Three Rivers Southeast Arkansas
Integrated Feasibility Report and Environmental Assessment

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EXECUTIVE SUMMARY

The Three Rivers Southeast Arkansas Feasibility Study (the Three Rivers Study), which encompasses the confluence of the Arkansas and White rivers with the Mississippi River in southeast Arkansas, is being conducted by the U. S. Army Corps of Engineers (USACE) to study the McClellan-Kerr Arkansas River Navigation System (MKARNS) in an effort to seek a long-term sustainable navigation system that promotes the continued safe and reliable economic use of the MKARNS.

The Three Rivers study area is located in a rural section of Arkansas and Desha counties, in southeast Arkansas (Figure A). The study area is about 208 square miles in total and includes approximately 64 square miles of the Dale Bumpers White River National Wildlife Refuge (the Refuge), currently owned and operated by the U. S. Fish and Wildlife Service (USFWS). Other landowners located within the study area include the Arkansas Game and Fish Commission, USACE, Anderson Tully Timber Company, and multiple local hunt clubs. The study area is large enough to capture long term impacts to the environment that may occur some distance from the footprint of the project due to changes a project could have on the hydrology of the region. The project area is defined as the isthmus between the rivers where they are close together in near the center of the larger study area (see Figure A).

The Ark-White Cutoff General Reevaluation Study was conducted by USACE to address this issue, however in 2009, the No Action Alternative was recommended and the study terminated due to potential impacts the preferred alternative might have on the USFWS Refuge.

Problem Identification and Existing Conditions

There is a risk of breach of the existing containment structures near the entrance channel to the MKARNS on the White River. During high water events, water backing up the Mississippi can create significant head differentials between the Arkansas and the White rivers. The existing containment structures are subject to damaging overtopping, flanking and seepage that could result in a catastrophic breach. The uninhibited development of a breach, or cutoff, has the potential to create various navigation hazards, increase the need for dredging, and adversely impact an estimated 200 acres of bottomland hardwood forest in the isthmus between the Arkansas and White rivers.

A cutoff between the Arkansas and White rivers would allow uncontrolled sediment deposition, cross flows, and would create a shallow navigation channel in the White River. Headcutting is a term used throughout this report to refer to a form of erosion that occurs when a channel is in its infancy, forming a natural stream slope and channel capacity. It is the cause of a potential cutoff for study area. Headcutting involves the initiation of channel incision at a particular point, generally called a "knick point", as the streambed elevation adjusts to a particular flow or stream slope disturbance, either natural or man-made. As the headcutting progresses, streambanks slough into the stream and are eroded. The eroded streams become more incised and unstable. If left in an unstable condition, the active headcutting then migrates upstream from the point of origin. Streambank and streambed erosion continues until equilibrium is reached between the stream slope and channel capacity that cause flow velocities to become more uniform.

A multi-component soil-cement containment system was completed within the project area in 1992 to reduce the chance of a cutoff forming as a result of active headcutting and erosion across the isthmus that began in the early 1970s. This system included the Historic

