined based on elevations and post project flood frequencies. Restoring hydrology to Big Oak Tree State Park and acquiring lands surrounding the park for mitigation are project priorities. Conservative estimates within each specific mitigation zone have been made in the FEIS to ensure that significant resources are compensated to the extent justified. The FEIS provides additional discussion documenting compliance with the Mitigation Rule. Table S.1 provides a summary of major changes that have been made to complete the 2014 FEIS.

Table S.1. Major Changes from previous NEPA documents and 2014 FEIS.

ITEM	2002 RSEIS/2006 RSEIS 2	2014 FEIS
Independent External Peer Review	Not conducted	IEPR panel consists of an eight person panel that were independently selected and are nationally recognized experts in the fields of wetland ecology, fishery biology, shorebird ecology, waterfowl ecology, water quality, H+H engineering, economics, and NEPA. IEPR conducted during four key phases including a review of past NEPA documents (Phase 1), a review of a Project Work Plan that describes overall methodologies and fundamental assumptions that would be followed during the completion of the new EIS (Phase 2), a pre-draft EIS (Phase 3), and a to be conducted pre-final EIS (Phase 4).
H+H Period of Record	1943-1974	1943-2009
Future Conditions		
WRP Enrollment	Did not estimate.	Estimates future WRP enrollment of 1,445 acres and 765 acres in the St. Johns Bayou Basin and New Madrid Floodway, respectively.
Relevant Resources		
Social	Assessed	Updated to reflect current social conditions.
Economic	Benefit to cost ratio of 1.01 at the authorized interest rate of 2.5%. Benefit:cost not calculated at current interest rate.	Benefit to cost ratio of 2.7 at the current interest rate of 3.375% and 4.1 at the authorized rate of 2.5%.
Environmental		
Wetlands	• Wetland impacts determined by WETSORT Model and NRCS estimate. • HGM Model used to quantify impacts. o HGM Model developed and analysis conducted by ERDC staff without conducting field work.	• Wetland impacts determined for all potential vegetated wetlands located at and below the pre-project five year flood frequency and NRCS farmed wetland estimate. • HGM Model used to quantify direct impacts and indirect impacts as a result of reduced flooding. o HGM Model underwent a peer review by independent experts. o ERDC staff revised the model based on peer review recommendations. o ERDC staff conducted the analysis with extensive fieldwork.

St. Johns Bayou Basin	• Direct Impacts = 155 vegetated acres, • Indirect Impacts = 374 farmed wetlands • Reduced Flooding = 554 vegetated acres, EIS concluded that the reduced flooding would not result in an impact since wetlands would still remain, although flooding would be reduced.	• Direct Impacts = 409 vegetated acres • Indirect Impacts = 4,969 vegetated acres, 1,445 future WRP acres, and 792 acres of farmed wetlands. • TSP = -116 LGRB FCU and -397 LGRO FCU
New Madrid Floodway	• Direct Impacts = 12 vegetated acres • Indirect Impacts =138 farmed wetlands • Reduced Flooding = 3,426 vegetated acres, EIS concluded that the reduced flooding would not result in an impact since wetlands would still remain, although flooding would be reduced.	• Direct Impacts = 9 vegetated acres • Indirect Impacts = 8,807 vegetated wetlands, 306 acres of farmed wetlands, and 765 acres of future WRP acres. • TSP = -3,487 LGRB FCU, -35 LGRO FCU, and -124 CD FCU • EIS concludes that although the wetlands would still be physically present, the reduced flooding would result in an HGM sub-class wetland shift from riverine connected to a flat.
Terrestrial Wildlife	• Terrestrial wildlife assessed based on the Habitat Evaluation Procedure Model. • Representative species consisted of the barred owl, fox squirrel, pileated woodpecker, Carolina chickadee, and mink. • Direct impacts would result in a loss of -1,993 AAHU and -66 AAHU in the St. Johns Bayou Basin and New Madrid Floodway, respectively.	• No changes to model. • No changes to representative species. • Direct impacts would result in -765 AAHU and -16.9 AAHU in the St. Johns Bayou and New Madrid Floodway, respectively. Changes are a result of updated land use, HSI values, and HEP assumptions. Changes in modeling results are not comparable to previous results. .
Waterfowl	• Waterfowl Assessment Method developed by USFWS. • Model assessed habitat during waterfowl season at a depth of less than 18 inches. Model utilized median flood elevations during specific months to determine 18 inch depth. • Recommended Plan Impacts = -204,039 DUD in Feb/March.	• Duck Use Day Model developed by Dr. Mickey Heitmeyer with most up to date values. • Model underwent independent peer review. • Model has been regionally certified for use in Civil Works projects. • Model assesses habitat during waterfowl season with no depth requirement. The hydrologic variable is based on a three consecutive days of flooding recurrence interval. Model quantified habitat up to the .01 three-day recurrence interval frequency.

		• TSP Impacts = -100,891 (Nov), +978,808 (Dec/Jan), and -995,104 (Feb/March) in St. Johns Bayou Basin and +57,590 (Nov), +1,376,754 (Dec/Jan), and -3,290,786 (Feb/March) in the New Madrid Floodway. Results are not comparable due to changes in model.
Shorebirds	• Shorebird model developed by USFWS. • Recommended Plan = -761 AAHU	• Previous shorebird model abandoned due to numerous fundamental issues identified by a model review panel. • New model developed by Dr. Dan Twedt with numerous improvements. • Model underwent peer review. • Model approved for project-specific use. • TSP = -116 and -615 optimal equivalent acres. Results are not comparable to previous NEPA documents due to a changed model.
Fish Spawning and Rearing Habitat	• EnviroFish Model used to quantify impacts. • Assessed habitat up to the 2-year floodplain. • Spawning and rearing habitat quantified separately. • HSI values based on representative species. • Fish access assumed to occur.	• EnviroFish Model updated. • Model underwent independent review, • Model approved for project-specific use. • Assesses habitat up to the 5-year floodplain for optimal habitat and the 2-year floodplain for sub-optimal habitat. • Spawning and rearing habitat combined. • Community level HSI values based on expert opinion and inter-agency team concurrence. • Fish access assessed based on fish access study.
Water Quality	Impacts/benefits to water quality assessed. EIS concludes that the project will not have a significant impact on water quality as a result of the project. Water quality will improve as a result of mitigation.	Impacts/benefits to water quality updated with most up-to-date water quality values. EIS concludes that the project will not have a significant impact on water quality as a result of the project. Water quality will improve as a result of mitigation.
Freshwater Mussels	Surveys indicated the presence of significant mussel population that required mitigation.	Updated surveys did not indicate the presence of significant mussel populations. No mitigation is recommended. Changes are likely the result of the recent non-USACE channel maintenance program.
Endangered Species	• Bald Eagle – USFWS granted a take • Pallid Sturgeon – USFWS concurred with no	• Bald Eagle – no longer endangered • Pallid Sturgeon – USFWS concurred with no effect.

	effect • Least Tern – USFWS granted an unquantifiable take.	• Least Tern – USFWS did not concur with USACE Biologic Assessment. Formal consultation ongoing.
Tentatively Selected Plan		
Flood Risk Management Features		
St. Johns Bayou Channel Modifications	Reduced channel widths and one sided construction	No change
St. Johns Bayou Pumping Station	1,000 cfs pumping station	No change
New Madrid Floodway Closure	Four 10-foot by 10-foot gated box culverts with a closure levee located in the 1,500-foot gap.	No change
New Madrid Floodway Pumping Station	1,500 cfs pumping station	No change
Operation Plan		
St. Johns Bayou	Close gates whenever river stage is higher than the interior sump stage. Use pumps to evacuate impounded interior runoff.	No change
New Madrid Floodway	Allow flooding up to an elevation of 284.4 feet (2,790 acres).	Allow flooding up to an elevation of 289.5 feet (19,702 acres) from 15 November to 28 February, 288 feet (12,507 acres) from 1 March to 15 April, 284 feet from 16 April to 31 May (2,415 acres), and 280 feet (519 acres) from 1 June to 14 November.
Winter Waterfowl Management		
St. Johns Bayou Basin	Inundate up to 286 feet from 1 December to 31 January	No change
New Madrid Floodway	Inundate up to 285.4 feet from 1 December to 31 January	No change
Compensatory Mitigation		
St. Johns Bayou Basin	• Reforest 1,293 acres of agricultural lands • Ecologically design and construct 387 acres of borrow pits • 105 acres of moist soil management	• 2,216 acres of vegetated wetland restoration • Ecologically design and construct 387 acres of borrow pits • 244 acres of seasonally inundated farmland • Vegetated grass/tree buffer on construction reaches • Vegetated grass/tree buffer on an additional 53.6 miles of ditches

		• Bank stability structures • Channel habitat structures

New Madrid Floodway	• Restore hydrology to Big Oak Tree State Park
	• Reforest 1,800 acres surrounding Big Oak Tree State Park
	• Reforest 2,326 acres of agricultural lands in New Madrid Floodway.
	• 660 acres of moist soil units
	• 64 miles of vegetated buffer strips
	• Wildlife Corridor between Big Oak Tree State Park and Ten Mile Pond Conservation Area
	• Additional Techniques to be determined during mitigation acquisition:
	  o Additional reforestation (New Madrid Floodway or batture)
	  o Increase Flood Duration
	  o Create/Restore Permanent Waterbodies (Riley Lake)
	  o Restore/enhance small waterbodies
	  o Modified Gate Operation (spawning and rearing pool) – all scenarios required the spawning and rearing pool.
		• Restore hydrology to Big Oak Tree State Park
		• Vegetated wetland restoration on 1,800 acres surrounding Big Oak Tree State Park
		• 2,357 acres of vegetated wetlands restoration within the New Madrid Floodway.
		• 3,050 acres of vegetated wetland restoration in the batture.
		• 1,286 acres of seasonally inundated farmland
		• Ecologically design and construct 60 acres of borrow pits.
		• Restore 432 acres of floodplain lakes (Riley Lake)

Risk and Uncertainty	Not addressed	Addressed with methods that reduce the risk of uncertainty.
Adaptive Management	Adaptive management plan briefly discussed.	Adaptive management plan contains objectives, monitoring requirements, reporting periods, and thresholds for incorporating changes.

Although this FEIS supplements the document prepared in 1976 entitled *Mississippi River and Tributaries Project* for the closure of the New Madrid Floodway and its supplement, the 1982 St. Johns Bayou and New Madrid Floodway supplemental EIS, it does not incorporate or supplement the 2002 Revised Supplemental Environmental Impact Statement or the 2006 Revised Supplemental Environmental Impact Statement 2. Both of these NEPA documents were set aside by the U.S. District Court decision and are no longer applicable due to the major changes made for the completion of the 2014 FEIS. However, applicable sections of prior documents as well as previous feasibility level analysis were included in the FEIS where appropriate. Unless specifically indicated in this FEIS, past comments, inter-agency agreements, and compensatory mitigation decisions were not considered as updated data and more accurate environmental methodologies, analyses, and results were used in this analysis.

Elevations presented in this FEIS are in feet above sea level. Elevations in the St. Johns Bayou Basin are based on National Geodetic Vertical Datum (NGVD) of 1929 and those presented in the New Madrid Floodway are based on North America Vertical Datum (NAVD) of 1988. Applicable adjustments have been made to account for the different survey datum. To correlate a Mississippi River NGVD elevation at New Madrid to stage (MS115 gage located at river mile 889), subtract 255.48 (gage zero) from the applicable elevation; to correlate a Mississippi River NAVD elevation at New Madrid to stage, subtract 255.71 (gage zero) from the applicable elevation.

For clarity, flood frequency is expressed in return periods in addition to percent annual chance exceedence. For example, the 2-year flood is also expressed as a flood that has a 50 percent annual chance of exceedence. Similarly, the 100-year flood is also expressed as a flood with a 1 percent annual chance of exceedence. Specific terms that required defining are presented in the glossary.

S2. Project Purpose and Need

USACE is obliged by law to accomplish the will of Congress for flood risk management[1] in Southeast Missouri. The statutory authority for and requirement to act in this case direct USACE to reduce the likelihood and adverse effects—on agricultural and urban lands—of backwater flooding in the New Madrid Floodway and flooding due to the impoundment of waters in St. Johns Bayou Basin (currently) and the New Madrid Floodway (in the future).

Using its project-specific and other civil works authorities, the challenge before USACE is to perform its mission, serving public welfare and national economic development, within the constraints of applicable environmental and natural resources laws. Beginning with the Chief of Engineers report of 1952, and continuing with the 1975 environmental impact statement *St. Johns Bayou and New Madrid Floodway Missouri* and the 1983 Chief of Engineers report, USACE has undertaken extensive studies in the

[1] Additional information on the history of USACE activities in New Madrid Floodway and St. Johns Bayou Basin, along with information on previous USACE studies and other relevant legislation, may be found in Appendix D, Part 1.

project area, resulting in not only a better understanding of the environment but also in a number of modifications to the nature and number of the flood risk management features and activities being considered. USACE also sought and heavily utilized extensive input from its local partner (the St. John Levee and Drainage District of Missouri), a variety of federal and state agencies, and the public.

With the exception of flood waters entering via the 1,500-foot gap located at the lower end of the New Madrid Floodway, the entire New Madrid Floodway is protected from high Mississippi River stages. Table S.1 provides existing flood frequencies and inundated acres[2] in both basins.

Within the project area, flooding causes social impacts primarily associated with community isolation and economic impacts primarily to agricultural areas and to a lesser extent infrastructure.

Although flooding impacts socio-economic resources, it is also the principal driving force responsible for the existence, productivity, and interactions of the major biota in river-floodplain systems (Junk *et al.*, 1989).

[2] Associated inundated acres were calculated by interpolating between contour elevations. For example, acreages associated with 281.6 feet NGVD29/NAVD88 were calculated by calculating the difference in acreages from 281 feet NGVD29/NAVD88 and 282 feet NGVD29/NAVD88, multiplying by 0.6, and adding the amount to the acreages of 281 feet NGVD29/NAVD88.

Table S.1. Existing flood frequencies and associated inundated acres, St. Johns Bayou Basin and New Madrid Floodway.

Event	St. Johns Bayou Basin		New Madrid Floodway		Total
	Elevation (Feet – NGVD29)	Acres	Elevation (Feet – NAVD88)	Acres	Acres
1.01 year (99 % annual chance exceedence)	281.6	753	279.3	404	1,157
2-year (50% annual chance exceedence	291.0	11,904	292.1	33,391	45,295
5-year (20% annual chance exceedence)	294.1	20,407	296.6	58,990	79,397
10-year (10% annual chance exceedence)	295.6	26,972	298.7	70,749	97,721
20-year (5% annual chance exceedence)	296.9	38,433	300.5	81,758	120,191
50-year (2% annual chance exceedence)	298.4	43,483	302.5	93,396	136,879

S3. Collaborative NEPA and Review Process

An Independent External Peer Review (IEPR) was utilized throughout the development of the FEIS. Figure S.1 provides an example of the significant amount of independent expert involvement in development, review, and application of environmental models throughout the progress of the FEIS. The independent panel was staffed with nationally-recognized experts to ensure objective, scientifically accurate information is presented in this FEIS to assist in agency decision making. In addition to IEPR involvement, inter-agency coordination was maintained throughout the formulation of the FEIS, including the independent external peer review process, model certification review process, scoping, project work plan, alternatives, impact analyses, and compensatory mitigation measures.

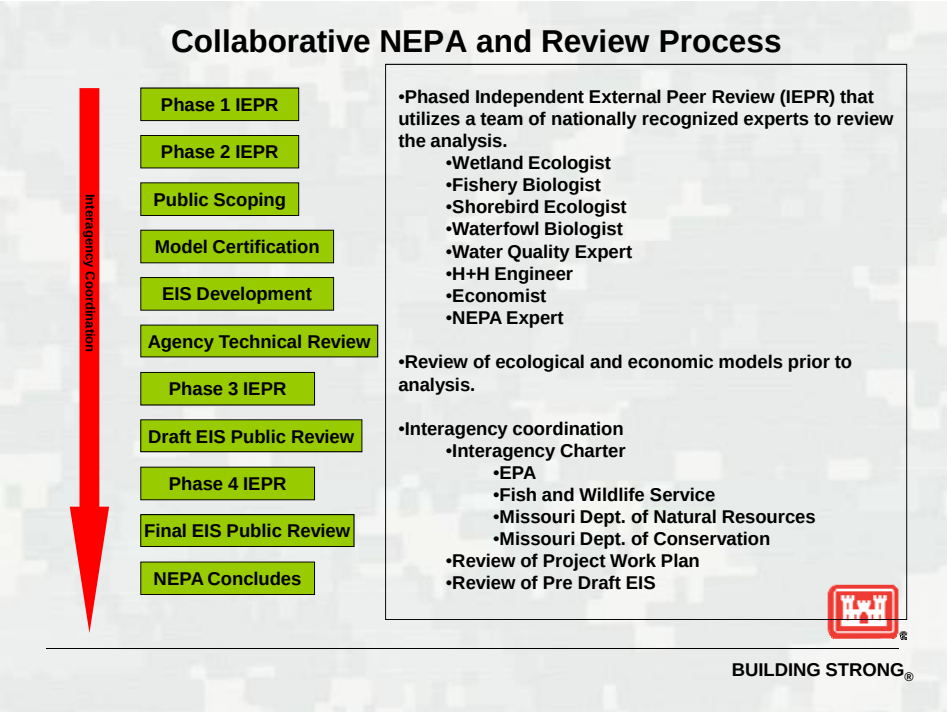

Figure S.1. Overview of IEPR involvement in review of environmental models used in analysis associated with the St. Johns Bayou and New Madrid Floodway Project.

The IEPR process was conducted in four phases. During Phase 1 IEPR, the panel reviewed past NEPA documentation to determine the adequacy of past NEPA documents and ensure that the scope of any future NEPA document would be complete and scientifically accurate. In addition to the consolidated 2002 and 2006 NEPA documents, the U.S. District Court decision was also submitted to ensure that the panel was aware of environmental concerns contrary to that of USACE. A project briefing was held for the panel as well as the inter-agency team on 4-5 August 2009. The project briefing included a tour of the project area. Based on the outcome of the Phase 1 IEPR, USACE determined that a new supplemental EIS was required in lieu of a revision.

Based on recommendations from the Phase 1 IEPR as well as inter-agency coordination, a Project Work Plan was developed that specifically outlined the methodologies and assumptions that were to be used to complete the new environmental impact analysis. The Project Work Plan also contained preliminary alternatives and mitigation options that would likely be analyzed. A draft of the Project Work Plan was submitted to the inter-agency team for comment, and an inter-agency meeting was conducted in December 2009 to discuss the overall aspects of the plan. The plan was revised and resubmitted to the inter-agency team for additional comment on 4 February 2010. The revised plan and inter-agency comments were submitted to the same panel of experts to conduct Phase 2 IEPR. The purpose of submitting the inter-agency comments was to ensure that the panel was aware of any opinions and views that were contradictory to that of USACE.

The panel identified numerous issues with the Project Work Plan that required extensive coordination between the USACE and the panel. A series of teleconferences occurred between USACE and the independent panel to clarify and discuss all of the issues. The inter-agency team was invited to participate in all discussions with the independent panel. With the exception of reforestation of agricultural land for mitigation and its relation to shorebird mitigation, the panel and USACE were able to reach resolution on all issues. An addendum to the Phase 2 IEPR report was prepared to document the extensive coordination between USACE and the panel (Volume 3, Part 3).

Utilizing the methodologies outlined in the Project Work Plan and revisions as a result of the Phase 2 IEPR, USACE conducted environmental analysis. The environmental analysis included the results of public scoping. A pre-draft EIS was completed that documented all of the preliminary conclusions. The pre-draft EIS was submitted for USACE Agency Technical Review as well as preliminary review by the inter-agency team. Although the entire team was requested to provide feedback, comments were only received by the EPA. USACE revised the pre-draft EIS based on Agency Technical Review and inter-agency preliminary review. The revised pre-draft EIS and EPA's comments were submitted to the same panel of experts for Phase 3 IEPR.

The panel provided numerous recommendations on the pre-draft EIS. Following discussions with the panel, revisions were made to the draft EIS to incorporate recommendations or address the panel's concerns. The final phase of IEPR will consist of a FEIS that includes USACE's response to public comments.

In addition to IEPR for the overall NEPA effort, ecological models underwent a separate review by independent panels of nationally-recognized experts selected by an impartial party (i.e., Battelle). The purpose of these reviews was to ensure the scientific integrity of the models that would be employed to support project decisions.

S4. Alternative Analysis

The alternative development process begins by identifying a wide array of preliminary flood risk reduction alternatives and then, by application of carefully formulated selection criteria, establishing a reasonable range of feasible alternatives. Ultimately, nine alternatives were

carried forward for detailed analysis, including the required no action alternative. These are:

- St. Johns Bayou Basin
    - A1: no action
    - A2: authorized project
    - A3: authorized project with avoid and minimize measures
- New Madrid Floodway
    - B1: no action
    - B2: authorized project
    - B3: authorized project with avoid and minimize measures (manage connectivity)
        - B3.1: manage connectivity scenario 1
        - B3.2: manage connectivity scenario 2
    - B4: authorized project with avoid and minimize measures (maintain connectivity)
        - B4.1: maintain connectivity scenario 1
        - B4.2: maintain connectivity scenario 2

S5. Recommended Plan

Alternative A3 in the St. Johns Bayou Basin and alternative B3.1 in the New Madrid Floodway is the recommended plan. The recommended plan consists of the following:

- Closure of the 1,500 gap by means of a closure levee. The levee would be constructed of 233,000 cubic yards of earth and have a crown elevation of 317.0 feet, top width of 16 feet, base width of approximately 302 feet, and side slopes of 4.5:1.
- Construction of four gated 10-foot by 10-foot box culverts across Mud Ditch. Gates would only be closed during periods of waterfowl management or high Mississippi River stages.
- Raising the lower section of the Frontline Levee to an equivalent grade of 317.0 feet. This would require approximately 127,000 cubic yards of material. The levee would have a similar footprint as the closure levee.
- Raising the crown elevation along 14.1 miles of the Setback Levee. It is anticipated that 2.4 million cubic yards of material would be required. No

changes to the base width are proposed. Therefore, construction would be entirely confined to the existing levee footprint.