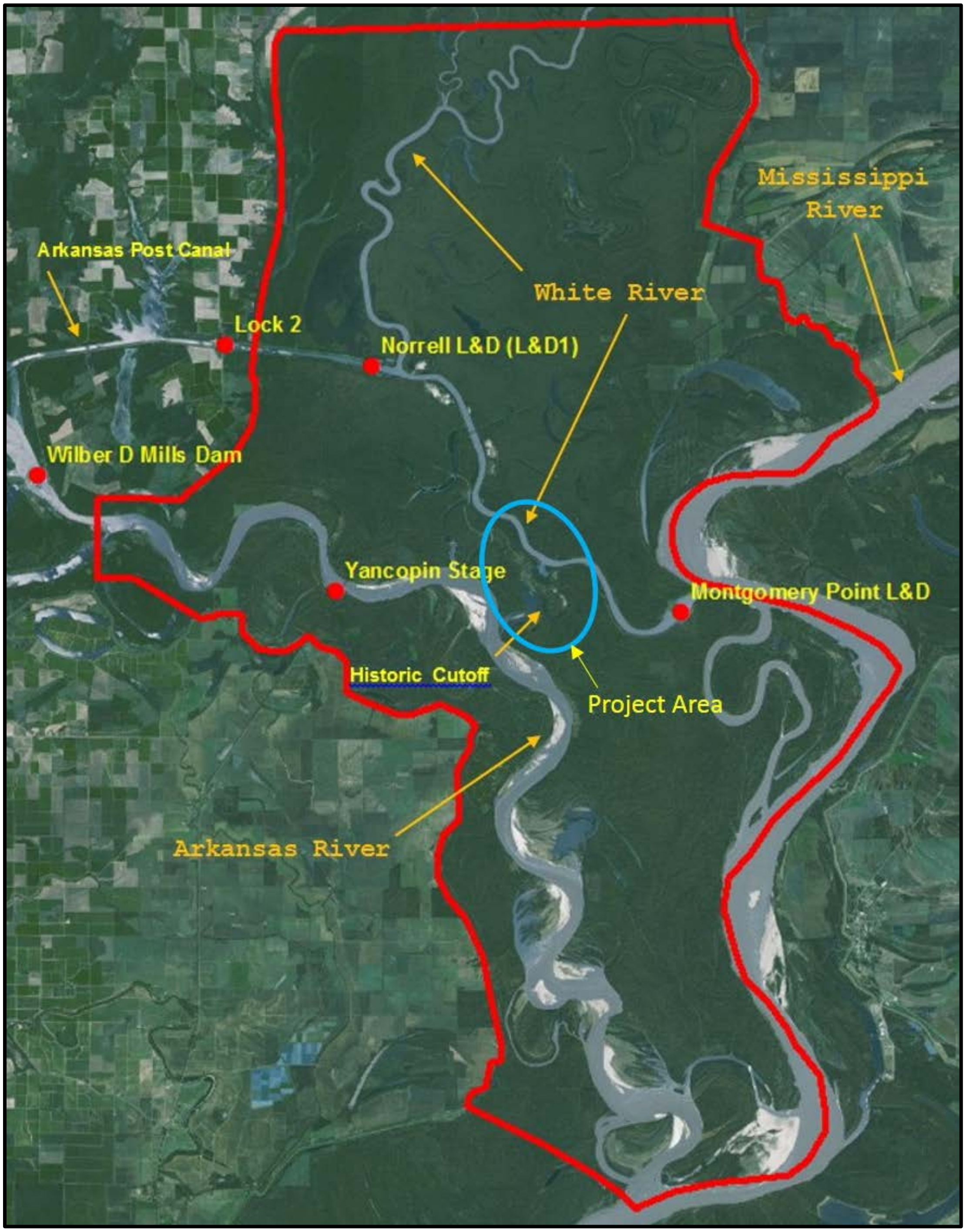

Figure A: Three Rivers Southeast Arkansas Study Area and Project Area.

Cutoff, which closed the path water used to cross the isthmus historically, the Melinda Headcut structure constructed to stop headcutting from the Arkansas River into Owens Lake, and linear soil-cement dike structure running east-west across the isthmus along the south side of the White River. However, headcutting continues to threaten the navigation system as high water could breach these structures, erode land, and cause a cutoff. Maintenance to repair damaged structures and prevent new headcuts continues to increase in cost and frequency.

Navigation is threatened by a risk of failure of any of the existing containment structures. Failure is defined in this study to mean the formation of an uncontrolled cutoff pathway between the Arkansas and White rivers within the project area. Failure can be caused by overtopping, erosion, flanking and seepage, or a combination of such processes. Failure of any structure affects the consistent safe use of the MKARNS and results in continued Federal investment in short term maintenance solutions to prevent long term lost navigation.

Since construction began in 1989, some $22,900,000 (in FY 2017 dollars) have been spent to construct containment structures in the area. This averages roughly $850,400 dollars annually (in FY 2017 dollars).

The goal in formulating alternatives in this study was to maximize National Economic Development benefits while meeting a varied combination of reducing the maximum head differential, reducing isthmus velocities, reducing the duration of the extreme values during overtopping events, and controlling the location of overtopping events. These variables not only address navigation concerns, but also allowed the team to find an environmentally sustainable alternative.

The study team built on the formulation process begun by the 2009 Ark-White Cutoff General Reevaluation Study. Form the measures considered in that study, and by developing engineering criteria that took the above variables into consideration, the team developed two alternatives for further consideration. Alternative 1 consists of the construction of a new stone containment structure on a different alignment, the opening of the Historic Cutoff and demolition of the Melinda Structure (Figure B). Alternative 2 consists of lowering portions of several of the existing structures to allow multiple flow paths across the isthmus (Figure C). The Historic Cutoff would be opened wider and at the same depth as proposed for Alternative 1. The alignment of the existing soil-cement dike would not be altered under this alternative.

Figure B: Alternative 1 Structure Alignment

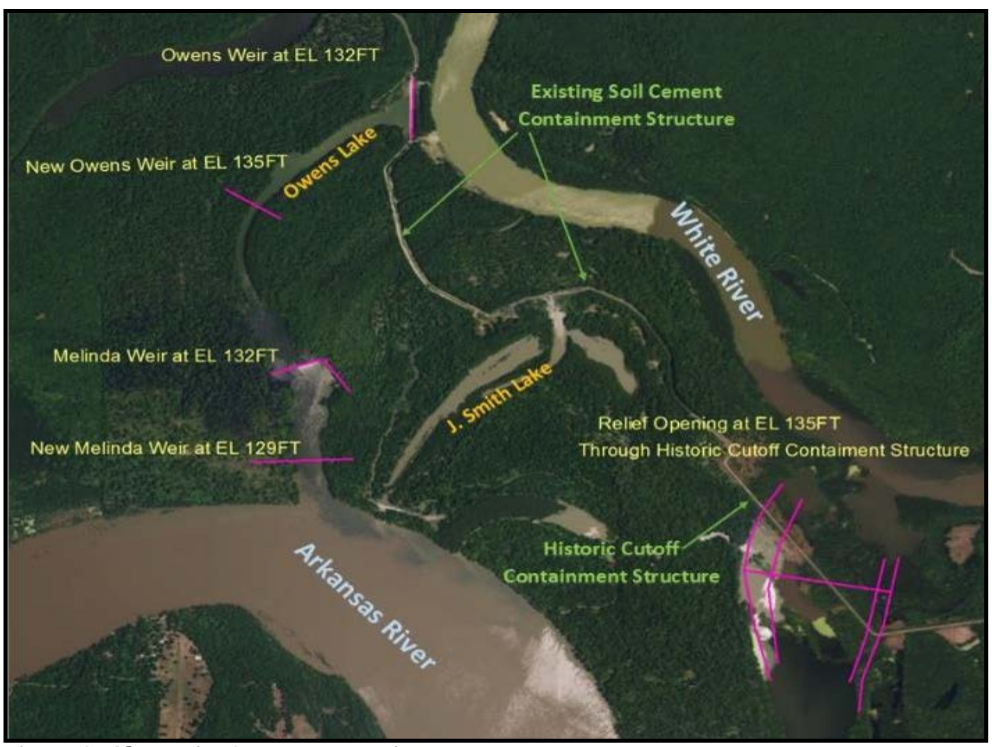

Figure C: Alternative 2 Feature Locations

Project benefits stem from a comparison of without project condition costs to the costs of constructing and operating alternative plans. Differences between the economic costs of an alternative and the economic costs of the without project condition will be either a positive cost savings (if costs of an alternative is less than the cost of the without project condition), or a negative cost savings (if costs of an alternative is more than the cost of the without project condition). Benefits (i.e., avoided costs) consist of repairs and rehabilitation costs for the existing containment structures (Jim Smith and Melinda) and costs associated with new containment structures expected to be implemented over the 50-year period of analysis (2025-2075).