- Construction of a 1,500-cfs pump station in the New Madrid Floodway at the closure location.
- Management of water levels in the New Madrid Floodway by means of the gated structure and pump as follows:

    - 15 Nov – 28 Feb – 289.5 feet NAVD88 maximum
    - 1 March – 15 April – 288 feet NAVD88 maximum
    - 16 April – 31 May – 284 feet NAVD88 maximum
    - 1 Jun – 14 Nov – 280 feet NAVD88 maximum

- Impoundment of water in the New Madrid Floodway to an elevation of 284.4 feet NAVD88 from 1 December to 31 January to benefit waterfowl.
- Modification of St. Johns Bayou Basin channels as follows:

    - 3.7 miles of the lower St. Johns Bayou would be enlarged from one side to a bottom width of 120 feet. Material would be deposited along the bank and would revegetate naturally as a conservation easement.
    - The lower 8.1 miles of Setback Levee Ditch would be enlarged from 40 feet to 50 feet along the left descending bank. Approximately 675,000 cubic yards of material would be placed in a 120-foot wide embankment and allowed to revegetate naturally as part of a conservation easement.
    - The lower 3.5 miles of St. James Ditch would be enlarged along the left descending bank by increasing the bottom width from 35 feet to 45 feet. The remaining 7.8 miles of channel work would increase the top bank width to 80 feet. Approximately 630,000 cubic yards of excavated material would be placed on a 100-foot wide embankment along the left descending bank.

- Construction of a 1,000-cfs pump station in the St. Johns Bayou Basin.
- Maintain the current operation plan for the St. Johns Bayou gravity outlet structure (*i.e.,* close gates to prevent backwater flooding).
- Impoundment of water in the St. Johns Bayou Basin to an elevation of 285.0 feet NGVD29 from 1 December to 31 January to benefit waterfowl.

S6. Compensatory Mitigation

Compensatory mitigation is proposed for unavoidable project-induced adverse impacts. Project-induced impacts were calculated by the model developers in consultation with USACE and the inter-agency team using the specific methodologies and assumptions outlined in the Project Work Plan[3] and model-specific parameters.[4]

[3] The Project Work Plan was reviewed during Phase 2 IEPR.
[4] Each model underwent a review by different panels of recognized experts.

To compensate for unavoidable impacts to different resource categories associated with the St. Johns Bayou Basin portion of the project, the following mitigation plan is proposed:

- Restore impacted ditch functions in channel modification reaches by:
    - Constructing nine transverse dikes in the lower 3.7 miles of St. Johns Bayou to create a low flow sinuous channel.
    - Constructing a bank stability structure (*i.e.,* weir) at the confluence of St. Johns Bayou and Setback Levee Ditch to provide stability as well as structure.
    - Constructing a bank stability structure at the confluence of Setback Levee Ditch and St. James Ditch.
    - Creating stream bank slopes that are designed to prevent erosion and maximize fish and wildlife habitat.
    - Establishing buffer strips consisting of both woody vegetation and warm season grasses along reaches of ditches that were previously farmed to top bank as well as replanting vegetation in areas cleared by construction efforts.

- Restore vegetated wetlands on 400 acres of agricultural land below an elevation of 285 feet NGVD29.
- Restore vegetated wetlands on 1,816 acres below the post project 5-year floodplain (20 percent chance annual exceedence).
- Ecologically design and construct 387 acres of borrow pits.
- Seasonally inundate 244 acres of farmland during the spring shorebird migration period.

To compensate for unavoidable impacts to different resource categories associated with the New Madrid Floodway portion of the project, the following mitigation plan is proposed:

- Restore hydrology to Big Oak Tree State Park by means of a gated culvert through the Mississippi River Frontline Levee.
- Restore vegetated wetlands on a minimum of 1,800 acres of farmland surrounding Big Oak Tree State Park.
- Restore vegetated wetlands on 387 acres of farmland below an elevation of 285 feet NAVD88.
- Restore vegetated wetlands on 1,970 acres of farmland below the post project 5-year floodplain (20 percent chance annual exceedence).
- Remove 3,050 acres of cropland from production in the batture and allow them to revert to bottomland hardwoods/riverfront forest naturally (vegetated wetlands).
- Ecologically design and construct 60 acres of borrow pits.
- Seasonally inundate 1,286 acres of farmland during the spring shorebird migration period. This would be accomplished by crediting the existing shorebird habitat provided by Ten Mile Pond Conservation Area (*i.e.,* 993 acres of moist

soil units) pursuant to the project's specific Congressional authorization as well as the creation of an additional 293 acres of seasonally inundated farmland.
- Restore 432 acres of floodplain lakes, such as Riley Lake.
- Plant buffer strips surrounding ecologically designed borrow pits.

As seen in the proposed mitigation measures, a holistic watershed approach to compensatory mitigation has been proposed. USACE has developed, through collaboration with the inter-agency team and completion of a historic land use inventory of the project area, mitigation measures that incorporate a full range of resource management activities, including:

- Improving ecological services, such as water quality in the project area watershed, and subsequently the Mississippi River Basin. Currently, over 80 percent of the project area is devoted to agricultural production and agricultural drainage ditches are a common feature throughout the landscape. While some reaches of larger ditches and streams have areas of appropriate riparian buffer, a vast majority of the project area ditches have little to no buffer and are farmed to top bank. The intensive soybean and corn farming operations coupled with the lack of protective buffers along ditches capable of retaining sediments and nutrients result in the area being a top contributor to Gulf of Mexico hypoxia. Water quality analysis conducted for the project concluded that the project showed little effect on total phosphorous, total nitrogen, and organic carbon export in the St. Johns Bayou Basin. However, in the New Madrid Floodway, net average export of total phosphorus and total nitrogen would be reduced by about 15-20 percent by the recommended plan due to the establishment of compensatory mitigation features. In addition, the recommended plan reduces organic carbon export by approximately 40 percent. Results comparing nitrogen loading analysis post-project with mitigation indicate that agricultural land taken out of production and reforested would yield significant nitrogen loading reductions, roughly 12,000 tons over the project life, leading to a reduction in non-point source pollution being delivered to the Mississippi River and possibly a reduction in growth of the hypoxic zone in the Gulf of Mexico. Carbon sequestration is also substantially increased with project mitigation measures in place, nearly 2 million tons more than with the no action alternative, helping to offset the effects of global climate change by sequestering greenhouse gas emissions.

- Providing forest management planning, including restoration of over 9,400 acres of wetlands. Historically, bottomland hardwoods covered much of the Mississippi Alluvial Valley and periodic flooding was commonplace. However, less than 20 percent of this important habitat remains and water resource developments and agricultural enhancement have drastically reduced the flood return interval on remaining habitats. The recommended plan proposes to take agricultural land, most of which is at low elevation and frequently subject to Mississippi River flood pulses, and revert it to historic forest habitat. With the exception of shorebirds, flooded agricultural land provides little to no habitat and the prior conversion of bottomland hardwoods to cropland is responsible for the

vast majority of wetland and habitat losses throughout the Mississippi River Alluvial Valley and Nation. Bottomland hardwood forests can support as many as five times as many game animals as nearby pine and upland forests. Many non-game species, such as small mammals, owls, raptors, and neotropical migrants also find ideal habitat in bottomland hardwood forests. The recommended plan proposes to acquire mitigation land in large blocks which provide much needed wildlife travel corridors in the project area. In addition to forest restoration within the floodway, restoration is also proposed in the batture area. Forested areas along the Mississippi River are among the nation's most important wetlands. They provide space for dispersal and temporary storage of flood waters, reducing potential damages from floods. Bottomland hardwoods growing in the batture are especially important to various fish species during annual flooding for food production, feeding, spawning, and rearing of young. Spring flooding allows many species of fish to spawn in the forested wetlands. Bottomland hardwoods also contribute to water quality by reducing sediment loads, filtering out chemical and organic wastes, and reducing nutrients, as well as reducing erosion by binding the soil with root systems.

- Providing year round fish habitat in the form of ecologically designed borrow pits and floodplain lakes. Borrow pits are an excellent method to compensate for impacts to floodplain spawning and rearing habitat (e.g., inundated agricultural lands) and provide excellent nursery habitat. Each pit would be designed so approximately half of the pit would be an average of six feet in depth, and the remaining half would be an average of three feet in depth. Shoreline sinuosity would also be incorporated into the design. Although there are many floodplain lakes located in the batture, many of these lakes are degraded due to past drainage projects and high sediment loads of the Mississippi River. Additionally, there are fewer of these lakes; and new lakes are not forming due to the levee system and navigation structures. Floodplain lakes located in the Mississippi Alluvial Valley have large aquatic populations of plants and animals. The total biomass of fish averages roughly 600 lbs/acre, indicating high fishery production. Periodic flooding recharges and relieves periodic overpopulation in floodplain lakes and results in a net export of fish to Mississippi River habitats. Furthermore, providing floodplain lakes and ecologically designed borrow pits would provide a reliable source of food for the interior least tern.

- Providing parkland management planning through hydrologic restoration of Big Oak Tree State Park and acquisition of 1,800 acres of prior converted cropland surrounding the park which would be restored to historic bottomland hardwood forest. Under existing conditions, Big Oak Tree State Park, of which 80 acres has been designated a National Natural Landmark by the U.S. Department of Interior is experiencing drier conditions due to adjacent agricultural practices. A hydrologic connection to the Mississippi River would be restored to the park by constructing a water delivery system. The restored flood pulse would inundate the park and mimic a flood regime as if the levees had not been constructed. Otherwise, the current drying condition is expected to continue under future

without project conditions. Following the 2011 flood, an existing levee that runs parallel to Wilkerson Ditch has been rebuilt and raised. Although the levee provides a degree of flood risk reduction from Mississippi River flooding, the levee reliability is unknown due to an assumed lack of engineering and construction standards employed in the project. The current estimated level of risk reduction provided by the private levee and the MDC levee limit Mississippi River flooding of Big Oak Tree State Park to flooding events that occur approximately once every 10 years (10 percent annual chance exceedence) or less frequently.

The project would be monitored and adaptive management reports would be prepared at prescribed intervals until mitigation has been determined to be successful. All aspects of the project would be monitored including flood risk management structures and compensatory mitigation (according to the requirements of the Mitigation Rule). Adaptive management would recommend if changes are warranted. Adaptive management reports may conclude that the overall management of water levels should be adjusted or no changes are warranted. The cost of monitoring and adaptive management is included in the project's total cost and would also be reflected in the Project Cooperation Agreement with the non-Federal sponsor.

S7. Section 404 Findings

As required by Section 404(b)(1) of the Clean Water Act (CWA), an evaluation to assess the short- and long-term impacts associated with the discharge of dredged and fill materials into Waters of the United States resulting from this project has been completed. The recommended plan includes features that were designed to avoid to the extent practicable wetlands and Waters of the United States, including reducing impacts in the St. Johns Bayou Basin by reducing channel dimensions and in the New Madrid Floodway by allowing for a much greater level of connectivity with the Mississippi River. Unavoidable project-induced adverse impacts to wetlands will be compensated.

Alternatives A3 and B3.1, the recommended plan, is demonstrably the most practicable in light of all relevant factors and has been identified as the least environmentally damaging practicable alternative (LEDPA). Please refer to Appendix E, Part 5 for additional details.

S8. Findings on Executive Order 11988, Floodplain Management

Executive Order 11988, Floodplain Management (signed 24 May 1977), requires Federal agencies to recognize the significant values of floodplains and to consider the public benefits that would be realized from restoring and preserving floodplains. The Executive Order has an objective of avoidance, to the extent possible, of long and short-term adverse impacts associated with the occupancy and modification of the base floodplain and the avoidance of direct and indirect support of development in the base floodplain wherever there is a practical alternative. Under this Order USACE is required to provide leadership and take action to:

a. Avoid development in the base floodplain unless it is the only practical alternative;
b. Reduce the hazard and risk associated with floods;
c. Minimize the impact of floods on human safety, health, and welfare; and
d. Restore and preserve the natural and beneficial values of the base floodplain.

It is USACE policy to formulate projects which, to the extent possible, avoid or minimize adverse impacts associated with the use of the base floodplain and avoid inducing development in the base floodplain unless there is no practical alternative. The recommended plan complies with the executive order for the following reasons:

- The significant value of the floodplain to fish and wildlife resources and wetland functions were assessed and mitigation is proposed to compensate for unavoidable significant impacts.
- Floodplain restoration of Big Oak Tree State Park is a priority of the project's mitigation.
- With the exception of conversion of agricultural land to forested areas as a result of the project's mitigation or WRP enrollment, no land use change is expected. Although agricultural areas will intensify (i.e., change in cropping patterns), no significant residential development is expected to occur.
- The project reduces the flood hazard and risk to residents, infrastructure, and agricultural areas within the floodplain.
- The recommended plan recognizes the importance of the floodplain by maintaining a level of connection between the Mississippi River and the New Madrid Floodway during portions of the year and at elevations that do not impact socio-economic resources.
- The project will not significantly increase flood heights to adjacent or downstream areas during significant flood events.
- The project will not change the operation of the Birds Point to New Madrid Floodway. The Floodway will continue to be operated as authorized by law. The project will not result in increased time period of operation or an increased time period for a decision to operate. No significant impacts are anticipated to adjacent and downstream areas.

Additional information is found throughout the FEIS.

S9. Findings on Executive Order 11990, Protection of Wetlands

Executive Order 11990 directs Federal agencies to avoid, to the extent possible, long- and short-term adverse impacts associated with destruction or modification of wetlands and to avoid direct or indirect support of new construction in wetlands if a practical alternative exists. Furthermore, agencies shall consider the action's effect on (a) public health, safety, and welfare; (b) maintenance of natural systems, including conservation and long-term productivity of existing flora and fauna, species and habitat diversity and stability, hydrologic utility, fish, wildlife, timber, and food and fiber resources; and (c) other wetland uses. Avoidance is determined first by demonstrating that the proposed project

is water dependent, and secondly by demonstrating that the proposed project is the least environmentally damaging practicable alternative. Since the purpose and need of the project is to reduce flood risks in the area, impacts on Waters of the United States, other waters, and wetlands would be unavoidable.

Alternatives were formulated that minimize the impacts to wetlands. With the exception of direct impacts as a result of channel modifications and fill, the project would indirectly impact wetlands as a result of changes to flood frequencies and durations. The wetlands would still exist following the completion of the project. However, they would not be flooded as frequently or as long as presently observed under existing conditions. Although the project will not impact overall acreages of wetlands, the impacts to functions as a result of hydrologic changes have been assessed and mitigation is proposed to compensate for the impacts to significant wetland functions. The recommended plan, alternatives A3 and B3.1, is the most practicable in light of all relevant factors and has been identified as the LEDPA.

S10. Findings on Executive Order 12898, Environmental Justice in Minority and Low Income Populations

Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations,* was signed by President Clinton in 1994. It directs federal agencies, "to the greatest extent practicable and permitted by law, to make achieving environmental justice (EJ) part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations in the United States and its territories and possessions…" As directed, USACE has developed an analytical methodology to evaluate EJ areas affected by water resource projects that are consistent with Environmental Protection Agency (EPA) recommendations, USACE policy, and Executive Order 12898.

For a full context of the community impacts, the Economics and Hydrologic sections and appendices should be read and considered when reviewing the EJ assessment. The analysis shows that, while there are EJ communities in the study area, implementation of the proposed action would reduce the flood risk to residents at low-lying elevations. Additionally, it would provide flood risk reduction benefits to all residents in the project vicinity, regardless of race or income level; and thus would not have a disproportionate impact to minority and low income residents. Furthermore, the hydrologic analysis shows that the project will have no impact on the Mississippi River flood stages nor would it adversely impact future operations of the Birds Point-New Madrid Floodway.

S11. Unresolved Issues

S11.1 State of Missouri Water Quality Certification

USACE will request water quality certification from the State of Missouri concurrent with public review of the FEIS.

S11.2 Endangered Species

The Reasonable and Prudent Measure (RPM) and non-discretionary Terms and Conditions described in the USFWS Draft Biological Opinion (Appendix J, Part 2) state that implementation of alternative B4.1 in the New Madrid Floodway is required to minimize project-related incidental take of interior least terns. Formal consultation is on-going. Alternative analysis and the associated impacts to endangered and threatened species, and rationale for alternative selection will be updated, as needed, upon completion of Phase 4 IEPR and prior to public review of the FEIS.

S11.3 U.S. Fish and Wildlife Service Coordination Act Report

USFWS provided a Fish and Wildlife Coordination Act Report (FWCAR) on July 11, 2013 (Appendix Q, Part 1). The document contains USFWS's findings and recommendations, outlining its vision for what is best for the project area insofar as fish and wildlife are concerned, and raising several issues for further exploration, especially those pertaining to uncertainties in scientific information, analytical methodologies, and statutory constraints. USACE responses to this document are located in Section 9.3 of this FEIS. USACE will continue to work collaboratively with USFWS and others on issues raised in the FWCAR.

In summary, USFWS recommends that flood risk reduction improvements be constructed in St. Johns Bayou Basin only (alternative A3), and that no action be taken in the New Madrid Floodway. If, however, limiting construction to St. Johns Bayou Basin is not possible, USFWS urges USACE to select alternatives A3 and B4.1 over the recommended plan, alternatives A3 and B3.1.

There are challenges associated with water resources development interests regarding the St. Johns Bayou Basin and New Madrid Floodway (i.e., socio-economic impacts vs. fish and wildlife habitat) that must be balanced. The objectives for the project area are derived from the statutes that are the basis for the proposed action. That is, flood risk management focuses on protecting people, places, and social and economic activity in the project area. However, it is also true that bottomland hardwoods connected to the Mississippi River and subject to its flood pulse provide a host of ecological goods and services. Currently, the New Madrid Floodway is a working landscape, providing flood risk reduction as a floodway, agricultural production, and fish and wildlife habitat. With or without a project, it is expected that the majority of the area will continue as agricultural lands. Harmonizing competing socio-economic and environmental interests is thus a complex, at times controversial, task that demands careful consideration of federal investment towards preferred uses of the project area. USFWS has recommended, and USACE has considered, the value of retaining connectivity between the Mississippi River and the New Madrid Floodway as a means of preserving the benefit of the flood pulse to that floodplain; and thereby serving the interests of conservation and

preservation advocated by USFWS.[5] The project's statutory authority is to reduce the likelihood and adverse effects—on agricultural and urban lands—of backwater flooding in the New Madrid Floodway and flooding due to the impounding of waters in St. Johns Bayou Basin. With the exception of restoration activities of sustaining some degree of connectivity associated with compensatory mitigation, USACE is not authorized to implement ecosystem restoration measures as a project purpose. To do so, USACE would have to obtain reconnaissance study authorization from Congress and appropriation to determine a federal interest, conduct a cost-shared feasibility study, obtain additional authorization to implement such a plan, and work with a cost-share sponsor to implement the plan.

Additionally, USFWS recommendation to implement flood risk reduction improvements only in the St. Johns Bayou Basin is economically justified (project benefits are greater than project costs, including mitigation). However, such a plan does not consider the socio-economic impacts in the New Madrid Floodway. When project costs and benefits from both basins are combined, constructing a St. Johns Bayou Basin only alternative does not result in the greatest excess benefits.

USACE acknowledges that implementing other alternatives, as urged by USFWS, would reduce environmental impacts because a larger geographic area remains subject to flooding. Although the decrease in environmental impacts results in less mitigation, when net excess benefits are compared, they do not result in the greatest net excess benefits.

While a recommended plan has been identified in this FEIS, one that delivers the greatest annual net excess benefit, according to National Economic Development criteria, a final decision will be made after the public has the opportunity to comment on the FEIS. Public comments are beneficial to the holistic decision making process and will also aid in the continued discussion between USFWS and USACE regarding the benefits and impacts of each alternative and the policy implications of each approach.