The economic basis for the No Action Alternative consists of the expected costs associated with operating and maintaining the existing containment structures in the project area, the cost of constructing new structures as they are needed, and the potential impacts of a cutoff forming between the Arkansas and White Rivers. A stochastic range of 95% and 5% Exceedance was used to capture the risk and uncertainty surrounding failure of any given structure. Annualized Costs and Lost NED Benefits Associated with the No Action Alternative are approximately $21,954,000. This figure is then considered the annualized cost savings, or benefits, to be gained by a given alternative. The Table below details the costs and benefits from the two alternatives, plus the no action

	No Action	Alternative 1	Alternative 2
Construction, Real estate and Interest	-	$137,653,000	$200,894,000
Mitigation	-	$200,000	$200,000
Total Investment	-	$137,853,000	$201,094,000
Annualized Costs	$21,954,000	$5,742,000	$8,379,000
Annualized Benefits	$0	$21,726,000	$21,726,000
Net Benefits	$0	$15,944,000	$13,347,000
Benefit Cost Ratio	0	3.8	2.6

Recommended Plan

Alternative 1 is the recommended plan. Alternative 1 consists of a newly constructed containment structure at an elevation of 157 feet above mean sea level (ft msl). This structure would be approximately 2.5 miles long (see Figure B). The new structure would begin on natural high ground just south and west of the existing Melinda Structure located on the south side of Owens Lake. It would continue east and cross the Melinda Headcut south of the existing Melinda Structure. From there, it would head northeast and connect to the existing containment structure north of Jim Smith Lake. It continues to follow the existing soil cement containment structure alignment terminating at the existing Historic Cutoff Structure. Because this layout takes advantage of natural high ground, in most locations it would only rise some five to seven feet above the ground surface, and would be no more than 10 feet above the ground surface at its highest point. This alternative includes an opening at the Historic Cutoff. The optimal width of the opening will be determined during design, but will be at elevation 145 ft msl regardless of the width. The new opening reduces, or at least does not increase, the maximum head differential across the isthmus allowing USACE to control the location of future overtopping events and decreases the duration of the head differential, which provides for safe navigation. It will decrease isthmus velocities. Further, the opening will restore the function of Webfoot Lake and reduce erosion on the east side of the lake, which has existing nick points that may lead to future head cutting. In addition to the stone containment structure, the existing Melinda Structure would be demolished in place (the debris will be pushed into the deep scour hole at the top of the head cut) as part of Alternative 1. This reduces the turbulence of the water against the toe of the new containment structure increasing its resiliency. Removal of the structure would also allow Owens Lake to reconnect to its former southern limb, returning open water function to the oxbow element of the flooded bottomland hardwood ecosystem that has been severely degraded by the construction, operation and maintenance of the MKARNS. Finally, alteration of the structure between Owens Lake and the White would prevent water from backing up into Owens which could impact the bottomland hardwood forest. Overall, the current hydrology in the surrounding bottomland hardwood forest will not be changed. Navigation would continue with no change in the current operation of the MKARNS.

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CHAPTER 1: INTRODUCTION

The Three Rivers Study, which encompasses the confluence of the Arkansas and White rivers with the Mississippi River in southeast Arkansas, is being conducted by the U. S. Army Corps of Engineers (USACE) to study the McClellan-Kerr Arkansas River Navigation System (MKARNS) in an effort to seek a long-term sustainable navigation system that promotes the continued safe and reliable economic use of the MKARNS.

There is a risk of breach of the existing containment structures near the entrance channel to the MKARNS on the White River. During high water events, water backing up the Mississippi can create significant head differentials between the Arkansas and the White rivers. The existing containment structures are subject to damaging overtopping, flanking and seepage that could result in a catastrophic breach. The uninhibited development of a breach, or cutoff, has the potential to create various navigation hazards, increase the need for dredging, and adversely impact an estimated 200 acres of bottomland hardwood forest in the isthmus between the Arkansas and White rivers. The project area is defined as the isthmus, or land, between the rivers where they are close together in near the center of the larger study area (Figure 1).

Study Location*

The Three Rivers study area is located in a rural section of Arkansas and Desha counties, in southeast Arkansas (see Figure 1). The Project Delivery Team (PDT) developed the study area boundary in consultation with Federal and state resource agencies. The study area is about 208 square miles in total and includes approximately 64 square miles of the Dale Bumpers White River National Wildlife Refuge (the Refuge), currently owned and operated by the U. S. Fish and Wildlife Service (USFWS).

Study Purpose and Need*

The purpose of this study is to develop and analyze alternatives that would lead to long-term environmentally sustainable navigation on the MKARNS, prevent lost navigation during large-scale repairs and address the continuing short term maintenance costs of the existing structures.

A cutoff between the Arkansas and White rivers would allow uncontrolled sediment deposition, cross flows, and would create a shallow navigation channel in the White River. Headcutting is a term used throughout this report to refer to a form of erosion that occurs when a channel is in its infancy, forming a natural stream slope and channel capacity. It is the cause of a potential cutoff for study area. Headcutting involves the initiation of channel incision at a particular point, generally called a "knick point", as the streambed elevation adjusts to a particular flow or stream slope disturbance, either natural or man-made. As the headcutting progresses, streambanks slough into the stream and are eroded. The eroded streams become more incised and unstable. If left in an unstable condition, the active headcutting then migrates upstream from the point of origin. Streambank and streambed erosion continues until equilibrium is reached between the stream slope and channel capacity that cause flow velocities to become more uniform.

A headcut containment system was constructed within the project area by 1992 to reduce the chance of a cutoff forming as a result of active headcutting and erosion across the isthmus that began in the early 1970s. However, headcutting continues to threaten the navigation system as high water could breach these structures, erode land, and cause a cutoff. Maintenance to repair damaged structures and prevent new headcuts continues to increase in cost and frequency. The numerous structures constructed in the area to address headcutting and erosion are detailed below.

Navigation is threatened by a risk of failure of any of the existing containment structures. Failure is defined in this study to mean the formation of an uncontrolled cutoff channel between the Arkansas and White rivers within the project area. Failure can be caused by overtopping, erosion, flanking and seepage, or a combination of such processes. Failure of any structure affects the consistent safe use of the MKARNS and results in continued Federal investment in short term maintenance solutions to prevent long term lost navigation.

Study Authority

Section 216 of the Flood Control Act of 1970 (Public Law 91-611) authorizes a feasibility study due to examine significantly changed physical and economic conditions in the Three Rivers study area. The study will evaluate and recommend modifications for long-term sustainable navigation on the MKARNS. Section 216 of the Flood Control Act of 1970 (Public Law 91-611) states:

> "*The Secretary of the Army, acting through the Chief of Engineers, is authorized to review the operation of projects the construction of which has been completed and which were constructed by the Corps of Engineers in the interest of navigation, flood control, water supply, and related purposes, when found advisable due to significantly changed physical or economic conditions, and to report thereon to Congress with recommendations on the advisability of modifying the structures or their operation, and for improving the quality of the environment in the overall public interest*."

Public Law 525, 79th Congress, Chapter 595, known as the River & Harbor Act of July 24, 1946, authorized the development of the Arkansas River and its tributaries for the purposes of navigation, flood control, hydropower, and recreation.

> *"Be it enacted…..That the following works of improvement of rivers, harbors, and other waterways are hereby adopted and authorized to be prosecuted……*

> *…..Arkansas River and tributaries, Arkansas and Oklahoma: The multiple-purpose plan recommended in the report of the Chief of Engineers dated September 20, 1945, and the letter of the Chief of Engineers dated March 19, 1946, is approved, and for initiation and partial accomplishment of said plan there is hereby authorized to be appropriated the sum of $55,000,000;"*

Public Law 91-649 stated that the project would be known as the McClellan-Kerr Arkansas River Navigation System (MKARNS). Construction of the project began in 1957 and the current 9-foot deep channel was opened to navigation in 1971. Section 136 of the Energy and Water Development Act of 2004 authorized a navigation channel depth of 12 feet, the channel is currently maintained at 9 feet within the study area.