S12. Relationship of Plans to Environmental Requirements

FEDERAL STATUTES	*Alt. A2/3*	*Alt. B2*	*Alt. B3.1*	*Alt B3.2*	*Alt. B4.1*	*Alt B4.2*
1. Clean Air Act, as Amended. Compliance requires coordination with the U.S. Environmental Protection Agency and analysis of potential impacts on air quality.	*FC*	*FC*	*FC*	*FC*	*FC*	*FC*
2. Clean Water Act of 1977. Compliance requires preparation	*PC*	*PC*	*PC*	*PC*	*PC*	*PC*

[5] As noted by USFWS, the New Madrid Floodway has considerable potential for conservation and restoration, the floodplain being one of but a very few places in the Lower Mississippi River Valley, outside of batture lands, where this could be accomplished.

of 404(b)(1) Evaluation and submission of such to Congress with the EIS or procurement of state water quality certification (WQC). See, Appendix E, for the 404(b)(1) evaluation. Pending State WQC.						
3. Endangered Species Act of 1973, as Amended. Compliance requires coordination with the U.S. Fish and Wildlife Service (USFWS) to determine if any endangered or threatened species or their critical habitat would be impacted by the project.	*NC*	*NC*	*NC*	*NC*	*NC*	*NC*
4. Federal Water Project Recreation Act. Compliance requires review by the Department of the Interior. Coordination of the FEIS will bring the project into full compliance.	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
5. Fish and Wildlife Coordination Act. Compliance requires coordination with the USFWS and recommendations are discussed in, Appendix Q, which includes the Fish and Wildlife Coordination Act Report (CAR).	*PC*	*PC*	*PC*	*PC*	*PC*	*PC*
FEDERAL STATUTES	*Alt. A2/3*	*Alt. B2*	*Alt. B3.1*	*Alt B3.2*	*Alt. B4.1*	*Alt B4.2*
6. Land and Water Conservation Fund Act. Compliance requires Secretary of the Interior approval of replacement property that would be acquired to mitigate converted property purchased with LWCFA funds.	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
7. National Historic Preservation Act. Compliance requires Corps to take into account the impacts of	*FC*	*FC*	*FC*	*FC*	*FC*	*PC*

project on any property included in or eligible for inclusion in the National Register of Historic Places.						
8. National Environmental Policy Act. Compliance requires preparation of this FEIS, consideration of public comments, and preparation and public review of the FEIS. Signing of the Record of Decision would bring this project into full compliance.	*PC*	*PC*	*PC*	*PC*	*PC*	*PC*
9. River and Harbor Act.	*PC*	*PC*	*PC*	*PC*	*PC*	*PC*
10. Farmland Protection Policy Act. Compliance requires coordination with the Natural Resources Conservation Service to determine if any designated prime or unique farmlands are affected by the project.	*FC*	*FC*	*FC*	*FC*	*PC*	*PC*
11. Watershed Protection and Flood Prevention Act. No requirements for Corps projects.	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
12. Wild and Scenic River Act. Compliance requires coordination with Department of the Interior to determine if any designated or potential wild, scenic, or recreational rivers are affected by the project. Coordination has been accomplished and there are no such rivers in the project area.	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
EXECUTIVE ORDER/MEMORANDA	*Alt. A2/3*	*Alt. B2*	*Alt. B3.1*	*Alt B3.2*	*Alt. B4.1*	*Alt B4.2*
1. Executive Order 11988, Floodplain Management. Compliance requires an assessment and evaluation together with the other general implementation procedures to be	*FC*	*FC*	*FC*	*FC*	*FC*	*FC*

incorporated into EIS.						
2. Executive Order 11990, Protection of Wetlands. Compliance requires results of analysis and findings related to wetlands be incorporated into the EIS.	*FC*	*FC*	*FC*	*FC*	*FC*	*FC*
3. Executive Memorandum, Analysis of Impacts on Prime and Unique Farmlands in EIS. Compliance requires inclusion of effects of proposed action on prime and unique farmlands in EIS.	*FC*	*FC*	*FC*	*FC*	*PC*	*PC*
4. Executive Order 11593, Protection and Enhancement of the Cultural Environment. Compliance requires Corps to administer cultural properties under their control in stewardship for future generations; preserve, restore or maintain such for benefit of the people; and assure that its plans contribute to preservation and enhancement of non-federally owned sites.	*FC*	*FC*	*FC*	*FC*	*FC*	*FC*
5. Executive Order 13112, Invasive Species. Compliance requires assessment of potential for the project to introduce invasive species to the project area.	*FC*	*FC*	*FC*	*FC*	*FC*	*FC*
6. Executive Order 12898, Environmental Justice in Minority and Low-income Populations. Compliance requires assessment of project effects on minority and low-income populations.	*FC*	*FC*	*FC*	*FC*	*FC*	*FC*

FC - In Full Compliance
PC - In Partial Compliance
NA - Not Applicable
NC – Not in Compliance, to date

GLOSSARY OF TERMS AND ACRONYMS

AAHU – Average Annual Habitat Units

BMP – Best Management Practices

CD – Connected Depression

CERCLA – Comprehensive Environmental Response, Compensation, and Liability Act

CEQ – Council on Environmental Quality

CRP – Conservation Reserve Program

EC – Enterprise Community

EIS – Environmental Impact Statement

EMAP – Environmental Monitoring and Assessment Program

EPA – Environmental Protection Agency

ERDC – Engineer Research and Development Center

ERS – Economic Research Service

FCA – Flood Control Act

FCI – Functional Capacity Index

FCU – Functional Capacity Unit

FEMA – Federal Emergency Management Agency

FPC – Flood Pulse Concept

FSA – Farm Security Administration

HEP – Habitat Evaluation Procedure

HGM - Hydrogeomorphic

H+H – Hydraulics and Hydrology

HSI – Habitat Suitability Index

HTRW – Hazardous, Toxic, and Radioactive Waste

HU – Habitat Units

GRTS – Generalized Random Tessellation Stratified

IEPR – Independent External Peer Review

LGRB – Low Gradient Riverine Backwater

LGRO – Low Gradient Riverine Overbank

LIDAR – Light Detection and Ranging

LMRCC - Lower Mississippi River Conservation Committee

LRR – Limited Reevaluation Report

MDC – Missouri Department of Conservation

MDNR – Missouri Department of Natural Resources

MEA – Millennium Ecosystem Assessment

MINT – Missouri Innovative Nutrient Trading Project

MoDOT – Missouri Department of Transportation

MR&T – Mississippi River and Tributaries Project

NAWQA – National Water Quality Assessment Program

NAACP – National Association for the Advancement of Colored People

NAVD – North American Vertical Datum

NED – National Economic Development

NEPA – National Environmental Policy Act

NGVD – National Geodetic Vertical Datum

NLCD – National Land Cover Dataset

NOI – Notice of Intent

NRCS – Natural Resources Conservation Service

NTT – Nutrient Trading Tool

NTU – Nephelometric Turbidity Unit

RSEIS – Revised Supplemental Environmental Impact Statement

SEIS – Supplemental Environmental Impact Statement

SPARROW – SPAtially Referenced Regressions on Watershed

STFU - Southern Tenant Farmers Union

TMDL – Total Maximum Daily Load

TN – Total Nitrogen

TP – Total Phosphorus

USACE – United States Army Corps of Engineers

USDA – United States Department of Agriculture

USFWS – United States Fish and Wildlife Service

USGS – United States Geological Survey

WRP – Wetland Reserve Program

WRDA – Water Resources Development Act

LIST OF DEFINITIONS

Batture - Undeveloped land, lying between the artificial levee and the river.

Backwater Flooding – Overflowing by water of the normal confines of a stream channel due to downstream conditions, such as impounded interior runoff produced by closure of a gravity structure, a debris blockage, or higher stages produced by a receiving stream channel.

Converted wetland - Wetland that had been drained, dredged, filled, leveled, or otherwise manipulated (including the removal of woody vegetation or any activity that results in impairing or reducing the flow and circulation of water) for the purpose of or to have the effect of making possible the production of an agricultural commodity without further application of the manipulations described herein if:

(i) Such production would not have been possible for such action, and

(ii) Before such action such land was wetland, farmed wetland, or farmed – wetland pasture and was neither highly erodible land not highly erodible cropland

Excess Benefits - Excess benefits are calculated as the total annualized dollars in expected benefit minus the cost of the investment, which is distinguished from return on investment or benefit to cost ratio.

Farmed Wetland - Wetland that prior to December 23, 1985, was manipulated and used to produce an agricultural commodity, and on December 23, 1985, did not support woody vegetation and met the following hydrologic criteria:

(i) Is inundated for 15 consecutive days or more during the growing season or 10 percent of the growing season, whichever is less, in most years (50 percent chance or more).

Growing Season - The average date (defined as 50 percent chance; as many freeze dates before as after the date), of the last spring moderate freeze (defined as temperatures in the range of 24-28°) is March 16. The average date of the first fall moderate freeze is November 20. Thus, the average length of the growing season in southeastern Missouri is 250 days (http://climate.missouri.edu/climate.php).

Headwater Flooding - Overflowing by water of the normal confines of a stream channel not due to downstream conditions, such as impounded interior runoff produced by closure of a gravity structure, a debris blockage, or higher stages produced by a receiving stream channel.

Impounded Interior Runoff – Waters produced within a drainage basin that are retained due to closure of a gravity outlet structure or other obstruction such as a debris blockage.

Moist Soil Units – Constructed habitats designed to provide food and cover for a wide variety of waterfowl and other migratory birds. Since quality moist-soil habitats are primarily composed of annual grasses, sedges and forbs, these areas must be maintained in an early successional stage. Management techniques most commonly used are water level management, shallow and deep disking, farming, and herbicide application.

Prime Farmland – Land as determined by the USDA that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, oilseed, and other agricultural crops with minimum inputs of fuel, fertilizer, pesticides, and labor, and without intolerable soil erosion. Prime farmland includes land that possesses the above characteristics but is being used currently to produce livestock and timber. It does not include land already in or committed to urban development or water storage.

Prior Converted Cropland - Converted wetland where the conversion occurred prior to December 23, 1985, an agricultural commodity had been produced at least once before December 23, 1985, and as of December 23, 1985, the converted wetland did not support woody vegetation and met the following hydrologic criteria:

> (i) Inundation was less than 15 consecutive days during the growing season or 10 percent of the growing season, whichever is less, in most years (50 percent change or more).

Riverfront Forest – Forest type that is predominant on sites immediately adjacent to large rivers and streams, which occurs over a large portion of the eastern U.S., most abundantly within the Mississippi River watershed and along the east coast. Soils are alluvial, range in texture from sand to clay, and generally moist year-round due to their topographic position and proximity to open water. Flooding occurs seasonally on most sites. The eastern riverfront hardwood forest contains many species, but is usually dominated by sycamore, silver maple, green ash, sugarberry, sweetgum and American elm. Common associates are red maple, boxelder, hackberry, black walnut and slippery elm.

Significant Resource – Resources identified from public scoping, inter-agency coordination, and/or IEPR in which both the context of the resource importance (e.g., local, regional, national) as well as the intensity of the proposed action on that resource require discussion. Intensity of the action can be beneficial or adverse and must consider the degree to which the proposed action affects those resources.

Sump Area – Level pool area that forms at the outlet of a drainage basin due to backwater flooding or impounded interior runoff.

Unique Farmland - Land other than prime farmland that is used for production of specific high-value food and fiber crops, as determined by the USDA. It has the special combination of soil quality, location, growing season, and moisture supply needed to economically produce sustained high quality or high yields of specific crops when treated and managed according to acceptable farming methods.

Wetland – Lands as determined by USACE and EPA that are inundated or saturated by surface or ground water 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. Wetlands generally include swamps, marshes, bogs, and similar areas. For the purpose of the FEIS, this term was only used to describe those wetlands that were also estimated to be Waters of the United States (*i.e.,* jurisdictional).

Waters of the United States –

(1) All waters which are currently used, or were used in the past, or may be susceptible to use in interstate or foreign commerce, including all waters which are subject to the ebb and flow of the tide;

(2) All interstate waters including interstate wetlands;

(3) All other waters such as intrastate lakes, rivers, streams (including intermittent streams), mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds, the use, degradation or destruction of which could affect interstate or foreign commerce including any such waters:

(i) Which are or could be used by interstate or foreign travelers for recreational or other purposes; or

(ii) From which fish or shellfish are or could be taken and sold in interstate or foreign commerce; or

(iii) Which are used or could be used for industrial purpose by industries in interstate commerce;

(4) All impoundments of waters otherwise defined as waters of the United States under the definition;

(5) Tributaries of waters identified in paragraphs (a) (1) through (4) of this section;

(6) The territorial seas;

(7) Wetlands adjacent to waters (other than waters that are themselves wetlands) identified in paragraphs (a) (1) through (6) of this section.

(8) Waters of the United States do not include prior converted cropland. Notwithstanding the determination of an area's status as prior converted cropland by any other Federal agency, for the purposes of the Clean Water Act, the final authority regarding Clean Water Act jurisdiction remains with EPA.

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1.0 PURPOSE OF AND NEED FOR ACTION

1.1 Introduction, Background, and Proposed Action

The U.S. Army Corps of Engineers (USACE) proposes to lessen the risk of damage, dislocation, and disruption due to recurrent heavy flooding in portions of New Madrid, Mississippi, and Scott counties in southeast Missouri. This would be accomplished by constructing a flood risk reduction levee, two floodwater pumping stations, ditch modifications, and other related water features in the St. Johns Bayou Basin and the adjacent New Madrid Floodway. The project area is shown in Figure 1.1. This Final Environmental Impact Statement (FEIS), prepared according to the National Environmental Policy Act (NEPA), NEPA regulations of the Council on Environmental Quality (CEQ), and NEPA directives of the Department of the Army and of USACE, assesses the reasonably foreseeable impact of the proposed action on the human environment.

The mission of USACE under federal law is to deliver to the American people the flood risk reduction[1] benefits approved by Congress. USACE, as a partner with states and localities in shared responsibility, is the lead federal agency in charge of protecting people and places from the ravages of flooding in the Mississippi River watershed. Driven largely by the Great Flood of 1927 and the resulting Flood Control Act of 1928, USACE has built and, with local sponsor participation, has maintained and operated an extensive but still incomplete system of flood risk reduction along the Mississippi River and its tributaries. The very great benefits of the system to the Nation were convincingly demonstrated by how well it performed during the Great Flood of 2011, preventing some $230 billion in flood damages (see Appendix L).

The Birds Point-New Madrid Floodway, a component of the protective system that grew out of the 1928 Flood Control Act, is an approximately 130,000-acre area between a frontline levee (running along the Mississippi River from Bird's Point, Missouri, in the north, to New Madrid, Missouri, in the south) and a setback levee (to the west). It was designed to divert floodwaters from the Mississippi and thereby reduce the likelihood or severity of catastrophic flooding from levee failure or overtopping of mainline levees protecting more than 2.5 million acres at the confluence of the Mississippi and the Ohio rivers. Since its construction in 1933, the floodway has been opened only twice, the most recent occasion being in 2011 (see Appendix L).

As built, the New Madrid Floodway is open at its southern end where an approximate 1,500-foot gap exists between the frontline and setback levees, through which Mud Ditch flows. It is through this opening that the floodway drains, but it is also where

[1] Flood risk reduction is the term USACE now uses to describe its flood prevention and control and consequence management missions. Flood risk reduction is the process of identifying, evaluating, selecting, implementing, and monitoring actions taken to reduce flooding-related risks. Social, cultural, ethical, environmental, political, and legal aspects are considered in the process (USACE, 2009). The ultimate purpose of flood risk reduction is to protect people and places by making them less susceptible to flooding, by limiting how often and how severely flooding occurs.

flooding, known as backwater flooding, regularly occurs, when the rising Mississippi River backs up into New Madrid Floodway. The Flood Control Act of 1954 authorized construction of a levee, with an outlet structure for Mud Ditch that would close the gap, thereby effectively eliminating the backwater flooding threat. However, the New Madrid Floodway would continue to be activated in the event of catastrophic flooding. Because of concerns that closing the gap without a pumping station would create a flooding problem from waters impounded within the floodway, the gap-closing levee has not been built.

The St. Johns Bayou Basin is a 324,173-acre watershed situated between Commerce, Missouri and New Madrid, Missouri, bounded by the New Madrid Floodway setback levee and frontline levee on the east, Sikeston Ridge on the west, and the Commerce Hills to the north. St. Johns Bayou, which runs to the east of New Madrid, Missouri, flows out of the basin through a gated outlet structure in the New Madrid Floodway setback levee (consisting of six 10- by 10-foot culverts) that was built in 1953 as part of a levee constructed to close a 4,200-foot gap between the setback levee and the Sikeston Ridge levee. These features prevent backwater flooding in the St. Johns Bayou Basin, but when the outlet structure is closed, St. Johns Bayou and waters from other streams and the basin's extensive system of agricultural ditches are impounded, causing or contributing to interior flooding, sometimes severe, in East Prairie and elsewhere in the St. Johns Bayou Basin.

Mud Ditch and St. Johns Bayou meet just south of the New Madrid Floodway setback levee outlet structure and flow into the Mississippi River about one-half mile east of New Madrid, Missouri. The project area is shown in Figure 1.1. It consists of the drainage area that flows through the St. Johns Bayou outlet structure in the New Madrid Floodway setback levee and the portion of New Madrid Floodway that drains through Mud Ditch.

The flood risk in the St. Johns Bayou Basin and in the New Madrid Floodway are inter-related. Existing levees protect the St. Johns Bayou Basin from Mississippi River flooding. A 1,500-foot gap permits Mississippi River flooding to back into the New Madrid Floodway (*i.e.*, backwater flooding). As noted, closing the St. Johns Bayou outlet structure in the New Madrid Floodway setback levee protects the St. Johns Bayou Basin from river flooding but creates a bathtub effect when the outlet structure is closed, by impounding water in the St. Johns Bayou Basin (*i.e.*, impounded interior runoff). Also as noted, a similar result is the main reason why a levee has not been constructed to close the 1,500-foot gap in the New Madrid Floodway, leaving it vulnerable to, and at the same time the beneficiary of, Mississippi River backwater flooding. Accordingly, a prudent solution to the flooding problems in the St. Johns Bayou Basin and the New Madrid Floodway must address river flooding and the resulting impounding of waters. The proposed action therefore contemplates contemporaneous action in both the St. Johns Bayou Basin and the New Madrid Floodway.

Destructive backwater flooding in the New Madrid Floodway and equally harmful flooding from impounded interior runoff in the St. Johns Bayou Basin frequently occur, though not every year as equally severe or damaging. Closing the New Madrid Floodway gap, by connecting the frontline levee to the setback levee, would lessen the frequency and severity of backwater flooding there, but additional measures would be required to control waters that would then be impounded within the New Madrid Floodway.

Beginning in 1954, for purposes of the proposed action now under consideration, Congress passed several laws aimed at providing additional flood risk reduction to people, places, and economic activity in the New Madrid Floodway and St. Johns Bayou Basin, directing and empowering USACE to build the civil works needed to do so. The proposed action is thus the means by which USACE would carry-out its congressional mandates. Two of the primary statutes requiring USACE to perform these missions are the Flood Control Act of 1954 and the Water Resources Development Act of 1986.

Section 203 of the Flood Control Act of 1954 states:

> The following works of improvement for the benefit of navigation and the control of destructive floodwaters and other purposes are hereby adopted and authorized to be prosecuted under the direction of the Secretary of the Army and the supervision of the Chief of Engineers in accordance with the plans in the respective reports hereinafter designated and subject to the conditions set forth therein.
>
> …
>
> Lower Mississippi River
>
> …
>
> The project for flood control and improvement of the lower Mississippi River, adopted by the Act of May 15, 1928[2], as amended and modified, is hereby further modified and expanded to include the following items of work and authorization for said project is increased accordingly.
>
> …
>
> (d) Modification of the authorized project for the New Madrid Floodway substantially in accordance with the recommendation of the Chief of Engineers in House Document Numbered 183, Eighty-third Congress, at an estimated cost of $1,743,000.

This act authorized construction of a levee, with an outlet structure for Mud Ditch, which would close the 1,500-foot gap between the New Madrid Floodway frontline levee and setback levee.

[2] The title of the Flood Control Act of 1928 is "An Act for the control of floods on the Mississippi River and its tributaries, and for other purposes."

Section 401(a) of the Water Resources Development Act of 1986 states:

> AUTHORIZATION OF CONSTRUCTION – The following works of improvement for the control of destructive floodwaters are adopted and authorized to be prosecuted by the Secretary substantially in accordance with the plans and subject to the conditions recommended in the respective reports designated in this subsection, except as otherwise provided in this subsection:
>
> …
>
> St. Johns Bayou and New Madrid Floodway, Missouri
>
> …
>
> The project for flood control, St. Johns Bayou and New Madrid Floodway, Missouri: Report of the Chief of Engineers, dated January 4, 1983 at a total cost of $112,000,000, with an estimated first Federal cost of $78,500,00 and an estimated first non-Federal cost of $33,500,00, except that the land for mitigation of damages to fish and wildlife shall be acquired as soon as possible from available funds, including the Environmental Protection and Mitigation Fund established by section 908 of the Act, and except that lands acquired by the State of Missouri after January 1, 1982, for mitigation of damage of fish and wildlife within the Ten Mile Pond mitigation area shall be counted as part of the total quantity of mitigation lands required for the project and shall be maintained by the State for such purpose.

A 1983 Chief of Engineers report recommended channel clearing, enlargement, and modifications in St. Johns Bayou Basin and the New Madrid Floodway; a floodwater pumping station in the St. Johns Bayou Basin and another in the New Madrid Floodway; and, other environmental and recreational features.

Together, the 1954 act and the 1986 act provide the statutory basis for USACE to address the flooding problems that continue to plague the New Madrid Floodway and the St. Johns Bayou Basin

1.2 Purpose and Need

USACE is obliged by law to accomplish the will of Congress for flood risk reduction[3] in Southeast Missouri. The statutory authority for and requirement to act in this case direct USACE to reduce the likelihood and adverse effects—on agricultural and urban lands—of backwater flooding in the New Madrid Floodway and flooding due to the impounding of waters in St. Johns Bayou Basin (currently) and the New Madrid Floodway (in the future).

[3] Additional information on the history of USACE activities in the New Madrid Floodway and in the St. Johns Bayou Basin, along with information on previous USACE studies and other relevant legislation, may be found in Appendix D, Part 1.

Using its project-specific and other civil works authorities, the challenge before USACE is to perform its mission, serving public welfare and national economic development, within the constraints of applicable environmental and natural resources laws. Beginning with the Chief of Engineers report of 1952, and continuing with the 1975 environmental impact statement *St. Johns Bayou and New Madrid Floodway Missouri* and the 1983 Chief of Engineers report, USACE has undertaken extensive studies in the project area, resulting in not only a better understanding of the environment but also in a number of modifications to the nature and number of the flood risk reduction features and activities being considered. USACE also sought and heavily utilized extensive input from its local partner (the St. John Levee and Drainage District of Missouri), a variety of federal and state agencies, and the public.

Concerns identified by the public during the scoping process are:

- Flood-induced hardships on residents;
- Flood-generated quality of life issues including community isolation, access to health care, contamination of drinking water sources, and disruption of wastewater treatment services;
- Flood-induced impacts to streets and roads;
- Flood-driven impacts on agricultural production; and
- Flood risk reduction related impacts to wetlands, wildlife, waterfowl, shorebirds, fish, mussels, water quality, river connectivity, cultural resources, ecosystem services[4], and ditch habitat.

The lands in the St. Johns Bayou Basin and the New Madrid Floodway are predominantly (*i.e.*, over 80 percent) agricultural, and the majority of these agricultural lands are prior converted croplands. Of the 79,397 acres of land in the 5-year flood floodplain (20 percent chance annual exceedence), some 6,024 acres of wetlands (vegetated and farmed) remain in the St. Johns Bayou Basin and 9,113 acres in the New Madrid Floodway, scattered across the project area. These lands, due to their hydrological connection to the Mississippi River, especially that resulting from regular flooding, serve a variety of important ecological purposes. Junk *et al.* (1989) describes the phenomenon as the "flood pulse concept."[5] The flood pulse provides wetland hydrology and fish and wildlife habitat while flooding destroys property and causes other damage, dislocation, and disruption. This makes flood risk reduction and environmental protection competing—but not necessarily or wholly incompatible—interests in this case, in an area that is both economically important and ecologically valuable. Additional information regarding the economic impacts of flooding and the environmental benefits of the flood pulse are discussed in Section 3.

[4] The Millennium Assessment Report (2005) defines ecosystem services as benefits people obtain from ecosystems. Services are categorized as supporting services, provisioning services, regulating services, and cultural services.

[5] Junk *et al.* (1989) developed the Flood Pulse Concept (FPC) that states the flood pulse is the principal driving force responsible for the existence, productivity, and interactions of the major biota in river-floodplain systems.

Agriculture has flourished in the St. Johns Bayou Basin and the New Madrid Floodway as a direct consequence of the flood risk reduction afforded by the levee system and drainage, with the result that the formerly expansive bottomland hardwood forest landscape has been extensively modified. These alterations produced well-documented environmental changes; but both areas, despite prodigious agriculture-oriented development, remain ecologically valuable as well as economically productive. Table 1.1 illustrates the acreage inundated in the St. Johns Bayou Basin and the New Madrid Floodway by different flood frequencies.

Flooding within the project area is widely variable. By analyzing a 67-year hydrologic period of record, it can be seen that the Mississippi River may flood at nearly any time of year, but most often in winter and spring, and least often in fall. Likewise, the extent and duration of flooding is also variable. The floods of greatest intensity are most prevalent in winter and spring. Figures 1.2 and 1.3 plot the water surface elevations (*i.e.*, hydrograph) within the St. Johns Bayou Basin and the New Madrid Floodway, respectively. These non-continuous hydrographs[6] present the maximum (red), mean (blue), median (black), and minimum (green) daily elevations from 1943 to 2009.