USACE conducted the Arkansas-White River Cutoff Study General Re-evaluation Report (Ark-White Study) to address the same problems the current study is seeking to resolve under the original 1946 Rivers & Harbors Act (USACE 2009). That study was terminated in 2009 when an impasse was reached between USACE and the USFWS over environmental impacts of the proposed project design that were not compatible with the National Wildlife Refuge System Improvement Act of 1997 (16 U.S.C. 668dd-668ee). Several other environmental agencies and groups were also opposed to the proposed 2009 design. As a result, USACE selected the No Action plan, and terminated the Ark-White Study.

Scope*

Based on the Section 216 authority, the study is investigating alternatives that would minimize the risk of cutoff development, including reducing the cost of maintence associated with preventing cutoff development, while minimizing impacts to the surrounding ecosystem.

<u>Ecosystem Restoration</u>

Pursuant to the Section 216 authority, the Three Rivers Southeast Arkansas study sought to address ecosystem degradation that has resulted from the construction, operation and maintence of the MKARNS. An Environmental Team made up of USACE, USFWS, the Arkansas Game and Fish Commission (AGFC), the Arkansas Natural Heritage Commission (ANHC), and the Arkansas Natural Resources Commission (ANRC) followed the USACE planning process, by identifying problems, opportunities, and measures for Ecosystem Restoration (ER). After thoroughly reviewing the functionality and degradation of various systems in the study area, the team determined oxbow lakes as having been significantly altered from the historic state. Measures were developed to restore form and function to the oxbow lakes, including fish passage that would allow for reliable access to spawning and nursey habitat during critical periods. However, formulation did not move beyond the step of developing measures. USACE was unable to secure a suitable non-Federal sponsor to cost share in the implementation of ER features as required by Section 7007 of the Water Resources Development Act of 1986, as amended. Therefore, ER was not carried forward through alternative development. The Three Rivers Southeast Arkansas Feasibility Report and Integrated Environmental Assessment does not include additional discussion of the ER formulation nor make recommendations for implementation of any ER measures or alternatives.

History of Control Structures within the Study Area

Navigation traffic enters the MKARNS through the White River from the Mississippi River after passing over or locking through Montgomery Point Lock and Dam. The traffic then travels through a 9 mile-long canal with two locks that raises vessels to the water level of the Arkansas River pooled by Dam 2 (See Figure 1). The navigation system provides a year-round navigation channel with a minimum depth of nine feet.

The Flood Control Act of 1928 and other subsequent legislation provided authorization for USACE to modify the Mississippi River to provide safe and dependable navigation and reduce flooding. USACE accomplished this objective through dredging, constructing stone bank stabilization structures and shortening the Mississippi River by approximately 150 miles between Memphis, Tennessee, and Old River, Louisiana by excavating bendway cutoffs that made shortcuts out of large river bends.

These changes steepened the stream slope, accelerated water velocities causing an immediate flowline lowering during higher flows near Arkansas City, AR, (approximately 35 miles downstream of the mouth of the White River) and a migration of the Mississippi River into the White River. This had two effects: the White River connects to the Mississippi River at a higher water surface elevation than it had previously, and the shortened White River stream length results in a shorter backwater response time in the historic cutoff; the natural path by which waters of the White historically flowed across to the Arkansas and vice versa. The changes in the Mississippi allowed more water to flow through the historic cutoff because it was closer to the

Mississippi River in stream distance and because the mouth moved upstream to be effected by a higher Mississippi River stage.