As noted, agriculture is the dominant economic engine throughout the project area. Agribusinesses include agricultural commodities, agricultural transportation, and seed and fertilizer sales. The primary crops grown in the project area are soybeans (71 percent), corn (9.5 percent), grain (13.1 percent), sorghum (2.6 percent), and rice (3.3 percent). State and county agricultural profiles (New Madrid and Mississippi counties) are available in Volume 2, Part 2. As of 2007, there were 350 and 228 farms in New Madrid County and Mississippi County with an average size of 1,088 acres and 1,134 acres, respectively. Market value of products sold totaled $141,262,000 (with a per farm average of $403,606), in New Madrid County, and $108,420,000 (with a per farm average of $475,525) in Mississippi County. Total government farm subsidy payments were $13,667,000 (with a per farm average of $42,845) in New Madrid County, and $4,459,000 (with a per farm average of $22,294) in Mississippi County.

[6] Note that the individual parameter lines do not represent continuous hydrographs. The maximum elevation for 1 January represents the highest elevation that occurred on 1 January considering all years in the period of record. Similarly, the minimum elevation that occurred on 15 March represents the lowest elevation that occurred on 15 March considering all years in the period of record. More detailed information regarding the hydrologic period or record, including yearly hydrographs, is found in Appendix C, Part 1.

Table 1.1. Existing flood frequencies and associated inundated acres[1], St. Johns Bayou Basin and New Madrid Floodway.

Event	St. Johns Bayou Basin		New Madrid Floodway		Total
	Elevation (Feet – NGVD29)	Acres	Elevation (Feet – NAVD88)	Acres	Acres
1.01 year (99 % annual chance exceedence)	281.6	753	279.3	404	1,157
2-year (50% annual chance exceedence	291.0	11,904	292.1	33,391	45,295
5-year (20% annual chance exceedence)	294.1	20,407	296.6	58,990	79,397
10-year (10% annual chance exceedence)	295.6	26,972	298.7	70,749	97,721
20-year (5% annual chance exceedence)	296.9	38,433	300.5	81,758	120,191
50-year (2% annual chance exceedence)	298.4	43,483	302.5	93,396	136,879

[1]Associated inundated acres were calculated by interpolating between contour elevations. For example, acreages associated with 281.6 were calculated by calculating the difference in acreages from 281 and 282, multiplying by 0.6, and adding the amount to the acreages of 281.

The timing of floods is a consideration that is highly important to area producers. Each year farmers must make risk-based decisions on what to plant and when to plant. More profitable crops such as corn must be planted by late April to early May to obtain profitable yields (Wiebold, 2010). The longer planting is delayed, the smaller the yield (Table 1.2). By comparison, less profitable soybeans can be planted later, from late April to 1 June. Delaying planting until June results in a loss of 1 bushel per acre per week, and delaying planting until July results in a loss of three bushels per acre per week (Helsel and Minor, 1993). In short, area farmers can choose to plant more profitable, higher yield crops early in the growing season, when the risk of flooding is greater, or to plant less profitable, lower yield crops later in the growing season, when the risk of flooding is lower. Either way, some risk that flooding would destroy recently planted crops always exists.

Table 1.2. State of Missouri estimates regarding corn planting dates (Wiebold, 2010).

Planting Date	Yield Estimate
1 May	94%
6 May	92%
11 May	89%
16 May	86%
21 May	83%
26 May	80%
31 May	77%
5 June	75%
10 June	71%
15 June	65%

Flooding in the St. Johns Bayou Basin has been identified by local communities as a primary impediment to prosperity. Flooding in and around East Prairie and other communities adversely affects the heavily agriculture-oriented economy. Among several ill effects, flood waters overtop roads, isolates communities, interrupts utility service and damages infrastructure, hinders emergency services and mail delivery, closes schools and businesses, and curtails farming activity. East Prairie, one of the communities regularly affected by flooding, favors the congressionally-authorized flood risk reduction measures in order to improve the quality of life and living conditions for residents (City of East Prairie, 1994).

Several small communities rich in history are also located throughout the New Madrid Floodway, where flooding causes damage, disruption, and dislocation similar to the St. Johns Bayou Basin. New Madrid Floodway residents have also expressed strong support for the congressionally-authorized measures to minimize flood risk (see Volume 2, Part 1). Historically, New Madrid Floodway residents' support for the closure has always been conditioned on construction of the pump stations authorized by WRDA 1986, as they have witnessed the damage from waters impounded within the St. Johns Bayou

Basin. According to the 2010 Census, there were 307 residents in the New Madrid Floodway, though that number may be smaller due to impacts within the floodway from the 2011 flood. Some residents are expected not to return to the New Madrid Floodway, but others are returning and rebuilding, possibly reflecting the potentiality that the New Madrid Floodway, which prior to 2011 was last flooded (i.e., used for its intended purpose) in 1937, would not have to be inundated again for many years. Additionally, farmers were able to plant upwards of 90,000 acres of soybeans by the summer of 2011 and an additional 30,000 acres of soybeans or corn by spring 2012, indicating that while individuals may not return to the floodway to live, farming continues (Olsen and Morton 2013).

1.2.1 St. Johns Bayou Basin

The primary flood-related issues in the St. Johns Bayou Basin are the economic damages sustained by agriculture (crop and non-crop) and infrastructure (streets and roads), and the consequent social disruption that results from isolation, interruption of services, and other flood-related impacts.

High river stages on the Mississippi River usually occur in winter and spring, resulting in a need to close the gravity-operated St. Johns Bayou outlet structure. The 1.01-year flood (99 percent chance annual exceedence) covers lands lying at or below an elevation of 281.6 feet NGVD29. With the exception of 710 acres, flood water is mostly contained within existing waterway channels and ditches in the lower portion of the watershed (Figure 1.4).

The 2-year flood (50 percent chance annual exceedence) inundates lands lying at or below an elevation of 291 feet NGVD29. Approximately 11,904 acres are flooded under these conditions (Figure 1.4). Among other adverse effects that occur when flood waters reach this elevation, County Road 732 is impassable, as are portions of Highway P.

A 5-year flood (20 percent chance annual exceedence) submerges lands lying at or below an elevation of 294.1 feet NGVD29 (Figure 1.4). Approximately, 20,000 acres are flooded under these conditions. Agricultural lands make up approximately 14,000 (or 70 percent) of these 20,000 acres.

A 10-year flood (10 percent chance annual exceedence) inundates lands lying at or below an elevation of 295.6 feet NGVD29 (Figure 1.4). Approximately 29,000 acres are flooded under these conditions. Agricultural lands make up approximately 19,930 (or 69 percent) of these 29,000 acres. When flood waters reach the 295.3-foot NGVD29 elevation the Missouri Department of Transportation (MoDOT) starts pumping in the median of Interstate 55. Without pumping and sandbagging, Interstate 55 would begin to be impassable when flood waters reach an elevation of 296.4 feet NGVD29.

A 25-year flood (4 percent chance annual exceedence) inundates lands lying at or below an elevation of 297.3 feet NGVD29 (Figure 1.4). Approximately 40,000 acres are flooded under these conditions. Agricultural lands make up approximately 31,000 (or 78

percent) of these acres. Although MoDOT can keep I-55 open with pumping and sandbagging, other transportation corridors (Highways 80 and OO) leading into East Prairie begin to be overtopped, leading to the isolation of East Prairie.

A 50-year flood (2 percent chance annual exceedence) inundates land lying at or below an elevation of 298.4 feet NGVD29. At this elevation, over 43,000 acres are inundated, of which 33,718 (or 78 percent) are agricultural lands. Transportation corridors leading into and out of East Prairie are cut. Depending on rainfall conditions, portions of East Prairie itself may lie beneath the deluge. Intensive pumping and sandbagging efforts are required to keep I-55 open.

Rising floodwaters impounded within St. Johns Bayou Basin follow the network of drainage ditches. Socio-economic problems are compounded when heavy rainfall coincides with high Mississippi River stages, exacerbating the problem caused by impounding St. Johns Bayou. For example, during high Mississippi River stages in April 2008, 7.98 inches of rain fell in Sikeston, Missouri, with a maximum 24-hour total of 3.95 inches (National Weather Service, 2011).

East Prairie and its surroundings drain into St. James Ditch, which flows south until it reaches Setback Levee Ditch, which continues south until it connects to St. Johns Bayou. The drainage ditches in this area are not of sufficient size (*i.e.,* depth and width) to effectively transport the run-off from heavy rain storms. As storm drains in and around East Prairie reach capacity, the water they carry pours into St. James Ditch and then St. Johns Bayou, which are themselves backing up when the St. Johns Bayou outlet structure is closed. Storm waters then flow over and out of the drains, ditches, and St. Johns Bayou, flooding the town and lands around it.

1.2.1.1 Agriculture Damages

Flooding in the St. Johns Bayou Basin imposes a stiff toll in foregone and lost economic opportunity. Reliable estimates of crop damage due to flooding do not exist. Therefore, an economic model was used to quantify the economic impact of flooding on agricultural areas. The model is based on Current Normalized Prices (normalized prices smooth out the effects of short-term price fluctuations so that plans can be evaluated on a more realistic basis). Additional information can be found in Appendix B.

Flooding destroys recently planted crops, inhibits yield, and delays re-planting. The average annual flood-related economic crop damage in St. Johns Bayou Basin is $3,953,000.

Flooding also damages equipment, irrigation structures, and drainage structures. The average annual flood-related economic non-crop agricultural damage in St. Johns Bayou Basin is $1,051,000, for a total of $5,004,000.

Flooding also constrains what crops may be planted, where, and when. In areas that are subject to frequent floods, instead of planting more profitable crops such as corn, for example, producers are limited to less profitable late-season soybeans.

1.2.1.2 Infrastructure Damages

Floods damage streets and roads. St. Johns Bayou Basin experienced reduced average annual economic damage to infrastructure of $682,000. In addition, flooding in the St. Johns Bayou Basin routinely threatens Interstate 55, a major north/south transportation artery that runs through its center. On several occasions in recent years the Missouri Department of Transportation (MoDOT) has had to sandbag this section of I-55 to keep it open. MoDOT provided data on the cost of sandbagging and flood fighting. From this data it is estimated that annual costs of flooding for this stretch of interstate is approximately $106,000.

1.2.1.3 Social Impacts

Community Isolation

Community isolation is a concern to residents in both the St. Johns Bayou Basin and the New Madrid Floodway, as related during the public scoping meeting. Flooding severs roads causing area residents to sometimes resort to extraordinary measures to perform basic tasks such as going to work, attending school, purchasing groceries, and obtaining medical care. Residents either have to take miles-longer alternate routes or use boats or heavy equipment to navigate flood waters. Flooding also disrupts emergency vehicles from being able to service communities; for example, ambulances cannot travel through floodwaters. In addition to emergency vehicles, flooding also disrupts important services such as U.S. Mail delivery, garbage pick-up, and sewage treatment. As previously noted, roads are put at risk when flood waters reach an approximate elevation of 290 feet NGVD29. Based on the 67-year period of record studied, flood waters reach the 290-foot NGVD29 elevation in the St. Johns Bayou Basin an average of 17.4 days per year.

Health

Another major concern conveyed by residents during the public scoping meeting is the sickness and disease that can accompany flooding. Blastomycosis is of particular concern. Blastomycosis is a fungal infection caused by the organism *Blastomyces dermatitidis*. Found typically in moist soil where there is rotting vegetation, it is endemic in the Mississippi and Ohio River basins (Chapman 2000). Once inhaled into the lungs, the fungus multiplies affecting the blood, lymphatic system, vital organs, skin, bone, genitourinary tract, and brain. The incubation period is 30 to 100 days, although infection can be asymptomatic.

The annual incidence of blastomycosis in Missouri is 0.2/100,000. However, Mississippi County has the highest incidence in the state of Missouri (12/100,000) with a much higher rate among blacks (43.2/100,000) than whites [Cano *et al.* 2003]. Cano *et al.*

(2003) observed 36 cases of blastomycosis reported in the State of Missouri from 1992 to 1999. Twenty of the cases occurred in five counties in the southeastern part of the state and of those 12 (60 percent) were in Mississippi County, resulting in four deaths. Furthermore, Cano *et al.* (2003) stated:

> "Although the number of blastomycosis infections in humans documented during 1993 was not significantly greater compared with other years, the increase during that year may be related to environmental changes that occurred in the southeastern part of the state. Yearly floods are common in the areas bordering the Mississippi River, but in 1993, the Southeastern Missouri counties along the Mississippi River had a drought and then late flooding that lasted for several months. In particular, the amount of rainfall reported during 1993 in Mississippi County was the higher than in other years. During that year, river stages for the Ohio and Mississippi River were also the highest. Higher incidence rates of endemic blastomycosis, as well as outbreaks, had been previously associated with regions of low elevation containing acidic soil and bodies of water."

Drinking Water Wells

A total of 1,046 drinking water wells are located in the St. Johns Bayou Basin. Wells are the predominant source of water for rural residents, as well as the primary irrigation supply. Following floods, increased levels of contaminants can be expected, forcing residents to purge their drinking water wells. Although decontamination costs were not calculated, the public health risks associated with contaminated drinking water wells must be acknowledged.

Waste Water Treatment

Since the majority of the St. Johns Bayou Basin is rural, most wastewater treatment is by means of septic tanks. During periods of flooding, tile fields do not function, and waste water co-mingles with flood water (Chittenden 2011 (Volume 2, Part 3)). Although difficult to detect, co-mingled waste water may contaminate drinking water wells and poses other direct and indirect health risks.

There are 17 waste water outfalls in the St. Johns Bayou Basin that treat sewage. Flooding damages sewage treatments plants and sanitary sewer systems (Chittenden 2011 (Volume 2, Part 3). As floods rise, the rising water table causes soil to enter the underground sewer system, resulting in the system becoming engorged with sand which must be removed to ensure system integrity. Although difficult to quantify, costly repairs are required.

Since all flow out of the St. Johns Bayou Basin passes through the St. Johns Bayou outlet structure in the New Madrid Floodway setback levee, when the structure is closed, treated waste water cannot flow into the Mississippi River, but remains trapped in the basin until the gates are opened and discharged into the Mississippi River.

1.2.2 New Madrid Floodway

The primary flood-related issues in the New Madrid Floodway, much like in the St. Johns Bayou Basin, are the economic damages sustained by agriculture (crop and non-crop) and infrastructure (roadways and utilities, for example) and the consequent social disruption that results from isolation, interruption of services, and other flood-related impacts. When the Mississippi River is high, backwater flooding inundates the New Madrid Floodway.

Previous analysis indicated that a private levee located along Wilkerson Ditch would be overtopped at an approximate elevation of 295 feet NAVD88. However, the levee has been modified consisting of a grade raise as well as a tie-in with the Missouri Department of Conservation's levee located at Ten Mile Pond Conservation Area (Figure 1.6). Recent analysis indicates that the levee is not constructed to USACE standards, has numerous culverts found throughout its length, and contains no pumping stations that would alleviate any impounded interior runoff on the protected side of the levee during periods of floods. Although this levee will provide some degree of flood risk reduction to an approximate elevation of 298 feet NAVD88, there is uncertainty regarding the amount of risk reduction that will be provided due to the levee construction and inability to alleviate impounded interior runoff as a result of precipitation. For the purposes of this FEIS, hydraulics and hydrology conditions assume analysis conducted prior to the levee raise are still valid. Additional discussion regarding the uncertainty of the levee and its associated risk is found in Section 6.

The existing 1.01-year flood frequency (99 percent chance annual exceedence) elevation is 279.3 feet NAVD88 and is mostly contained within the existing channels and ditches in the lower part of the watershed. Out of bank flood events follow the network of drainage ditches and first inundate the Eagle's Nest area located approximately 8 miles upstream from the 1,500-foot gap. Approximately 800 acres are inundated at an elevation of 281 feet NAVD88. Agricultural lands make up approximately 87 (or 11 percent) of these 800 acres. Flooding continues to follow the network of drainage ditches as Mississippi River stages rise. At an elevation of 284 feet NAVD88 floodwaters inundate portions of the Hubbard Lake area and Bogle Woods (Figure 1.5). Out of bank flooding occurs along Mud Ditch in the 1,500-foot gap at an elevation of 286 feet NAVD88.

Approximately 12,507 acres are inundated at an elevation of 288 feet NAVD88 (Figure 1.5). Agricultural lands make up 7,539 (or 60 percent) of these 12,507 acres. As can be seen from the figure, the majority of flooding occurs in the lowest elevation areas (*i.e.*, Holocene Mississippi River meander belts) within the floodway.

The existing 2-year flood frequency (50 percent chance annual exceedence) inundates lands at an elevation of 292.1 feet NAVD88 (Figure 1.5). Highway WW is overtopped at this elevation along with numerous county roads (404, 515, 518, and 521).

Approximately 33,000 acres are inundated at this elevation of which approximately 25,000 (or 76 percent) acres are agricultural. The perimeter levees surrounding Ten Mile Pond Conservation Area are overtopped.

Additional flooding continues to follow the network of drainage canals. The existing 5-year flood frequency (20 percent chance annual exceedence) elevation is 296.6 feet NAVD88 (Figure 1.5). There are approximately 60,000 acres inundated at this elevation. Agricultural lands make up approximately 48,130 (or 80 percent) of these 60,000 acres. Along with numerous county roads, portions of Highways VV, YY, FF, and 102 become inundated. Communities such as Bayouville become isolated.

As backwater flooding continues to rise, the Village of Pinhook[7] becomes isolated at the approximate 10-year flood elevation (298.7 feet NAVD88), which has a 10 percent chance annual exceedence (Figure 1.5). In addition to isolating Pinhook, there are approximately 71,000 acres inundated of which 60,000 acres (or 85 percent) are agricultural lands.

Additional backwater flooding continues to inundate large areas of the New Madrid Floodway. The 20 and 50-year flood frequency (5 percent and 2 percent chance annual exceedence, respectively) inundates lands at 300.5 and 302.5 feet NAVD88, respectively (Figure 1.5). These elevations inundate approximately 82,000 and 93,000 acres, respectively. Of these lands, over 83 percent are agricultural. All transportation corridors in the project area are inundated and portions of residential areas are inundated. Floods of this magnitude warrant mandatory evacuations should operation of the Birds Point-New Madrid Floodway be anticipated.

1.2.2.1 Agriculture Damages

Similar to the St. Johns Bayou Basin, flooding in the New Madrid Floodway imposes a stiff toll in foregone and lost economic opportunity. The major economic damage as a result of flooding in the New Madrid Floodway is to agricultural crop damages. Flooding destroys recently planted crops, inhibits yield, and delays re-planting. The average annual flood-related economic crop damage in the New Madrid Floodway is $7,187,000 (Appendix B).

Flooding also damages equipment, irrigation structures, and drainage structures. The average annual flood-related economic non-crop agricultural damage is $2,585,000, for a total of $9,772,000.

Flooding also constrains what crops may be planted, where, and when. In areas that are subject to frequent floods, instead of planting more profitable crops such as corn, producers are limited to less profitable late-season soybeans.

[7] As existed prior to the Flood of 2011.

1.2.2.2 Infrastructure Damages

Floods damage streets and roads. New Madrid Floodway experienced reduced average annual economic damages of $213,000 (Appendix B).

1.2.2.3 Social Impacts

The current population of the New Madrid Floodway is not known following the 2011 activation of the Birds Point-New Madrid Floodway. The Village of Pinhook has requested to be federally purchased and relocated at federal expense. In addition, the Village has requested that they be re-located as a single community. Three potential areas are being investigated, all within the St. Johns Bayou Basin in the vicinity of East Prairie, itself a community impacted by flooding. However, no plans or funding have been finalized or approved. Although the current population is not known, some residents have rebuilt within the floodway following its activation. Likewise, some residents have moved back into Pinhook. It is anticipated that with time and the infrequency of floodway operation, more residents would return. Regardless, the population of the floodway would remain relatively low. Similar to floods in the St. Johns Bayou Basin, roads are threatened to become inundated at an approximate elevation of 290 feet NAVD88. Based on the 67-year period of record studied, flood waters reach the 290-foot NAVD88 elevation in the New Madrid Floodway an average of 20.4 days per year.

Impacts related to health, drinking wells, and wastewater treatment is similar to that described for the St. Johns Bayou Basin discussed in Section 1.2.1.3. The major difference is the New Madrid Floodway has a smaller population and no waste water outfalls. Although the population in the New Madrid Floodway is less than what occurs in the adjacent St. Johns Bayou Basin, flooding isolates communities (Pinhook, Dorena, Wolf Island, Bayouville), impacts health, and damages drinking water wells (approximately 132 wells).

1.3 Criteria

1.3.1 Objectives

The Water Resources Council's Economic and Environment Principles for Water and Related Land Resources Implementation Studies (1983) (Principles) state:

> 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 orders, and other Federal planning requirements.
>
> Contributions to national economic development (NED) are the net increases, expressed in monetary units, in the value of the national output of goods and services. Contributions to NED thus reflect the direct net benefit of a civil works project that accrues in a planning area and throughout the rest of the nation.

> Federal water resources policy requires that a planning study must recommend adoption of the plan that contributes to NED ("the NED plan," as it is called), unless there are sufficient overriding reasons for recommending another plan.

Consistent with the Principles, the NED objective, and the project-specific and other civil works authorities granted to USACE by Congress, the following objectives were formulated:

- **Reduce the number of days that communities are isolated by flood waters.** This criterion was quantified by measuring the average number of days that roads are made impassable by flooding. Community isolation reduces economic vitality, governance, and public safety.

- **Reduce crop and non-crop agricultural damage.** This criterion was quantified in monetary units in terms of net benefit within the St. Johns Bayou Basin and within the New Madrid Floodway. Flood risk reduction creates economic benefit in a variety of ways:

    - Crops are not destroyed and fields do not have to be re-planted or re-fertilized.
    - Crops may be planted at optimal times for optimal yields.
    - Farm equipment, irrigation equipment, drainage networks, and other infrastructure are not damaged or disabled.
    - Wider varieties of crops and more profitable crops can be grown.

- **Reduce critical infrastructure damages to streets and roads.** This criterion was quantified in monetary units in terms of net benefits within the St. Johns Bayou Basin and the New Madrid Floodway. Street and road flooding result in damages that require repair. Thus, reducing floods would result in economic benefits. Likewise, reducing floods would prevent costly modifications necessary to keep traffic/commerce moving on Interstate 55.

1.3.2 Constraints

The following project constraints were used in the consideration and planning of project alternatives.

- **Preserve the benefits of the flood pulse.** This criterion was quantified utilizing non-monetary habitat units based upon the ecological resource analyzed, (*e.g.*, wetlands, waterfowl, fish spawning and rearing habitat).

- **Continued Operation of the Birds Point to New Madrid Floodway.** Features constructed and measures implemented in the St. Johns Bayou Basin and the New Madrid Floodway must not prevent, hinder, or delay utilization of the floodway for its congressionally-authorized purposes.

1.4 Project Review

As a consequence of the manner in which Congress directs USACE to act, by granting authority and appropriating funds to construct and operate civil works projects according to congressionally-approved plans and specifications, USACE uses the term "project," as in *St. Johns Bayou – New Madrid Floodway Project*, both as a term of art and according to its usual and customary meaning, and sometimes synonymously with the NEPA term "proposed action." The project review process described in this section pertains not merely to the congressionally-authorized Mississippi River Levees New Madrid Floodway closure levee (FCA 1954) and the *St. Johns Bayou – New Madrid Floodway Project* (WRDA 1986), as now configured, but also to the proposed action being assessed in this FEIS.

A project review plan was approved on 1 April 2009 that outlined different levels of review that would be conducted to complete the EIS. Review consisted of model review (Volume 3, Parts 6.1 – 6.4), conducted by nationally-recognized independent experts (*i.e.*, PhD in respective field of study with peer reviewed research publications) and USACE subject matter experts; Agency Technical Review (ATR), conducted by USACE personnel that are located outside of the Memphis District; inter-agency team coordination and review, conducted by the U.S. Environmental Protection Agency (EPA), U.S. Fish and Wildlife Service (USFWS), Missouri Department of Conservation (MDC), and Missouri Department of Natural Resources (MDNR); and Independent External Peer Review (IEPR), conducted by nationally-recognized experts in the fields of wetland ecology, waterfowl biology, shorebird ecology, fisheries biology, water quality, hydrologic and hydraulic engineering, economics, and NEPA.

1.4.1 Model Review

Models were required to quantify project impacts and benefits. All models were developed by subject matter experts and were independently reviewed by nationally-recognized experts. Contracts were awarded to Battelle Memorial, a global research and development organization, to manage the independent review. Battelle Memorial recruited nationally-recognized experts to serve on review panels and comment on the scientific validity of EnviroFish Version 1.0 (Volume 3, Part 6.1), Manual for Calculating Duck-Use-Days (Volume 3, Part 6.2), Delta Region of Arkansas Hydrogeomorphic Methodology Guidebook (Volume 3, Part 6.3), and Assessment of Shorebird Habitat Within the St. Johns Bayou Basin - New Madrid Floodway, Missouri (Volume 3, Part 6.4). Each model was reviewed separately. Comments received were addressed and all of the models have been certified or approved for project use by USACE. Additional information regarding how the models were applied can be found in Section 4.

1.4.2 Inter-agency Coordination and Review

Inter-agency coordination was initiated early in, and has been maintained throughout the course of, developing this FEIS. Issues addressed include the IEPR process, model review, scoping, the project work plan, alternatives, impact analysis, and mitigation measures.

1.4.3 Independent External Peer Review

The review plan prescribes a four-phased process of IEPR. IEPR is typically conducted at the conclusion of a project feasibility study or at the end of the environmental impact assessment (NEPA) process, but can be, and in this case was, commenced early in the NEPA process. Similar to the model review process, contracts were awarded to Battelle Memorial to autonomously manage the IEPR process and to independently obtain the necessary experts to serve throughout the IEPR process.

1.4.3.1 Phase 1 Independent External Peer Review

The first phase of IEPR reviewed prior USACE NEPA studies and made recommendations on the scope and content of future NEPA analyses. USACE briefed the IEPR panel in August 2009, providing a tour of the project area. Also attending the brief were the inter-agency team and representatives of the St. John Levee and Drainage District.

Battelle submitted the Phase 1 IEPR report on October 23, 2009. The report, which recommended an entirely new NEPA study, may be found in Volume 3, Part 2.

1.4.3.2 Phase 2 Independent External Peer Review

The second phase of IEPR focused on a Project Work Plan, prepared by USACE, outlining proposed assumptions, alternatives, methodologies, mitigation strategies, and ecological models to be used in a new EIS.

The proposed Work Plan was submitted to the inter-agency team in December 2009 and again, as revised, in February 2010. The Work Plan, along with inter-agency team comments, was then submitted to the IEPR panel.

Battelle submitted the Phase 2 IEPR report on 28 April 2010, after which a lengthy dialog occurred between USACE and the IEPR panel, in which the inter-agency team participated. An addendum to the Phase 2 report, dated 5 November 2010, documents the extensive collaboration among USACE, the IEPR panel, and the inter-agency team. The full report, with addendum, may be found in Volume 3, Part 3.

1.4.3.3 Phase 3 Independent External Peer Review

Utilizing the methodologies described in the Project Work Plan, as revised in Phase 2, a proposed draft EIS was prepared in July 2011. Following ATR and further inter-agency team review, the proposed draft EIS and inter-agency team comments were submitted to the IEPR panel. Battelle submitted the Phase 3 IEPR report on 8 December 2011, after which another lengthy dialog occurred between USACE and the IEPR panel on the panel's 27 comments and recommendations. The report, with all supporting material, may be found in Volume 3, Part 4.

1.4.3.4 Phase 4 Independent External Peer Review (RESERVED)

1.5 Scoping Process

The scoping process consisted of publishing a Notice of Intent (NOI) in the Federal Register, conducting a public scoping meeting, and numerous inter-agency communications throughout the development of the draft FEIS.

1.5.1 Notice of Intent

A NOI to prepare an EIS was published in the Federal Register on 6 April 2010 (Federal Register Volume 75, Number 65, pages 17393-17394). The NOI is included in Volume 2, Part 1. The NOI also served as a request for public scoping input and encouraged all interested parties to participate in the scoping process, including the public scoping meeting.

1.5.2 Public Scoping Meeting

A public scoping meeting was held on 11 May 2010 in East Prairie. The purpose of the meeting was to inform the public about the proposed action and to gather input on issues to be addressed in an EIS. Ninety-two persons attended the meeting, which began with a brief presentation on the history of the project, proposed construction and other features, and the purpose of NEPA and public scoping. The St. John Levee and Drainage District also made a statement on its role as project sponsor.

Following the presentations, the attendees were divided into three groups to facilitate comments. Information on the scoping process, including comments received, may be found in Volume 2, Part 1. A list of relevant issues and resources identified can be found in Section 1.7.

1.6 NEPA Public Review

The public has an important role in the NEPA process, particularly during scoping, in providing input on what issues should be addressed in an EIS and in commenting on the findings in an agency's NEPA documents. The public can participate in the NEPA process by attending NEPA-related hearings or public meetings and by submitting comments directly to the lead agency. USACE must take into consideration all comments received from the public and other parties on NEPA documents during the comment period.

1.6.1 Notice of Availability

The St. Johns Bayou and New Madrid Floodway Project draft Environmental Impact Statement (EIS) was filed with the U.S. Environmental Protection Agency. A Notice of Availability was published in the Federal Register on 26 July 2013, to begin the 45-day public review period pursuant to regulations of the President’s Council on Environmental

Quality for implementing NEPA (40 CFR Parts 1500-1508). In response to requests from Federal and State agencies, as well as from NGO's, USACE extended the public review period to 25 November 2013.

1.6.2 Public Meetings

USACE held two public meetings on the St. Johns Bayou and New Madrid Floodway Project draft EIS on 27 and 28 August 2013. Each meeting was divided into two parts. The first part consisted of an open house and project information was on display for public viewing. USACE staff was on hand to address questions. Following the open house, USACE provided a project overview and attendees provided public testimony.

1.6.2.1 East Prairie, Missouri

The first of two public meetings on the St. Johns Bayou and New Madrid Floodway Project draft EIS was held on 27 August 2013, in East Prairie, Missouri. Eighty-eight individuals registered on contact forms provided at the meeting and 17 individuals provided public testimony (comments from the meeting are located in Volume 2, Part 3).

1.6.2.2 Cairo, Illinois

The second of two public meetings on the St. Johns Bayou and New Madrid Floodway Project draft EIS was held on 28 August 2013, in Cairo, Illinois. Thirty-eight individuals registered on contact forms provided at the meeting and 11 individuals provided public testimony (comments from the meeting are located in Volume 2, Part 3).

1.6.3 Comments Received

A total of 23,381 individual comments were received from 920 comment submittals. The individual comments were distributed into 26 themes (e.g., fisheries, waterfowl, and wetlands). Responses to comments received on the DEIS are provided in Volume 2, Part 3.

1.7 Relevant Issues and Resources

The issues for impact analysis identified through the IEPR process, public scoping, and inter-agency coordination are of four kinds: residents' hardships and quality of life, the local economy, agriculture, and fish and wildlife. Table 1.3 lists these and identifies where in this FEIS they are discussed.

Table 1.3. Relevant issues, resources, and concerns, St. Johns Bayou Basin and New Madrid Floodway, Missouri.

Category	Issue	Section
Resident Hardships	Social	3.6
Quality of Life	Community Isolation	1.2.1.3, 1.2.2.3, 3.6.3.1
	Health	3.6.3.2
	Minority and Low Income Populations	3.17 and 4.17
	Decline of Local Populations	3.6.2
	Recreation	3.14 and 4.14
	Drinking Water Sources	3.6.3.3
	Waste Water Treatment	3.6.3.4
Local Economy	Economics	3.7 and 4.7
	Residential	3.7.1
	Roads and Infrastructure	3.7.1
Agricultural	Agriculture	3.3.1, 3.7.2, and 4.3.1
Ecological	Wetlands	3.8.1 and 4.8.1
	Terrestrial Wildlife	3.8.2 and 4.8.2
	Waterfowl	3.8.3 and 4.8.3
	Shorebirds	3.8.4 and 4.8.4
	Fish (Spawning and Rearing Habitat)	3.8.5 and 4.8.5.1
	Fish Access	3.8.5 and 4.8.5.3
	Freshwater Mussels	3.9.1 and 4.9.1
	Water Quality	3.10 and 4.10
	River Connectivity	3.5 and 3.8
	Ecosystem Services	3.12 and 4.12
	Ditch Habitat	3.11 and 4.11
Cultural Resources	Cultural	3.13 and 4.13

2.0 ALTERNATIVES

This section describes the process used to develop, screen, eliminate, and evaluate alternatives for implementing the proposed action. The alternative development process begins by identifying a wide array of preliminary alternatives and then, by application of carefully formulated selection criteria, establishing a reasonable range of feasible alternatives.[8] Described in this chapter are nine alternatives that were carried forward for detailed analysis, including the required no action alternative, and the process by which they were selected. These are:

- St. Johns Bayou Basin
    - A1: no action
    - A2: authorized project
    - A3: authorized project with avoid and minimize measures
- New Madrid Floodway
    - B1: no action
    - B2: authorized project
    - B3: authorized project with avoid and minimize measures (manage connectivity)
        - B3.1: manage connectivity scenario 1
        - B3.2: manage connectivity scenario 2
    - B4: authorized project with avoid and minimize measures (maintain connectivity)
        - B4.1: maintain connectivity scenario 1
        - B4.2: maintain connectivity scenario 2

Alternative A3 in the St. Johns Bayou Basin and B3.1 in the New Madrid Floodway, is the recommended plan for project planning purposes.

2.1 Preliminary Flood Risk Reduction Alternatives

A variety of structural and non-structural preliminary alternatives that reduce flood risk were developed as means to address one or more of the planning objectives. These preliminary alternatives were drawn from previous engineering and environmental

[8] A reasonable alternative is one that achieves the project's purpose and need.

studies, congressional authorizations, input received from public scoping, the results of inter-agency collaboration, and recommendations of the IEPR panel. The preliminary alternatives underwent a screening process that analyzed each preliminary alternative separately and as combinations. From this screening process, a number of alternatives were formulated that underwent detailed analysis.

2.1.1 St. Johns Bayou Basin Structural Preliminary Alternatives

2.1.1.1 St. Johns Bayou Basin Pumping Station

Pumping stations are a common, highly effective method of flood risk reduction in the Lower Mississippi Valley. For example, pumping stations have been constructed in the upper portion of the St. Johns Bayou Basin (Drinkwater Pumping Stations #1 and #2), in the upper portion of the New Madrid Floodway (Peafield Pumping Station), in the City of Cairo, Illinois, and in the City of Hickman, Kentucky. In the St. Johns Bayou Basin, pumping stations remove impounded water from the basin during periods in which outlet structure gates are closed due to high water in the Mississippi River. As discussed in Section 1, closing the St. Johns Bayou outlet structure does prevent backwater flooding from the Mississippi River, but it prevents the out-flow of water from the basin creating a bathtub effect. The resulting flooding (also referred to as impounded interior runoff) is exacerbated by any rainfall that occurs while the gates remain closed.

Initial planning for a pumping station began with the Chief of Engineers Report of 26 September 1975, and the Environmental Impact Statement *St. Johns Bayou and New Madrid Floodway, Missouri,* filed with the Council on Environmental Quality on 2 June 1976. The Water Resources Development Act of 1976 authorized USACE to undertake advanced engineering and design culminating in a Phase 1 General Design Memorandum (GDM). The resulting Chief of Engineers report was submitted to the Secretary of Army on 4 January 1983, and a Record of Decision was signed on 5 January 1983.

The Water Resources Development Act of 1986 authorized its construction. A Limited Reevaluation Review was completed in 1997 and did not modify its design. Previous studies and modeling are valid. Therefore, no modifications to the pumping station design were made for the purpose of this FEIS.

2.1.1.2 St. Johns Bayou Basin Ditch Modifications

Agricultural ditches in the St. Johns Bayou Basin are not of sufficient capacity to carry flood waters that rise within the basin during periods of heavy rainfall under conditions in which the St. Johns Bayou outlet structure is closed (during high Mississippi River stages) or open (Mississippi River non-flood period). In addition to a pumping station, previous USACE studies (Phase 1 GDM, 1983 Chief of Engineers Report, and Phase 2 GDM) analyzed modifying ditches as another means of alleviating the risk and consequences of such flooding. Modifications include channel enlargement and vegetative clearing. Enlargement entails increasing the bottom and/or top widths of ditches so they can carry a greater volume of flood water. Vegetative growth in and

along the channels inhibit effective drainage. Vegetative clearing entails removing trees and other vegetation along the channel banks to ensure drainage is not inhibited.

From these previous studies, proposals were developed to clear vegetation on 18.8 miles of rural channels and 3.0 miles of urban channel, and enlarge 93.3 miles of rural channels and 3.7 miles of urban channel. The combined 118.8 miles of modifications would protect against a 2-year flood (50 percent chance annual exceedence) in all areas except Sikeston, Missouri, where the level of protection would handle a 1.1-year flood (99 percent chance annual exceedence) involving agricultural lands and a 5- to 7.5-year flood (20 and 13 percent chance annual exceedence, respectively) involving urban areas. Additional information regarding the specific ditches and reaches can be found in the Phase 2 GDM.

The 1997 Limited Reevaluation Report examined the previous authorized proposals that would offer immediate benefit to East Prairie and vicinity (referred to as Phase 1 features or East Prairie Phase features). To help reduce flooding in and around East Prairie, channel enlargement and drainage improvements would only be constructed along the lower 4.5 miles of St. Johns Bayou, beginning at New Madrid, continue along Setback Levee Ditch, and extend 10.8 miles along St. James Ditch. Selective clearing and snagging has already been completed along a 4.3-mile reach of Setback Levee Ditch beginning at the confluence with St. James Ditch.

2.1.1.3 East Prairie, Missouri Ring Levee

A ring levee would be constructed surrounding East Prairie, Missouri. The levee would protect the city from high water on St. James Ditch and Lateral 2 to a 25-year flood (4 percent chance annual exceedence).

This agriculture-oriented city of 3,227 people, which was designated an Enterprise Community in 1994, lies entirely above the 300-foot elevation. Therefore, flooding in the city occurs primarily as a result of two factors - high water in St. James Ditch and Lateral 2 (*i.e.*, headwater flooding) and poor drainage, mainly the result of a deficient storm water sewer system. Headwater flooding in East Prairie does not result directly from closure of the St. Johns Bayou outlet structure, but closure is a contributing factor. Heavy rainfall and Mississippi River floods frequently occur at the same time; and thus, the bathtub effect is created by closing the St. Johns Bayou outlet structure.

Since 2006, four sewer collapses have caused flooding in East Prairie (EPA, 2009). EPA has awarded the City of East Prairie $194,000 for improvements to its existing storm water system. These improvements will alleviate flooding as a result of the deficient storm water system. Therefore, remaining flooding occurs primarily from high water in St. James Ditch and Lateral 2 as a result of headwater floods and compounded by closing the St. Johns Bayou outlet structure.

2.1.2 St. Johns Bayou Basin Non-Structural Preliminary Alternatives

2.1.2.1 St. Johns Bayou Basin Fish and Wildlife Refuge

This preliminary alternative involves the purchase in fee of low-lying portions of the St. Johns Bayou Basin that are flood prone for use as a wildlife refuge or conservation area.

A similar plan was investigated by USFWS in 1993 with USACE serving as a cooperating agency. The USFWS proposal called for the purchase of 11,425 acres of land in the St. Johns Bayou Basin (bounded on the north by County Road P, on the west by the Farrenburg Levee, and on the east/southeast by the Setback Levee) and re-foresting it. However, the local community did not support the proposal, which meant that land for a refuge could not be obtained through purchase. Consequently, the proposal was considered unachievable by the USFWS and was eliminated from further consideration.

Although the previous USFWS proposal was non-implementable, USACE was requested to re-analyze the proposal as a preliminary alternative. Flood damages occur to agricultural areas and a refuge would remove the agricultural area. Thus, the flood damage would be removed and a flood risk reduction benefit could be quantified according to the project's purpose.

2.1.2.2 Expanded St. Johns Bayou Basin Fish and Wildlife Refuge

This preliminary alternative would expand the proposed refuge/conservation area to 20,407 acres (approximately 14,327 agricultural acres), by making it coextensive with the 5-year flood frequency elevation (20 percent chance annual exceedence). The previous USFWS proposal did not consider flood frequency as a factor in the establishment of boundaries. Therefore, under the previous USFWS proposal, damage would occur to other agricultural areas at or below the elevation of the refuge. This expanded refuge preliminary alternative would cover all agricultural lands at or below the elevation of 294.1 feet NGVD29, the level of the 5-year flood frequency (20 percent chance annual exceedence) in the St. Johns Bayou Basin. Therefore, the flood damage would be removed from 14,327 acres of agricultural lands and a flood risk reduction benefit could be quantified according to the project's purpose.

2.1.2.3 St. Johns Bayou Basin - Agriculture to Silviculture

This preliminary alternative would convert frequently flooded agricultural land within the 5-year flood frequency (20 percent chance annual exceedence) to silviculture by means of a program similar to the Wetland Reserve Program (WRP) administered by the Natural Resources Conservation Service (NRCS). As previously stated, converting agriculture to silviculture would remove the flood damage since trees can tolerate flooding. Although this preliminary alternative is similar to the refuge preliminary alternative, it does not purchase land in fee. Instead, an easement would be obtained and lands would remain in private ownership with the opportunity to harvest timber.

USACE, or the program agency, would obtain a conservation easement on 14,327 acres of agricultural lands located within the St. Johns Bayou Basin's 5-year flood frequency elevation (20 percent chance annual exceedence).

2.1.2.4 St. Johns Bayou Basin - Convert Non-Flood Tolerant Crops to Flood Tolerant Crops

This preliminary alternative would convert agricultural commodities from mostly soybeans to switchgrass by means of a restrictive easement. Soybeans are the dominant crop grown within the 5-year flood frequency (20 percent chance annual exceedence) because they can be planted later in the growing season to manage flood risk. However, late planting reduces yield. For example, delaying planting until June could result in a loss of one bushel per acre per week and delaying until July could result in a loss of three bushels per week (Helsel and Minor, 1993). Although new technologies have recently been developed for alternative/renewable energy sources such as lignocellulose feedstock with agricultural commodities like switchgrass, implementation of those features is slow due to limited markets and competition with other more profitable crops. Several varieties of switchgrass are flood tolerant and could conceivably be grown in the project area.

Similar to the proposal to convert agriculture to silviculture within the 5-year floodplain (20 percent chance annual exceedence), this preliminary alternative would convert frequently flooded agricultural lands (within the five-year flood frequency (20 percent chance annual exceedence)) to switchgrass production by means of a program similar to the USDA's Commodity Credit Corporation (CCC) Biomass Crop Assistance Program (Sections 9001 and 9011, Food, Conservation, and Energy Act of 2008).

2.1.2.5 St. Johns Bayou Basin - Nutrient Trading

This preliminary alternative would establish a nutrient trading program to provide additional incentives to landowners to convert from agriculture to silviculture. Nutrient trading is essentially the transfer of pollution reduction credits from one source to another (Greenhalgh and Faeth 200, Latane and Stephenson 2011). If a source has reduced its effluent for a given variable (for example, phosphorus) below what it is otherwise required, additional reductions may be available to sell in the form of credits. Alternatively, a source that cannot reduce its effluent to the level required has the option of buying credits made available by another source. When done properly, trading can be a very effective way to balance resources within a watershed.

The preliminary alternative would obtain a conservation easement on 14,327 acres of agricultural lands within the 5-year flood frequency (20 percent chance annual exceedence) and provide additional income as a result of a nutrient trading program. Thus, the flood damage would be removed by the conversion to trees and additional income would be provided to the landowner as a result of nutrient trading credits.

2.1.2.6 East Prairie, Missouri - Relocations

This preliminary alternative would relocate 646 structures (homes, buildings, government buildings, etc.) in East Prairie that are subject to flooding and relocate them to an area that has less risk of floods.

2.1.2.7 St. Johns Bayou Basin - Raise Road Surface Elevations

This preliminary alternative would raise the surface elevation of 17 miles of roads in the St. Johns Bayou Basin, including Interstate 55. Community isolation as a result of flooding of streets and roads was a major concern conveyed during the public scoping meeting. Therefore, this preliminary alternative would involve raising the surface elevation of roads to allow for travel during periods of floods. Raising roads is considered a non-structural solution because it does not involve a structure to prevent the flood. Floods would still occur.

2.1.3 New Madrid Floodway Structural Preliminary Alternatives

2.1.3.1 Construct a Levee Completing the New Madrid Floodway

As authorized by the Flood Control Act of 1954 and stated in the 1957 Phase 1 General Design Memorandum, a closure levee would be constructed at the 1,500-foot gap in the New Madrid Floodway; and four 10-foot by 10-foot gated box culverts would be constructed in the levee as a gravity outlet structure for Mud Ditch. The gates would be managed in a fashion similar to the St. Johns Bayou outlet structure; they would be closed when the level of the Mississippi River is higher than the elevation of the interior sump and would be re-opened when the river level fell below the interior sump elevation.

2.1.3.2 Alternative New Madrid Floodway Closure

Figure 2.1 shows other locations where a levee might be built to close the New Madrid Floodway gap. The lengths of these levees would be 6,500 feet and 18,500 feet, respectively. The levees would have a gravity outlet structure in Mud Ditch consisting of four 10-foot by 10-foot gated box culverts. Alternate levee closures would result in maintaining a greater area of connectivity between the New Madrid Floodway and the Mississippi River.

2.1.3.3 New Madrid Floodway Pumping Station

Due to the risks and effects of internal flooding that would occur if a levee were constructed to close the New Madrid Floodway gap (i.e., when the Mud Ditch outlet structure gates had to be closed to prevent backwater flooding), the Water Resources Development Act of 1986 authorized the construction of a pumping station. A Limited Reevaluation Review was completed in 1997 and did not modify its design. Previous

studies and modeling are valid. Therefore, no modifications were made for the purpose of this FEIS.

2.1.4 New Madrid Floodway Non-Structural Preliminary Alternatives

2.1.4.1 New Madrid Floodway Fish and Wildlife Refuge

This preliminary alternative involves the purchase in fee of low-lying portions of the New Madrid Floodway for use as a wildlife refuge or conservation area. The previous USFWS plan for a refuge in the St. Johns Bayou Basin also included the purchase of approximately 5,175 acres of land in the New Madrid Floodway. The local community did not support the proposal, and consequently, the proposal was considered unachievable by the USFWS and was eliminated from further consideration.

Although the previous USFWS proposal was non-implementable, USACE was requested to re-analyze the proposal as a flood risk reduction alternative. Flood damages occur to agricultural areas. A refuge would remove the agricultural area. Thus, the flood damage would be removed and a flood risk reduction benefit could be quantified according to the project's purpose.

2.1.4.2 Expanded New Madrid Floodway Fish and Wildlife Refuge

Similar to the St. Johns Bayou Basin expanded refuge preliminary alternative, the size of the New Madrid Floodway refuge would be expanded to the 5-year flood frequency elevation (20 percent chance annual exceedence). The 5-year flood frequency (20 percent chance annual exceedence) corresponds to an elevation of 296.6 feet NAVD88 in the New Madrid Floodway. This corresponds to approximately 58,990 acres (approximately 48,130 agricultural acres). Therefore, the flood damage would be removed from 48,130 acres of agricultural lands; and a flood risk reduction benefit could be quantified according to the project's purpose.

2.1.4.3 New Madrid Floodway - Agriculture to Silviculture

This preliminary alternative would convert agricultural land within the 5-year flood frequency (20 percent chance annual exceedence) to silviculture by means of a program similar to the WRP administered by the NRCS. As previously stated, converting agriculture to silviculture would remove the flood damage since trees can tolerate flooding. Although this preliminary alternative is similar to the refuge feature, it does not purchase land in fee. Instead, an easement would be obtained and lands would remain in private ownership with the opportunity to harvest timber. USACE, or the program agency, would obtain a conservation easement on 48,130 acres of agricultural lands located within the New Madrid Floodway's 5-year flood frequency elevation (20 percent chance annual exceedence).

2.1.4.4 New Madrid Floodway - Convert Non-Flood Tolerant Crops to Flood Tolerant Crops

Similar to the preliminary alternative proposed in the St. Johns Bayou Basin, this preliminary alternative would convert agricultural commodities within the 5-year flood frequency elevation (20 percent chance annual exceedence) from mostly soybeans to switchgrass by means of a restrictive easement.

2.1.4.5 New Madrid Floodway - Nutrient Trading

Nutrient trading was previously discussed in 2.3.1.2.5. The same type of program would be established within the 5-year flood frequency elevation (20 percent chance annual exceedence) of the New Madrid Floodway.

2.1.4.6 New Madrid Floodway - Relocations

As previously discussed, the current population of the New Madrid Floodway is not known following the 2011 activation. Although some residents have moved back and there will likely be more, there is currently no reliable information regarding the present number of structures within the New Madrid Floodway. Likewise, the floodway will continue to be operated in the future. Therefore, any repopulation of the floodway would be subject to future evacuations.

2.1.4.7 New Madrid Floodway – Raise Road Surface Elevations

This preliminary alternative would raise the surface elevation of 19 miles of roads in the New Madrid Floodway. Although any repopulation of the floodway would still be subject to future evacuation in the event of floodway activation, isolation would still occur at more frequent, less destructive floods. Therefore, this preliminary alternative would involve raising the surface elevation of roads to allow for travel during periods of floods. Raising roads is considered a non-structural solution because it does not involve a structure to prevent the flood. Floods would still occur.

2.2 Screening process

To demonstrate consideration of a reasonable range of feasible alternatives, preliminary alternatives underwent an iterative screening process to determine alternatives that would be carried into detailed analysis. Reasonable alternatives include those that are economically and technically feasible, focusing on the accomplishment of the underlying project objectives and constraints. The following screening process was used to assess the overall characteristics of each preliminary alternative resulting in the selection of the reasonable range of alternatives that were considered in-detail.

Screening Process Step 1 evaluated preliminary alternatives to see if they met any of the project objectives. Preliminary alternatives that did not meet any project objective were eliminated from further analysis.

Screening Process Step 2 combined preliminary alternatives that were subsequently reviewed against project objectives. Combined preliminary alternatives that were inconsistent with one another were rejected in this step.

Screening Process 3 developed preliminary costs to look at the cost-effectiveness of each preliminary alternative/combination of preliminary alternatives. Since USACE policy requires a positive benefit to cost for implementation, preliminary alternatives and or combinations that did not have a positive benefit to cost were rejected in this step.

Screening Process Step 4 looked at avoid and minimize measures that could reduce the environmental impacts of the preliminary alternatives/combination of preliminary alternatives, in consideration of social and cost effectiveness.

Screening Process Step 5 selected a final range of alternatives for detailed review by validating that the remaining alternatives satisfy the project criteria (*i.e.*, objectives and constraints).

2.2.1 Iterative Screening Process Step 1

The first iterative screening process evaluated the ability of the individual preliminary alternatives to achieve the project objectives (see Section 1.3.1). Tables 2.1 and 2.2 show the proposed preliminary alternatives and associated objective that each preliminary alternative addresses for the St. Johns Bayou Basin and New Madrid Floodway, respectively.

Table 2.1. St. Johns Bayou Basin preliminary alternatives and project objectives.

Preliminary alternative	Reduce Community Isolation	Reduce Agricultural Flood Damages	Reduce Street and Road Flood Damages	Retain for Screening
St. Johns Bayou Basin Pumping Station	X	X	X	Y
St. Johns Bayou Basin Ditch Modifications	X	X	X	Y
East Prairie Ring Levee			X	Y
St. Johns Bayou Basin Fish and Wildlife Refuge		X		N
St. Johns Bayou Basin Expanded Fish and Wildlife Refuge		X		Y
St. Johns Bayou Basin Agriculture to Silviculture		X		Y
St. Johns Bayou Basin Crop Conversion		X		Y
St. Johns Bayou Basin Nutrient Trading				N
St. Johns Bayou Basin Relocations	X			Y
St. Johns Bayou Basin Raise Roads	X			Y

Table 2.2. New Madrid Floodway preliminary alternatives and project objectives.

Preliminary alternative	Reduce Community Isolation	Reduce Agricultural Flood Damages	Reduce Street and Road Flood Damages	Retain for Screening
New Madrid Floodway Authorized Closure Levee	X	X	X	Y
New Madrid Floodway Alternate Levee Locations	X	X	X	Y
New Madrid Floodway Pumping Station	X	X	X	Y
New Madrid Floodway Fish and Wildlife Refuge		X		N
New Madrid Floodway Expanded Fish and Wildlife Refuge		X		Y
New Madrid Floodway Agriculture to Silviculture		X		Y
New Madrid Floodway Crop Conversion		X		Y
New Madrid Floodway Nutrient Trading				N
New Madrid Floodway Relocations	X			Y
New Madrid Floodway Raise Roads	X			Y

With the exception of nutrient trading, all preliminary alternatives achieve at least one project objective. Therefore, nutrient trading was not retained for further analysis. However, since the project area is mostly agricultural, implementation of other preliminary alternatives would not preclude future implementation of a nutrient trading program in the area.

Wildlife refuges previously analyzed by the USFWS were not retained for additional screening. Although these preliminary alternatives could reduce agricultural flood damages, they would only reduce the damages in the confines of the refuge itself. Therefore, there will be remaining damages outside the refuge boundary on lands that are found at a similar elevation. Because there would be remaining agricultural damages outside the refuge boundary, USACE deemed the expanded refuge preferable to the smaller refuge size to be analyzed in additional screening.

2.2.2 Iterative Screening Process Step 2

The next step in the iterative screening process was to combine individual preliminary alternatives to achieve multiple project objectives. For example, non-structural preliminary alternatives such as wildlife refuges and crop conversions reduce agricultural damages but they do not prevent community isolation. Likewise, raising the surface elevation of roads prevent community isolation but does not reduce agricultural flood damages. Therefore, single preliminary alternatives were combined to achieve multiple objectives.

St. Johns Bayou Basin

Table 2.3 suggests how various preliminary alternatives could be combined and indicates whether or not they were retained for further screening.

Table 2.3. St. Johns Bayou Basin combined preliminary alternatives.

Preliminary Alternative	SJB Pumping Station	SJB Ditch Modifications	East Prairie Ring Levee	SJB Expanded Fish and Wildlife Refuge	SJB Agriculture to Silviculture	SJB Crop Conversion	SJB Relocations	SJB Raise Roads
SJB Pumping Station	-	Y	N	N	N	N	N	N
SJB Ditch Modifications	Y	-	N	N	N	N	N	N
East Prairie Ring Levee	N	N	-	Y	Y	Y	N	Y
SJB Expanded Fish and Wildlife Refuge	N	N	Y	-	N	N	Y	Y
SJB Agriculture to Silviculture	N	N	Y	N	-	N	Y	Y
SJB Crop Conversion	N	N	Y	N	N	-	Y	Y
SJB Relocations	N	N	N	Y	Y	Y	-	Y
SJB Raise Roads	N	N	Y	Y	Y	Y	Y	-

The bullets below explain the reasoning used to determine if the preliminary alternatives were retained or not retained for further screening.

- St. Johns Bayou Basin Pumping Station – The only other preliminary alternative combined with the St. Johns Bayou Basin pumping station was ditch modifications. Construction of a pumping station achieves all of project objectives for the St. Johns Bayou Basin. Thus, there would be no need to combine this preliminary alternative with other preliminary alternatives such as raising roads, relocations, etc. The pumping station and ditch modifications

can be combined because both of these preliminary alternatives complement one another. For example, ditches can be modified to quickly remove flood waters in the vicinity of East Prairie and the pumping station can pump the floodwaters over the levee during period of Mississippi River floods when the gates are closed.

- St. Johns Bayou Ditch Modifications – Ditch modifications cannot be combined with any other measures with the exception of the pumping station. Any channel modifications without a pumping station would compound the impounded interior runoff problem at the structure because of the increase in drainage (timing). For example, a combination of ditch modifications and raising road elevations would reduce flood damages on agricultural lands due to headwater flooding as well as prevent community isolation. However, this would compound the impounded interior runoff problem when the St. Johns Bayou outlet structure is closed. Therefore, ditch modifications were only combined with a pumping station and not retained as a stand-alone alternative.

- East Prairie Ring Levee – There is no need to construct a ring levee around East Prairie if a pumping station were constructed. Likewise, there is no need to relocate East Prairie if a ring levee is constructed. Therefore, the East Prairie ring levee was combined with non-structural preliminary alternatives for further screening.

- St. Johns Bayou Basin Expanded Refuge – Since the refuge would be located within the 5-year flood frequency elevation (20 percent chance annual exceedence), there is no need for other flood risk reduction features on agricultural areas. Therefore, the refuge feature was combined with the ring levee, relocations, and raising roads.

- St. Johns Bayou Agriculture to Silviculture – Since all agricultural lands in the 5-year flood frequency (20 percent chance annual exceedence) would be converted to silviculture there is no need for other flood risk reduction features (e.g., pump station) for agricultural areas at higher elevations (consequently less annual damages) because the benefits would likely not justify the additional costs. Therefore, the preliminary alternative was combined with the ring levee, relocations, and raising roads.

- St. Johns Bayou Crop Conversion – Since all agricultural lands in the 5-year flood frequency (20 percent chance annual exceedence) would be converted to a flood tolerant crop, there is no need for other flood risk reduction features on agricultural areas. Therefore, the preliminary alternative was combined with the ring levee, relocations, and raising roads.

- St. Johns Bayou Relocations – Relocations were combinable with all other preliminary alternatives except the pumping station (no longer necessary if a pumping station is constructed), ditch modifications, or a ring levee.

- St. Johns Bayou Road – Raising roads was combinable with all other preliminary alternatives except the pumping station, ditch modifications, and the ring levee.

New Madrid Floodway

Table 2.4 suggests how various preliminary alternatives could be combined and indicates whether or not they were retained for further screening.

Table 2.4. New Madrid Floodway combined preliminary alternatives.

Preliminary Alternative	NMF Authorized Closure Levee	NMF Alternate Levee Locations	NMF Pumping Station	NMF Expanded Fish and Wildlife Refuge	NMF Agriculture to Silviculture	NMF Crop Conversion	NMF Relocations	NMF Raise Roads
NMF Authorized Closure Levee	-	N	Y	N	N	N	N	N
NMF Alternate Levee Locations	N	-	Y	N	N	N	N	N
NMF Pumping Station	Y	Y	-	N	N	N	N	N
NMF Expanded Fish and Wildlife Refuge	N	N	N	-	N	N	N	Y
NMF Agriculture to Silviculture	N	N	N	N	-	N	N	Y
NMF Crop Conversion	N	N	N	N	N	-	N	Y
NMF Relocations	N	N	N	N	N	N	-	N
NMF Raise Roads	N	N	N	Y	Y	Y	N	-

The bullets below explain the reasoning used to determine if the features were retained or not retained for further screening.

- New Madrid Floodway Authorized Closure Levee – Due to the problem associated with impounded interior runoff, the closure levee has to be combined with a pumping station. Constructing the closure levee and pumping station make all other preliminary alternatives unnecessary. Therefore, no other preliminary alternatives were combined.

- New Madrid Floodway Alternate Levee Locations – Similar to the authorized location, the closure levee has to be combined with a pumping station. All other preliminary alternatives are unnecessary.

- New Madrid Floodway Pumping Station – There is no benefit to the project area by a pumping station without the attendant closure levee as backwater would continue to flood the area. Therefore, a pumping station was only combined with a closure levee.

- New Madrid Floodway Expanded Refuge – Since the refuge would be located within the 5-year flood frequency elevation (20 percent chance annual exceedence), there is no need for other preliminary alternatives on agricultural areas. Therefore, the refuge preliminary alternative was combined with raising roads.

- New Madrid Floodway Agriculture to Silviculture – Since all agricultural lands in the 5-year flood frequency (20 percent chance annual exceedence) would be converted to silviculture; there is no need for other flood risk reduction features (e.g., pump station) for agricultural areas at higher elevations (consequently less annual damages) because the benefits would likely not justify the additional costs. Therefore, the preliminary alternative was combined with raising roads.

- New Madrid Floodway Crop Conversion – Since all agricultural lands in the 5-year flood frequency (20 percent chance annual exceedence) would be converted to a flood tolerant crop, there is no need for other flood risk reduction features on agricultural areas. Therefore, the preliminary alternative was combined with raising roads.

- New Madrid Floodway Relocations – Although relocations are combinable with other preliminary alternatives, they were not retained because the current amount of structures is unknown following the activation of the floodway; and any population that moves back into the floodway would still be subject to evacuation in the event the floodway has to be activated. Thus, relocations in the New Madrid Floodway were not considered.

- New Madrid Floodway Roads – Raising roads was combinable with all other preliminary alternatives except the closure levee and pumping station.

2.2.3 Iterative Screening Process Step 3

The next step in the screening process was to develop preliminary costs and benefits. Only those preliminary alternatives or a combination of preliminary alternatives that had a positive benefit to cost ratio were carried forward for additional screening.

St. Johns Bayou Basin

Tables 2.5 and 2.6 provide the preliminary costs and benefits for the St. Johns Bayou Basin preliminary alternatives and combined preliminary alternatives, respectively. A discussion follows.

Table 2.5. Preliminary costs and benefits, St. Johns Bayou Basin preliminary alternatives.

Preliminary Alternative	St. Johns Bayou Basin ($000's)		
	Annual Cost	Annual Benefit	Benefit/Cost
SJB Pump Station and Channel Modification	2,895	6,911	2.4
East Prairie Ring Levee	325	238	0.7
SJBB Refuge	3,516	1,622	0.5
SJBB Conversion to Silviculture	2,816	1,209	0.4
SJBB Conversion to Flood Tolerant Crops	3,165	1,002	0.3
SJBB Relocations	1,954	236	0.12
SJBB Roads (Excludes I-55)	4,986	149	0.03

The only preliminary alternative that had a positive benefit to cost ratio was the St. Johns Bayou pumping station and the channel modifications. Relocation and roads annual costs provided in Table 2.5 are conservative estimates. It is very likely that due to site-specific considerations like bridges, culverts, relocation of businesses and governmental buildings, the actual costs could be substantially greater. The resulting economic analysis does not indicate that these preliminary alternatives have any potential to be recommended.

Table 2.6. Preliminary costs and benefits, St. Johns Bayou Basin combined preliminary alternatives.

Combined Preliminary Alternatives	Annual Cost ($000)	Annual Benefit ($000)	Benefit/Cost
SJ Pump Station and Channel Modification	2,895	6,911	2.4
Ring Levee, Refuge	3,841	1,860	0.5
Ring Levee, Silviculture	3,141	1,447	0.5
Ring Levee, Flood Tolerant Crops	3,490	1,240	0.4
Ring Levee, Roads	5,311	387	0.1
Ring Levee with Interior Ditches, Refuge	4,432	2,313	0.5
Ring Levee with Interior Ditches, Silviculture	3,732	1,900	0.5
Ring Levee with Interior Ditches, Flood Tolerant Crops	4,081	1,693	0.4
Ring Levee with Interior Ditches, Roads	5,902	840	0.1
Relocations, Refuge	5,470	1,858	0.3
Relocations, Silviculture	4,770	1,445	0.3
Relocations, Flood Tolerant Crops	5,119	1,238	0.2
Relocations, Roads	6,940	385	0.1
Roads, Refuge	8,502	1,771	0.2
Roads, Silviculture	7,802	1,358	0.2
Roads, Flood Tolerant Crops	8,151	1,151	0.1
Relocations, Refuge, Roads	10,456	2,007	0.2
Relocations, Silviculture, Roads	9,756	1,594	0.2
Relocations, Flood Tolerant Crops, Roads	10,105	1,387	0.1

The only combination of preliminary alternatives that had a positive benefit to cost ratio was the St. Johns Bayou pumping station and the channel modifications. Constructing the pumping station and channel modifications would achieve the objectives of reducing the number of days communities are isolated, reduces agricultural damages, and reduce street and road flood damages. Although other preliminary alternatives or a combination of preliminary alternatives would achieve the objectives, they are not cost effective. Thus, USACE cannot implement them and they were dropped from further analysis.

- **Ring Levee –** Constructing a ring levee would limit benefits to the City of East Prairie and would not provide any benefits to the vast surrounding areas subject to flooding outside of East Prairie. Therefore, a ring levee does not reduce agricultural flood damages. Additionally, the ring levee would not benefit the agriculturally-based area economy. In other words, the East Prairie residential

community may be spared from flooding by a ring levee, but local business and commerce would not, with adverse impacts to local income. A ring levee would also isolate the community without raising roads, because transportation corridors would not be protected for people that travel to and from East Prairie. Therefore, a ring levee alone would not reduce the number of days communities are isolated. For example, during the Floods of 2011 and 2008, roads were closed leading in and out of the city. A ring levee is not cost effective as a standalone preliminary alternative, or in combination with other preliminary alternatives. Thus, it was not retained as a standalone preliminary alternative or in combination with other preliminary alternatives.

- **Refuge –** Since flooding would continue, a standalone refuge feature does not reduce the number of days communities are isolated or reduce street and road flooding. Although it reduces agricultural damages, it is not cost effective. Likewise, combining a refuge feature with other measures that provide benefits to streets and roads and reduces the number of days of community isolation is not cost effective. Thus, it was not retained.

- **Agriculture to Silviculture –** Converting from agriculture commodities (soybeans, corn, etc.) to silviculture is not economically justified. The purchase of conservation easements in the project area is currently estimated at $2,800 per acre for WRP enrollment (Debra Burgess, NRCS, personal communication). Converting from agriculture to silviculture does not reduce the number of days communities are isolated or reduce street and road flooding. Although it reduces agricultural damages, it is not cost effective. Likewise, combining this preliminary alternative with other preliminary alternatives that provide benefits to streets and roads and reduces the number of days of community isolation is not cost effective. Thus, it was not retained.

- **Conversion to Flood Tolerant Crops –** Similar to agriculture conversion to silviculture, this preliminary alternative would convert agricultural lands within the 5-year flood frequency (20 percent chance annual exceedence) to switchgrass production by means of a program similar to the USDA's CCC Biomass Crop Assistance Program (Sections 9001 and 9011, Food, Conservation, and Energy Act of 2008).

  The USDA's program does not purchase easements in perpetuity. Consequently, flood risk reduction benefits would be considered temporary for such a program. Therefore, restrictive easements were considered for the preliminary costs similar to those obtained for the WRP program (*i.e.*, $2,800 per acre). All these factors combined indicated that converting to flood tolerant crops is not cost effective. In addition, converting from agriculture to flood tolerant crops does not reduce the number of days communities are isolated or reduce street and road flooding. Although it reduces agricultural damages, it is not cost effective. Likewise, combining this preliminary alternative with other preliminary alternatives that provide benefits to streets and roads and reduces

the number of days of community isolation is not cost effective. Thus, it was not retained.

- **Relocations –** Relocations are not cost effective as a standalone preliminary alternative or in a combination with other preliminary alternatives. Thus, it was not retained.

- **Raising Roads –** Raising the surface elevation of roads is not cost effective as a standalone preliminary alternative or in a combination with other preliminary alternatives. Thus, it was not retained.

New Madrid Floodway

Tables 2.7 and 2.8 provide the preliminary costs and benefits for the NMF preliminary alternatives and combined preliminary alternatives, respectively. A discussion follows.

Table 2.7. Preliminary costs and benefits, New Madrid Floodway preliminary alternatives.

	Annual Cost ($000)	Annual Benefit ($000)	Benefit/Cost
NMF Closure and Pump Station	6,120	9,205	1.5
Alt Closure 1 (6,500 foot) and Pump Station	4,673	5,923	1.3
Alt Closure 2 (18,500 foot) and Pump Station	4,662	5,971	1.3
NMF Refuge - Expanded	14,891	6,842	0.5
NMF Silviculture	2,690	1,150	0.4
NMF Tolerant Crops	13,402	4,226	0.3
NMF Roads	5,572	205	0.0

The only preliminary alternative that had a positive benefit to cost ratio was the New Madrid Floodway closure and pumping station, including the alternate levee alignments. Annual road costs provided in Table 2.7 are conservative estimates. It is very likely that due to site-specific considerations like bridges, culverts, and rights-of-ways, the actual costs could be substantially greater. The resulting economic analysis does not indicate that these preliminary alternatives have any potential to be recommended.

Table 2.8. Preliminary costs and benefits, New Madrid Floodway combined preliminary alternatives.

Combined Preliminary Alternatives	Annual Cost ($000)	Annual Benefit ($000)	Benefit/Cost
NMF Closure and Pump Station	6,120	9,205	1.5
Alt Closure 1 (6,500 foot) and Pump Station	4,673	5,923	1.3
Alt Closure 2 (18,500 foot) and Pump Station	4,662	5,971	1.3
Refuge, Roads	20,463	7,047	0.3
Silviculture, Roads	8,262	1,355	0.2
Flood Tolerant Crops, Roads	18,974	4,431	0.2

The only combination of preliminary alternatives that had a positive benefit to cost ratio was the New Madrid Floodway closure and pumping station, including the alternate levee alignments. Constructing the closure levee and pumping station achieves the objectives of reducing the number days communities are isolated, reduces agricultural damages, and reduces street and road flood damages. Although other preliminary alternatives or a combination of preliminary alternatives achieve the objectives, they are not cost effective to implement. The following preliminary alternatives and or combination of preliminary alternatives were not retained for further analysis.

- **Refuge –** A stand alone refuge does not reduce the number of days communities are isolated or reduce street and road flooding. Although it reduces agricultural damages, it is not cost effective. Likewise, combining a refuge preliminary alternative with raising roads is not cost effective.

- **Agriculture to Silviculture –** Converting from agriculture commodities (soybeans, corn, etc.) to silviculture is not economically justified. The purchase of conservation easements in the project area is currently estimated at $2,800 per acre for WRP enrollment (Debra Burgess, NRCS, personal communication). Converting from agriculture to silviculture does not reduce the number of days communities are isolated or reduce street and road flooding. Although it reduces agricultural damages, it is not cost effective. Likewise, combining this preliminary alternative with raising roads is not cost effective. Thus, it was not retained.

- **Conversion to Flood Tolerant Crops -** Similar to agriculture conversion to silviculture, this preliminary alternative would convert agricultural lands within the 5-year flood frequency (20 percent chance annual exceedence) to switchgrass production by means of a program similar to the USDA's CCC Biomass Crop Assistance Program (Sections 9001 and 9011, Food, Conservation, and Energy Act of 2008).

The USDA's program does not purchase easements in perpetuity. Consequently, flood risk reduction benefits would be considered temporary for such a program. Therefore, restrictive easements were considered for the preliminary costs similar to those obtained for the WRP program (*i.e.,* $2,800 per acre). This being the case, converting to flood tolerant crops is not cost effective. In addition converting from agriculture to flood tolerant crops does not reduce the number of days communities are isolated or reduce street and road flooding. Although it reduces agricultural damages, it is not cost effective. Likewise, combining this preliminary alternative with other preliminary alternatives that provide benefits to streets and roads and reduces the number of days of community isolation is not cost effective. Thus, it was not retained.

- **Raising Roads –** Raising the surface elevation of roads is not cost effective as a standalone preliminary alternative or in a combination with other preliminary alternatives.

2.2.4 Iterative Screening Process Step 4

The next step in the screening process was to refine preliminary alternatives that were retained in steps 1-3 with practical avoid and minimize measures to reduce environmental impacts. Avoid and minimize measures are part of the mitigation sequencing process and serve two primary functions. First, the avoidance and minimization, to the extent practicable, of environmental impacts is a requirement of the Clean Water Act Section 404(b)(1) Guidelines. Second, reducing environmental impacts also reduces the amount of required compensatory mitigation and overall project costs.

St. Johns Bayou Basin

The authorized project in the St. Johns Bayou Basin consists of construction of a 1,000-cfs pumping station and channel modifications. Channel modifications entail clearing of overbank areas and channel enlargement along both banks. Excavated material would be placed along both banks. Thus, any ecological resources, including wetlands, would be impacted along the channels.

Direct impacts would be lessened in the St. Johns Bayou Basin by reducing channel enlargement dimensions of the authorized project. Instead of impacting both banks, construction would only occur on one side. Likewise, channel dimensions can be reduced to decrease the total amount of excavated material placed along the bank.

No changes in the operation of the existing flood risk reduction structure or the operation of the proposed pumping station in the St. Johns Bayou Basin are warranted due to the potential to increase flood risk in an area that is currently protected from Mississippi River backwater flooding.

New Madrid Floodway

Based on screening Steps 1 – 3, flood control preliminary alternatives in the New Madrid Floodway consist of the authorized closure levee, alternate closure levee locations, and the 1,500-cfs pumping station. Since the pumping station is required regardless of levee location, the three different levee alignments underwent additional screening. Preliminary costs of the different closure levee locations are presented in Table 2.9.

Table 2.9. Alternative closure levee location preliminary costs.

	1,500-foot	6,500-foot	18,500-foot
Real Estate (acres)	9	36	100
Real Estate Cost[1]	$28,800	$115,200	$320,000
Fill material (cubic yards)	233,000	537,000	1,316,000
Fill material cost[2]	$2,064,380	$4,757,820	$11,659,760
Preliminary Total Cost	$2,093,180	$4,873,020	$11,979,760

[1]Based on a cost of $3,750 per acre used for calculating mitigation costs.
[2]Based on an average cost of $8.86 per cubic yard ($10.00 and $7.72) based on costs for repairing crevassed sections of levee.

Flooding contributes ecological functions. Therefore, maintaining flooding (*i.e.*, the flood pulse) on portions of the floodplain would avoid and minimize environmental impacts. The "amount" of impacts depends on underlying land use (*e.g.*, agriculture, forest), flood frequency (*e.g.*, 2-year (50 percent chance annual exceedence), 5-year (20 percent chance annual exceedence), 10-year (10 percent chance annual exceedence)), flood duration (*e.g.*, 15 days, 10 days, 5 days, etc.), season (*e.g.*, spring, summer, etc.), and specific ecological resource (*i.e.*, wetlands, fish, waterfowl, and shorebirds). The 6,500-foot levee and 18,500-foot levee would maintain flooding on 981 and 4,276 acres, respectively (Figure 2.1). Therefore, alternate levee locations would somewhat reduce the environmental impact but construction costs would be greater. Likewise, economic damages would continue in these areas.

These closure locations were previously considered in detail (circa 2002). The two longer closure locations had increased implementation costs and reduced benefits, while only slightly reducing the ecological impacts. This is due to the topographic nature of the lower end of the floodway. As the next paragraph explains, the lands immediately inside of the 1,500-foot gap are predominantly higher elevation cropland. The sump area in the lower end of the floodway is the Eagles Nest area, which is further up the floodway than either the 6,500-foot or 18,500-foot closure locations. Moving the closure levee further away from the Mississippi River reduced benefits substantially due to the cropland that would no longer be protected, while only slightly reducing the environmental impacts. This is because the Eagles Nest sump area would remain behind the closure levee and not fully connected to the river.

Within the New Madrid Floodway, out of bank flooding (flooding >280 feet NAVD88) first occurs in the Eagle's Nest area that is located approximately 8 miles upstream of the

1,500-foot gap, followed by remaining bottomland hardwoods in the vicinity of the Ten Mile Pond Conservation Area[9] that is located approximately 20 miles upstream of the 1,500-foot gap. Both areas are at lower elevations than the gap itself (Figure 2.2) and provide valuable ecological resources. Both alternate levee alignments (6,500-foot and 18,500-foot) would not maintain connection of these areas to the Mississippi River. Thus, they were not carried forward into detailed analysis.

To maintain a connection to these areas (Eagles Nest and Ten Mile Pond Conservation Area) as well as reduce agricultural flood damages, an alternate levee would be many miles in length because it would have to follow specific elevation contours in order to maintain the connection to the Mississippi River. Such a levee would not be cost effective compared to the recommended alignment because total costs would greatly increase while providing the same level of benefits.

As opposed to constructing a levee many miles in length, practical avoid and minimize measures were formulated for a levee at the 1,500-foot gap location (least construction costs) but changes the operation of the gravity outlet structure and pump. For example, gates can remain open allowing the flood pulse to continue to inundate ecologically sensitive areas at lower elevation areas in the New Madrid Floodway such as the Eagles Nest Area and the bottomland hardwoods in the vicinity of Ten Mile Pond Conservation Area. Gates could then be closed and or pumps turned on to provide flood control benefits to agricultural areas at higher elevations. As opposed to closing the structure gates at the onset of flooding, gates can be left open to allow backwater flooding at lower elevations of the New Madrid Floodway. Therefore, the goal of avoiding and reducing impacts while maintaining flood benefits at lower elevations can be best met with the construction of a shorter (thus less expensive with less direct impacts) levee alignment.

2.2.5 Iterative Screening Process Step 5

Continued operation of the Birds Point-New Madrid Floodway is required regardless of any feature. Constructing flood risk reduction features in the St. Johns Bayou Basin would not impact the continued operation of the Birds Point-New Madrid Floodway. Based on hydraulic and hydrologic modeling, closure of the 1,500-foot gap in the levee would reduce the conveyance for flood water passage within the floodway when activated. Therefore, an increase in water elevation along portions of the Birds Point-New Madrid Setback Levee would occur during periods of operation. To maintain the authorized 3-foot freeboard above the project design flood, a 14.1-mile section of the Setback Levee would require a grade raise to ensure flood protection in the St. Johns Bayou Basin at the authorized level of protection.

[9] The Missouri Department of Conservation manages the conservation area with levees. Although these levees provide waterfowl habitat, they also prevent backwater flooding in the lowest portions of the conservation area. The area is not subject to Mississippi River flooding until the river elevation is approximately 290 feet NAVD, approximately 6-8 feet higher than natural ground elevation. However, remaining areas not behind MDC levees are subject to backwater flooding, the most notable being the Bogle Woods tract that has been previously purchased for mitigation.

2.3 Alternatives Retained for Detailed Analysis

The following alternatives were formulated based on the preliminary alternatives that underwent the iterative screening process.

2.3.1 Alternatives A1 and B1 (No Action)

As required by NEPA, a no action alternative—alternatives A1 and B1—is considered for comparative purposes. These alternatives, by looking at existing and reasonably foreseeable future conditions, contemplate how the environment in the project area will be affected if no action is taken. These alternatives describe what USACE refers to as "the without-project condition."

No flood reduction improvements would be constructed under alternatives A1 and B1. Under alternatives A1 and B1, the existing St. Johns Bayou gravity outlet structure would continue to be operated to prevent Mississippi River backwater flooding in the St. Johns Bayou Basin which would continue to cause and to contribute to flooding from the impounding of water in the basin. The gates would be closed whenever the level of the Mississippi River (*i.e.*, the elevation of the river in relation to the land around it) is higher than the elevation of the basin's interior sump, meaning that water would not be able to flow by gravity through the outlet structure and into the river. Damages, disruptions, and dislocations described in Section 1 would continue, varying in severity seasonally and from year-to-year.

The gap at the lower end of the New Madrid Floodway would remain open, thus allowing Mississippi River backwater flooding. Damages, disruptions, and dislocations described in Section 1 would continue, varying in severity seasonally and from year-to-year.

Over the next 50 years, conditions in the Lower Mississippi River Valley are projected to remain substantially as they are at present. This is based on observed river conditions and the results of hydraulic modeling using data from the hydrologic period of record[10] (Appendix C, Part 1). The model assumes stationarity, meaning future conditions are based upon the observed conditions over the past 67-years. Therefore, the model assumes future extreme floods and droughts, normal floods and droughts, and wet and dry precipitation years at roughly the same frequency, duration, and seasonality as that observed from the period of record analysis.

Further over the next 50 years, conversion of currently forested areas to additional agricultural land is not expected. This projection assumes that all potential farmland in the project area has been cleared. The remaining tracts of forested land are currently publicly owned (*e.g.*, Big Oak Tree State Park, portions of Ten Mile Pond Conservation Area, and Donaldson Point Conservation Area), in silvicultural production, or are too wet to farm because they are located in depressions that remain saturated for prolonged

[10] The hydrologic period of record is being used to determine the project's benefits, costs, environmental impacts, and compensatory mitigation requirements.

periods due to precipitation. Based on current silvicultural practices in the project area, forested areas not in public ownership would likely be cut for timber production (once in the next 50 years) and then be allowed to re-generate naturally.

Little or no conversion from agriculture to other land uses would be expected under alternatives A1 and B1. This is attributed to the projected increases in agricultural commodity prices. Agricultural prices are expected to significantly increase in the project area due to increasing scarcity of agricultural land and water in other parts of the country (Battelle, 2010).[11] Some producers may take land out of production due to environmental incentives such as the WRP administered by the NRCS. Based on existing WRP lands in the project area and input from the NRCS, USACE has forecasted that there would be annual increases of 119 acres and 36 acres in the St. Johns Bayou Basin and New Madrid Floodway, respectively. Additional information regarding this no action assumption can be found in Appendix M, Part 1.

Under alternatives A1 and B1, it is possible that some small on-farm drainages may not be maintained or may be intentionally plugged due to WRP. However, it is more likely that existing ditches and drainage infrastructure would be maintained in substantially the same condition. Ditch maintenance consists of periodic vegetation and sediment removal to ensure drainage is maintained. Ditch maintenance is conducted by local levee and drainage districts. Similarly, the existing gravity outlet structure for St. Johns Bayou would likely undergo periodic maintenance, repair, or replacement; however, no appreciable change in its operation and management would occur.

No plans with funding mechanisms have been identified to restore hydrology to Big Oak Tree State Park with Mississippi River surface water. Although the Missouri Department of Natural Resources (MDNR) had a previous plan for the park that relied on groundwater pumps, this plan has been abandoned and no plans exist to restore the park independent of the St. Johns Bayou - New Madrid Floodway Project (R. Stout, MDNR, personal communication). Therefore, the observed progression from hydric vegetation to drier species would continue (McCarty 2005), and Big Oak Tree State Park would continue to decline in ecological significance. See McCarty (2005) for additional information regarding the parks progression from hydric vegetation to drier species. Following the 2011 flood, an existing levee that runs parallel to Wilkerson Ditch has been rebuilt and raised. Although the levee provides a degree of flood risk reduction from Mississippi River flooding, the levee reliability is unknown due to an assumed lack of engineering and construction standards employed in the project. The current Big Oak Tree State Park and MDC levee reduce the risk of Mississippi River flooding to events that occur approximately once every 10 years (10 percent annual chance exceedence) or less frequently.

[11] During Phase 2, the IEPR panel stated that "Agricultural land has declined in the United States because of conversion to other uses. In addition, water scarcity may be a future issue due to climate change. Energy prices may also rise as society converts to alternatives to fossil fuels. Thus, real price and cost change may be a reality for agricultural producers in this and other regions of the United States."

Under alternative B1, the New Madrid Floodway would be activated to receive Mississippi River flood waters when and as needed, according to federal law (i.e., approximately once every 80 years, based on historic conditions). Following these major events, levees would be rebuilt to provide the level of protection as authorized by legislation. Local governments, communities, and homeowners would repair damages to structures, roads, and other infrastructure. Although there may be temporary impacts on agricultural production and short- or long-term dislocation of local populations, life in the New Madrid Floodway should return to pre-flood conditions. Subsequent to the activation of the floodway in May 2011 (see Appendix L), levees have been rebuilt, large scour holes filled with sand, ditches cleaned out, roads re-surfaced, and agricultural areas re-planted.

Residential areas are expected to remain relatively unchanged under alternative B1. Although the activation of the floodway in 2011 resulted in immediate displacement of residents, some have already moved back and others are making plans to return, suggesting that infrequent opening of the floodway (on average once in 80 years) does not cause permanent population shifts. Although the Village of Pinhook (population 30) has applied for a buy-out, no funds have been provided to date (Connie Duke, personal communication). Even if a buy-out occurs, residents have returned to other areas in the New Madrid Floodway.

Climate change was considered as a basis for changes in land use and in hydraulics and hydrology. Predicting the effects of climate change on discrete areas, however, is extremely difficult. The capabilities of global circulation models to predict future climate change are generally recognized as approximate, strongest in predicting temperature changes and weak in predicting precipitation changes. Climate change models are strongest in predicting changes over large regions and weak in downscaling to watersheds (Battelle, 2010). Although changes as a result of future global climate change were not quantified, potential global climate scenarios and associated ramifications to this project are discussed in Section 4.

Additional information on alternatives A1 and B1 is presented throughout Section 4.

2.3.2 Alternative A2 – Construct and Operate Flood Risk Reduction Improvements in the St. Johns Bayou Basin

Alternative A2 concerns the reduction of flood risks in the St. Johns Bayou Basin only (Figure 1.1). The alternative consists of channel enlargement and drainage improvements along the lower 4.5 miles of St. Johns Bayou, beginning at New Madrid, Missouri, continuing along the Birds Point-New Madrid Setback Levee Ditch, and ending with 10.8 miles along St. James Ditch. In addition, a 1,000-cfs pumping station would be constructed a few hundred feet east of the existing gravity outlet at the lower end of St. Johns Bayou.

The lower 4.3 miles[12] of St. Johns Bayou would be cleared and enlarged on both sides; bottom widths would be increased from approximately 80 feet to 200 feet. Approximately 2,485,000 cubic yards of material would be deposited along both banks, creating a 220-foot wide embankment on each side. Embankment dimensions would vary but would generally have side slopes of 1 vertical to 2.5 feet horizontal and a crown slope no steeper than 1 vertical on 20 feet horizontal to minimize erosion. Maximum embankment height would vary by construction reach. However, embankments would be no greater than 20 feet above natural ground elevation.

The lower 8.1 miles of the Birds Point-New Madrid Setback Levee Ditch would be enlarged from approximately 40 feet to 50 feet. The work would take place along the left descending bank and approximately 675,000 cubic yards of material would be placed in a 120-foot wide embankment located along the left descending bank. The area would be allowed to revegetate naturally as part of a conservation easement, however no mitigation credit would be provided as this action is implemented as a best management practice.

St. James Ditch would be enlarged along the left descending bank. Bottom width along the lower 3.5 miles would be enlarged from 35 feet to 45 feet. No changes to bottom width would be anticipated along the remaining 7.8 miles of channel. However, top width along the left descending bank would be widened to an 80-foot average. Approximately 630,000 cubic yards of excavated material would be placed on a 100-foot wide embankment along the left descending bank. The area would be allowed to revegetate naturally as part of a conservation easement, however no mitigation credit would be provided as this action is implemented as a best management practice.

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. Pumping would commence when water in the sump area reached an elevation of 279.0 feet NGVD29 and would continue until the sump elevation dropped to 277.0 feet NGVD29. Gates would remain closed when river stages were greater than the interior sump elevation. Gates would remain open when the interior sump elevation exceeded the Mississippi River elevation, thus allowing for gravity drainage through the St. Johns Bayou gravity outlet structure.[13]

During waterfowl season (1 December to 31 January), gates would be closed to impound interior runoff in the lower St. Johns Bayou Basin for the benefit of waterfowl. Impounded interior runoff would be managed to maintain an interior sump elevation of 285.0 feet NGVD29.

Although alternative A2 does not contain avoid and minimize measures, it was carried forward for detailed analysis for comparative purposes. In other words, alternative A2

[12] Total construction limits are the lower 4.5 miles of St. Johns Bayou. However, the first 0.2 miles would only consist of a construction access road placed along the right descending bank in farmland. Channel modifications would only take place on the remaining 4.3 miles.

[13] Adherence to water levels would be a requirement of the Project Cooperation Agreement between the Federal government and the non-federal sponsor.

served as a baseline to measure the effectiveness of avoid and minimize measures developed for other alternatives.

2.3.3 Alternative B2 – Construct and Operate Flood Risk Reduction Improvements in New Madrid Floodway

Alternative B2 concerns the reduction of flood risks only in the New Madrid Floodway. This alternative consists of the closure of the 1,500-foot levee gap at the lower end of the New Madrid Floodway between setback levee mile 35 and 37 (Figure 2.1). The levee would be constructed of approximately 233,000 cubic yards of material. Cross sectional dimensions would be a crown elevation of 317.0 feet, a top width of 16 feet, a base width of approximately 302 feet, and side slopes of 1:4.5. In addition, the lower section of the Frontline Levee would be raised to a height equivalent to the rest of the Frontline Levee. The levee raise would require an additional 127,000 cubic yards of material. Fill material (totaling 360,000 cubic yards) would be obtained from approximately 60 acres of borrow pits that would be ecologically designed to benefit floodplain fisheries. Four 10-foot by 10-foot gated box culverts would be constructed in Mud Ditch to maintain drainage in the New Madrid Floodway.

This alternative would also include a grade raise in a 14.1-mile section of the Setback Levee to ensure flood protection in the St. Johns Bayou Basin at the authorized level of protection. Setback Levee grade raises would range from 0.1 feet to 3 feet (average 1.28 feet) and would require 2.4 million cubic yards of material. Material would be obtained from 387 acres of borrow pits. The grade raise would be limited to the crown only. No increases to the levee width and right of way are contemplated.

A 1,500-cfs pump station would be constructed in the New Madrid Floodway. Pumping would normally commence when the water in the sump reached 278.0 feet NAVD88 and would continue until the interior sump elevation dropped to 275.0 feet NAVD88. Should Mississippi River stages drop during pumping to levels below the interior sump elevation, pumping operations would cease and the floodgates would be opened to allow for gravity drainage.[14]

During waterfowl season (1 December to 31 January) gates would be closed to impound interior runoff in the lower New Madrid Floodway for the benefit of waterfowl. Impounded interior runoff would be managed to maintain an elevation of 284.4 feet NAVD88.

[14] Adherence to water levels would be a requirement of the Project Cooperation Agreement between the Federal government and the non-federal sponsor.

2.3.4 Alternatives A3 and B3 – Combined Authorized Project with Avoid and Minimize Measures

2.3.4.1 Alternatives A3 and B3.1 – Manage Connectivity Scenario 1

Alternative A3 – St. Johns Bayou Basin Channel Modifications

In contrast to the authorized project (alternative A2) that calls for a two-sided channel enlargement from an existing bottom width of 80 feet to 200 feet, the avoid and minimize measures would enlarge the lower 3.7 miles of St. Johns Bayou from the right descending bank only and the proposed bottom width would increase from 80 feet to 120 feet.

Setback Levee Ditch would be enlarged from one side (left descending bank). The Setback Levee runs parallel to Setback Levee Ditch along the left descending bank. This alternative was refined to avoid the relatively high concentration of freshwater mussels discovered in 2002 and 2006 along the right descending bank in this reach. A 2010 survey indicated that these populations have decreased due to recent basin wide ditch maintenance efforts; however, the avoid and minimize measure was retained in the final array of alternatives.

Rights of way along St. James Ditch would be obtained along alternate sides to protect areas of riparian vegetation (*i.e.*, spoil material would be placed into areas that are likely prior converted cropland as opposed to vegetated areas, where practical).

Alternative B3.1 – New Madrid Floodway

The proposed New Madrid Floodway gravity outlet structure and pumps would be used to strategically manage socioeconomic flood risks while minimizing environmental damages. For example, backwater flooding would be allowed to occur at elevations that would still provide connectivity to the majority of remaining forested habitat during portions of the year in which flooding is beneficial (approximate elevation of 290 feet NAVD88). Likewise, flooding would be managed at different elevations during periods of the year that coincide with agriculture (approximate elevation of 285 feet NAVD88). Furthermore, floods could be managed to reduce the risk of flooding to project area roads and infrastructure (approximate elevation of 290 feet NAVD88). Table 2.10 provides alternative B3.1 gate and pump management scenarios.

Winter Period (Figure 2.3)

For the winter period (*i.e.*, 15 November to 28/29 February), flood waters would naturally inundate the New Madrid Floodway to a maximum flood elevation objective[15] of 289.5 feet NAVD88 (MS 115[16] = 34 feet). This elevation is approximately 0.5 feet

[15] The maximum flood elevation is a management objective. However, floods can and will still occur above this elevation due to intense rainfall of prolonged duration that often occurs during high Mississippi River elevations.
[16] MS 115 is the Mississippi River gage located at New Madrid.

below flood stage, which corresponds to the elevation of area roads. Therefore, roads would remain open. During this period, the proposed gravity outlet structure would be closed at an elevation of 288 feet NAVD88 (MS 115 = 32.5 feet). Pumps would be turned on when the interior sump elevation reached 289.5 feet NAVD88. Pumps would be turned off at an interior sump elevation of 288.5 feet NAVD88. In the event that the Mississippi River elevation fell below the interior sump elevation, pumps would be turned off and gates would be opened to allow for gravity drainage.

During waterfowl season (*i.e.,* 1 December – 31 January), gates would be closed to impound interior runoff. However, dependent on river stages, flood waters would still be allowed to inundate the floodway up to an elevation of 289.5 feet NAVD88 (MS 115 = 34 feet).

Early Spring (Figure 2.3)

For the early spring period (*i.e.*, 1 March – 15 April), flood waters would naturally inundate the New Madrid Floodway to an elevation of 288 feet NAVD88 (MS 115 = 32.5 feet). During this period, the proposed gravity outlet structure would be closed at an elevation of 286 feet NAVD88. Pumps would be turned on when the interior sump elevation reached 288 feet NAVD88. Pumps would be turned off at an interior sump elevation of 287 feet NAVD88. In the event that the Mississippi River elevation fell below the interior sump elevation, pumps would be turned off and gates would be opened to allow for gravity drainage.

Late Spring (Figure 2.3)

For the late spring period (*i.e.,* 16 April – 31 May), flooding would be allowed in the New Madrid Floodway to an elevation of 284 feet NAVD88 (MS 115 = 28.5). This would be accomplished by closing gates and turning on pumps at an elevation of 284 feet NAVD88. Pumps would be turned off at an elevation of 282 feet NAVD88. In the event that the river elevation fell below the interior sump elevation, pumps would be turned off and gates would be opened to allow for gravity drainage.

Remainder of the Year (Figure 2.3)

For the remainder of the year (1 June to 14 November), flood elevations would be limited to an elevation of 280 feet NAVD88. This would be accomplished by closing gates at an elevation of 278.5 feet NAVD88, starting pumps at an elevation of 280 feet NAVD, and turning pumps off at an elevation of 278.5 feet NAVD88. In the event that the Mississippi River elevation fell below the interior sump elevation, pumps would be turned off and gates would be opened to allow for gravity drainage.[17]

[17] Adherence to water levels would be a requirement of the Project Cooperation Agreement between the Federal government and the non-federal sponsor.

2.3.4.2 Alternative B3.2 – Manage Connectivity Scenario 2

In the New Madrid Floodway, overall management of alternative B3.2 is the same as alternative B3.1 except that additional flood risk reduction is provided in the spring (Table 2.10).

Table 2.10. Alternative B3.1 and B3.2 gate and pump management scenarios, New Madrid Floodway.

Date	Close Gate Elevation NAVD88		Start Pump Elevation NAVD88		Stop Pump Elevation NAVD88	
	Alt B3.1	Alt B3.2	Alt B3.1	Alt B3.2	Alt B3.1	Alt B3.2
15 Nov – 28 Feb[1]	288	288	289.5	289.5	288.5	288.5
1 March – 15 April	286	284	288	286	287	285
16 April – 31 May	284	282	284	282	282	280
1 June – 14 Nov	278.5	278.5	280	280	278.5	278.5

[1] Elevations do not depict winter waterfowl management pool.

2.3.5 Alternative B4 – Maintain Connectivity

Alternative B4 is similar to alternative B3 in that all project features are constructed, including the, 1,500-foot closure levee, 1,500-cfs pump, and waterfowl management. However, with the exception of waterfowl season, alternative B4 would not close the New Madrid Floodway structure or utilize pumps until floods reach an elevation in which roads are threatened (approximate elevation of 289.5 feet NAVD88). This would be accomplished by closing the gates at an elevation 287.5 feet NAVD88, starting pumps at an elevation 289.5 feet NAVD88, and stopping pumps at an elevation of 288 feet NAVD88.[18] Gates would be opened to allow for gravity drainage during periods in which the Mississippi River elevation is less than the interior sump elevation.[19]

During the Phase 3 IEPR review, the panel recommended that other potential benefits be investigated that would provide benefits to agricultural areas below an elevation 289.5 feet NAVD88. Since some of these measures may be problematic for USACE to implement, the alternative was divided into two different sub-alternatives.

2.3.5.1 Alternative B4.1 – Maintain Connectivity Scenario 1

<u>New Madrid Floodway</u>

Alternative B4.1 calls for construction of the flood risk reduction features only with no additional measures to areas below an elevation of 289.5 feet NAVD88.[20]

[18] Note that these are the same elevations as the period 15 Nov – 28 Feb for Alternatives 3.1 and 3.2.
[19] Adherence to water levels would be a requirement of the Project Cooperation Agreement between the Federal government and the non-federal sponsor.
[20] Adherence to water levels would be a requirement of the Project Cooperation Agreement between the Federal government and the non-federal sponsor.

2.3.5.2 Alternative B4.2 – Maintain Connectivity Scenario 2

New Madrid Floodway

Alternative B4.2 calls for reforestation of agricultural lands below an elevation of 289.5 feet NAVD88 in conjunction with the structural flood risk reduction features previously stated. There are 13,340 acres of agricultural lands below an elevation of 289.5 feet NAVD88. In addition to the benefit from the conversion of agriculture to silviculture, this alternative would augment that benefit with additional economic incentives from carbon sequestration and nutrient trading. Areas above an elevation of 289.5 feet NAVD88 would receive the same project benefits as previous alternatives.

Additional benefits to carbon sequestration and nutrient trading were computed in a similar method as was utilized by Shabman and Zepp (2000). As previously mentioned there is currently no nutrient trading program in the State of Missouri to base project benefits. Although carbon credits were previously traded on the market, they no longer are. Therefore, there is currently no existing available program to base carbon credits on.

Measures that take productive agricultural land out of production and reforest it are not supported by local landowners (St. John Levee and Drainage District, personal communication). Therefore, it is highly unlikely that a volunteer type of easement could be established to implement such a plan. The alternative estimated that real estate would be purchased fee title (current estimate is $3,750 per acre). Estimates did not include any costs associated with tree planting, earthmoving, forest maintenance etc. Therefore, costs are likely underestimated.

2.4 Comparison of Alternatives

Benefits and impacts of each alternative are summarized in Table 2.11. The relationship of each alternative to environmental protection statutes or other environmental requirements is summarized in Table 2.12. Alternatives A3 and B3.1 is the NED plan. Thus, it was identified as the recommended plan. Detailed information regarding project benefits, impacts, mitigation, monitoring, and adaptive management can be found in Sections 3-7.

Table 2.11. Impacts and benefits of alternative plans, St. Johns Bayou Basin and New Madrid Floodway.

	Alt. A2	Alt. A3	Alt. B2	Alt. B3.1	Alt. B3.2	Alt B4.1	Alt. B4.2
Reduced Flooding (total acres)[1]	3,085	3,085	52,108	46,248	48,145	41,883	41,883
Reduced Flooding (agricultural acres)[1]	2,646	2,646	44,372	40,597	42,105	37,030	23,690
Roads/Infrastructure (Risk Managed Y/N)	Y	Y	Y	Y	Y	Y	Y
Social Impacts (Risk Managed Y/N)	Y	Y	Y	Y	Y	Y	Y
Average days per year roads are inundated (SJB/NMF)	11.9	11.9	0	0	0	0.2	0.2
Wetland Impacts (LGRB Detain Floodwater FCU)	-116	-116	-6,449	-3,487	-4,046	-2,914	+35
Wetland Impacts (LGRO Detain Floodwater FCU)	-653	-397	-186	-35	-35	-186	-186
Wetland Impacts (CD Maintain Plant Communities FCU)	0	0	-211	-124	-138	-108	-196
Terrestrial Wildlife (AAHU)	-1,263	-766	-17	-17	-17	-17	+12,041
Waterfowl Impacts (Feb-March DUD)	-995,104	-995,104	-6,241,577	-3,290,786	-3,739,251	-2,727,716	+1,404,541
Shorebird Impacts (spring opt. equiv. acres)	-116	-116	-852	-615	-742	-323	-323
Fish Spawning and Rearing (mid-season AAHU)	-441	-441	-2,794	-2,061	-2,340	-1,493	+90
Total First Costs[2] ($000)	$68,768	$59,870	$217,458	$170,262	$184,365	$156,392	$185,595
Net Annual Costs[3] ($000)	$3,219	$2,824	$9,805	$7,724	$8,341	$7,099	$8,365
Net Annual Benefits[3] ($000)	$6,537	$6,202	$21,683	$20,573	$20,665	$19,797	$19,766
Excess Benefits[3] ($000)	$3,318	$3,378	$11,878	$12,849	$12,324	$12,698	$11,401
Benefit:Cost Ratio[3]	2.0	2.2	2.2	2.7	2.5	2.8	2.4

[1]Calculated as the difference between the pre and post project five year flood frequency.
[2]Based on original construction cost estimates inflated to reflect 2014 costs and revised mitigation costs.
[3]Based on the current interest rate of 3.5%
LGRB – Low Gradient Riverine Backwater (see Section 3.8.1)
LGRO – Low Gradient Riverine Overbank (see Section 3.8.1)
CD – Connected Depression (see Section 3.8.1)
AAHU – Average Annual Habitat Units (see Section 4.8.2 and Section 4.8.5)
DUD – Duck Use Days (see Section 4.8.3)

Table 2.12. Relationship of plans to environmental protection statutes or other environmental requirements, St. Johns Bayou Basin and New Madrid Floodway.

FEDERAL STATUTES	*Alt. A2/3*	*Alt. B2*	*Alt. B3.1*	*Alt B3.2*	*Alt. B4.1*	*Alt B4.2*
1. Clean Air Act, as Amended. Compliance requires coordination with the U.S. Environmental Protection Agency and analysis of potential impacts on air quality.	*FC*	*FC*	*FC*	*FC*	*FC*	*FC*
2. Clean Water Act of 1977. Compliance requires preparation of 404(b)(1) Evaluation and submission of such to Congress with the FEIS or procurement of state water quality certification (WQC). See, Appendix E, Part 5, for the 404(b)(1) evaluation. Pending State WQC.	*PC*	*PC*	*PC*	*PC*	*PC*	*PC*
3. Endangered Species Act of 1973, as Amended. Compliance requires coordination with the U.S. Fish and Wildlife Service (USFWS) to determine if any endangered or threatened species or their critical habitat would be impacted by the project.	*NC*	*NC*	*NC*	*NC*	*NC*	*NC*
4. Federal Water Project Recreation Act. Compliance requires review by the Department of the Interior. Coordination of the FEIS will bring the project into full compliance.	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
5. Fish and Wildlife Coordination Act. Compliance requires coordination with the USFWS and recommendations are discussed in, Appendix Q, which includes the Fish and Wildlife Coordination Act Report (CAR). Pending CAR from USFWS.	*PC*	*PC*	*PC*	*PC*	*PC*	*PC*
FEDERAL STATUTES	*Alt. A2/3*	*Alt. B2*	*Alt. B3.1*	*Alt. B3.2*	*Alt. B4.1*	*Alt. B4.2*
6. Land and Water Conservation Fund Act. Compliance requires Secretary of the Interior approval of replacement property that would be acquired to mitigate converted property purchased with LWCFA funds.	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
7. National Historic Preservation Act. Compliance requires Corps to take into account the impacts of project on any property included in or eligible for inclusion in the National Register of Historic Places.	*FC*	*FC*	*FC*	*FC*	*FC*	*PC*
8. National Environmental Policy Act. Compliance requires preparation of this FEIS,	*PC*	*PC*	*PC*	*PC*	*PC*	*PC*

consideration of public comments, and preparation and public review of the FEIS. Signing of the Record of Decision would bring this project into full compliance.						
9. River and Harbor Act.	*PC*	*PC*	*PC*	*PC*	*PC*	*PC*
10. Farmland Protection Policy Act. Compliance requires coordination with the Natural Resources Conservation Service to determine if any designated prime or unique farmlands are affected by the project.	*FC*	*FC*	*FC*	*FC*	*PC*	*PC*
11. Watershed Protection and Flood Prevention Act. No requirements for Corps projects.	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
12. Wild and Scenic River Act. Compliance requires coordination with Department of the Interior to determine if any designated or potential wild, scenic, or recreational rivers are affected by the project. Coordination has been accomplished and there are no such rivers in the project area.	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
EXECUTIVE ORDER/MEMORANDA	*Alt. A2/3*	*Alt. B2*	*Alt. B3.1*	*Alt. B3.2*	*Alt. B4.1*	*Alt. B4.2*
1. Executive Order 11988, Floodplain Management. Compliance requires an assessment and evaluation together with the other general implementation procedures to be incorporated into the FEIS.	*FC*	*FC*	*FC*	*FC*	*FC*	*FC*
2. Executive Order 11990, Protection of Wetlands. Compliance requires results of analysis and findings related to wetlands be incorporated into the FEIS.	*FC*	*FC*	*FC*	*FC*	*FC*	*FC*
3. Executive Memorandum, Analysis of Impacts on Prime and Unique Farmlands in EIS. Compliance requires inclusion of effects of proposed action on prime and unique farmlands in the FEIS.	*FC*	*FC*	*FC*	*FC*	*PC*	*PC*
4. Executive Order 11593, Protection and Enhancement of the Cultural Environment. Compliance requires Corps to administer cultural properties under their control in stewardship for future generations; preserve, restore or maintain such for benefit of the	*FC*	*FC*	*FC*	*FC*	*FC*	*FC*

people; and assure that its plans contribute to preservation and enhancement of non-federally owned sites.						
5. Executive Order 13112, Invasive Species. Compliance requires assessment of potential for the project to introduce invasive species to the project area.	*FC*	*FC*	*FC*	*FC*	*FC*	*FC*
6. Executive Order 12898, Environmental Justice in Minority and Low-income Populations. Compliance requires assessment of project effects on minority and low-income populations.	*FC*	*FC*	*FC*	*FC*	*FC*	*FC*

FC - In Full Compliance
PC - In Partial Compliance
NA - Not Applicable
NC – Not in Compliance, to date

2.5 Recommended Plan

Alternatives A3 and B3.1 is the recommended plan. It consists of closure of the New Madrid Floodway at the location of the 1,500-foot gap, construction of a 1,500 cubic foot per second (cfs) pumping station in the New Madrid Floodway, construction of a 1,000 cfs pumping station in the St. Johns Bayou Basin, modifications to 23 miles of ditches in the St. Johns Bayou Basin, waterfowl management during waterfowl season in both basins, and manages flood risks in a manner that recognizes the benefit of the flood pulse to the remaining natural environment.

2.5.1 Completeness

All alternatives considered in detail are considered complete. All alternatives comply with national environmental statutes, executive orders, and other planning requirements. Costs for each alternative include the necessary compensatory mitigation to comply with federal law and USACE policy. Likewise, all alternatives are economically justified. Thus, all alternatives (in the St. Johns Bayou Basin and the New Madrid Floodway) satisfy the Federal objective.

Although uncertainty has been identified and assessed regarding the amount of required compensatory mitigation, both basins include extensive monitoring and adaptive management. Therefore, adaptive management is recommended for all project alternatives to ensure they are complete. Future adaptive management decisions include the potential to change the overall operation of the gates and pumps. Thus, adaptive management decisions could recommend closing the gates later in the year to reduce environmental impacts. Therefore, each alternative is inherently sustainable and complete. Risk and uncertainty is discussed in greater detail in Section 6 and adaptive management is discussed in Section 7.

2.5.2 Efficiency

Efficiency is the extent to which an alternative plan is the most cost effective means of achieving the objectives. The National Economic Development (NED) Plan is the plan that provides the greatest net excess benefits. Based on the economic conclusions, alternative A3 in the St. Johns Bayou Basin and alternative B3.1 in the New Madrid Floodway are the NED plans respective to each basin. Per the Principals and Guidelines, the Federal action is to be the alternative plan with the greatest net economic benefit consistent with protecting the Nation's environment (the NED plan).

2.5.3 Effectiveness

Effectiveness is the extent to which the alternative plans contribute to achieve the planning objectives. There are three project specific planning objectives:

- Reduce the number of days that communities are isolated by flood waters,
- Reduce crop and non-crop agricultural damage (from flooding), and
- Reduce critical infrastructure damages to streets and roads.

A project alternative that totally eliminated each of these problems would be a 100 percent effective alternative. Under the analysis, the problems are quantitatively represented by estimate annual damages from a statistically based flooding frequency. There are no realistic alternatives that would be 100 percent effective. A measure of the effectiveness of the recommended plan is how much the plan reduced the annual damages expected from flooding in each of these three objective categories. In terms of isolation of communities, the recommended plan is effective because it reduces the expected annual days of isolation. In terms of agricultural damages, the recommended plan is 69 percent effective, or reduces the expected annual damaged from $14.776 million to $4.58 million. Hydraulics and hydrology analyses concluded that the recommended plan reduces the expected annual road overtopping by 100 and 32 percent in the New Madrid Floodway and St. Johns Bayou Basin, respectively.

2.5.4 Acceptability

Based on comments provided during the draft EIS, alternative A3 in the St. Johns Bayou Basin is acceptable. Most resource agencies were supportive of a plan in the Bayou Basin. Although comments were received from some environmental groups regarding the economic analysis in the St. Johns Bayou Basin, based on revisions made to the economic analysis, flood risk reduction solutions are justified.

Although alternative B4.2 provides benefits and satisfies the Federal objective, it is non-implementable by USACE. Nutrient trading requires a program that is usually administered by the states and is conducted on a voluntarily basis. Carbon also requires a similar type of program. Although carbon credits were previously traded on the market, they currently are not. Without these programs in place, the alternative cannot be implemented. In addition, the project would not prevent any future conversion from

agriculture areas to forest areas for the purpose of nutrient trading or carbon sequestering. For example, closure of the New Madrid Floodway would not prevent landowners in the future from enrolling lands in programs that are established to provide nutrient trading and carbon sequestering incentives. Therefore, alternative B4.2 is currently not acceptable.

The general public supports a plan that would manage flood risk in the project area. Based on discussions with the project sponsor, alternatives B4.1 and B4.2 are not acceptable from a non-Federal cost sharing perspective because it does not provide the benefits as intended by the Congressional authorization. Alternatives B2, B3.1, and B3.2 are acceptable to the sponsor. However, alternative B2 does not allow for any remaining connectivity. Therefore, it is not acceptable to numerous environmental stakeholders.

2.5.5 Conclusion

Alternative A3 is the recommended plan in the St. Johns Bayou Basin. This plan will manage flood risk in the Bayou Basin by reducing the overall acres of inundated farmland and maintaining important transportation corridors, most notably to Interstate 55. Alternative B3.1 is the recommended plan in the New Madrid Floodway. Analysis conducted for this FEIS concludes that the greater the area removed from flooding the greater the economic benefits. However, the greater the area removed from flooding, the greater the environmental impacts. Alternative B3.1 recognizes the importance of both the socio-economic and environmental effects. It maintains connectivity to the vast majority of remaining natural environment (*i.e.,* forested area) found within the floodway but also provides economic benefits to the vast majority of agricultural areas. Alternative B2 maximizes economic benefits but does not recognize the importance of the flood pulse to the remaining natural environment. Likewise, alternative B4.1 recognizes the ecological importance of the flood pulse by maximizing the level of connectivity with the Mississippi River but it does not recognize the value of protecting existing highly productive farmland from flooding. Therefore, alternative B3.1 was selected as the recommended plan for the New Madrid Floodway because it is the NED plan and provides the greatest compromise between competing economic benefits and environmental impacts.

USACE and the project sponsor are committed to adaptively managing the project following construction. Future adaptive management decisions could result in changing the operation of the project that would fall somewhere between alternative B3.1 and alternative B4.1 while achieving the overall objectives of the authorized project. Since all alternatives are economically justified, it is reasonable to conclude that any future adaptive management scenarios would also be justified. Thus, alternatives A3 and B3.1 is the recommended plan. Mitigation will be provided to compensate for the significant impacts of this plan. The project will be operated (gate opening, pump operation) according to the plan. In the event that monitoring demonstrates a need, adaptive management decisions could change project operations towards a scenario that is described in alternative B4.1.