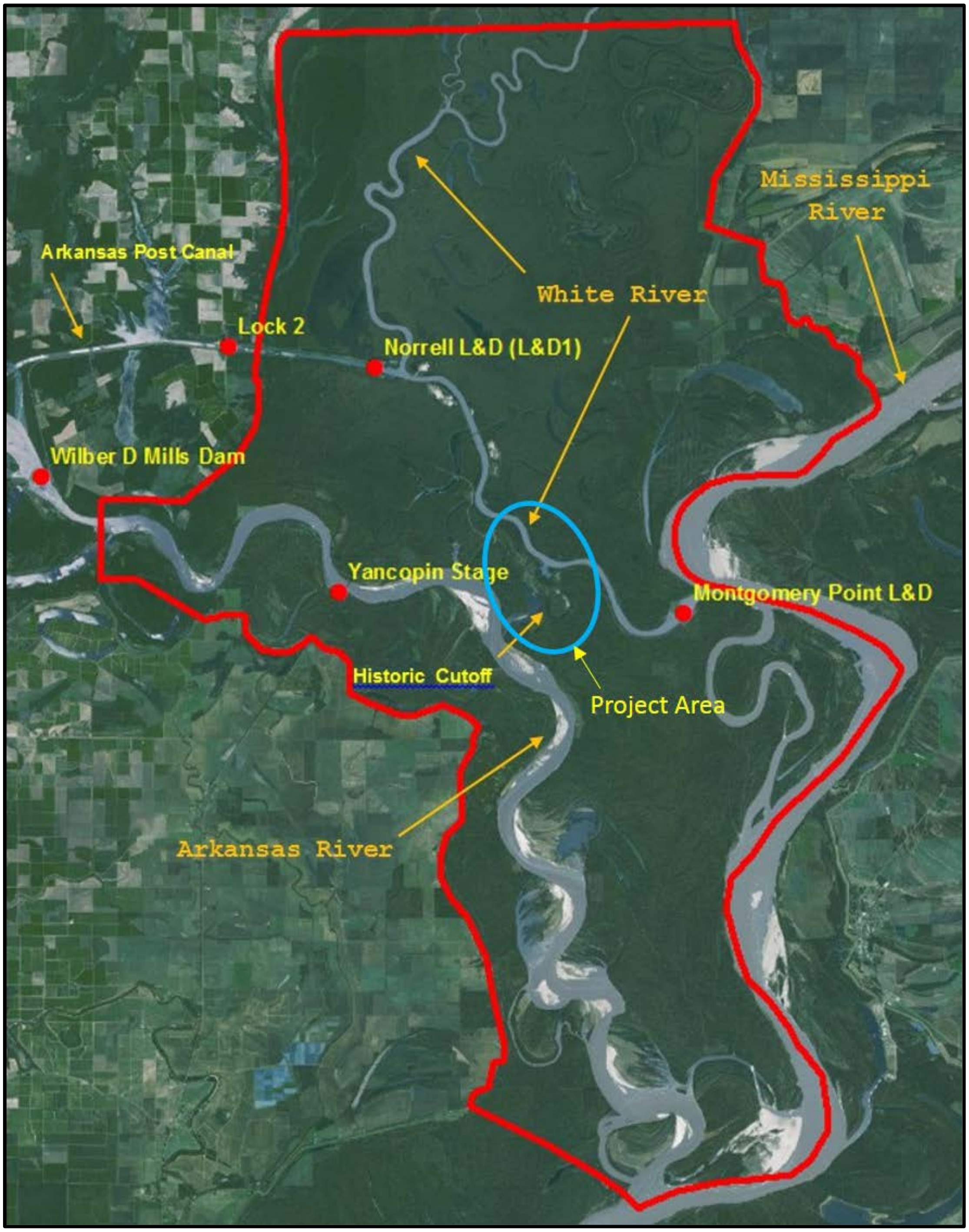


Figure 1: Project Location Map

The following section describes the construction of the various containment structures designed to control the flow between the Arkansas and White rivers and reduce the potential for dangerous navigation conditions.

Historic Cutoff Structure

Allowing water to flow uncontrolled across the historic cutoff presented two problems: 1) dangerous cross currents sometimes occurred in the White River when flow passed through the cutoff between the rivers and 2) the historic cutoff could contribute sediment into the White River Entrance Channel at a high rate when flows come across from the Arkansas River to the White River because of the Arkansas River's higher sediment load. For these reasons, the historic cutoff was closed in 1963 to avoid the possible navigation risk and lower the dredging cost. The natural flow path was closed with a soil cement structure that prevents most flows from passing between the rivers, although during especially high flows it is designed to be overtopped (Figure 2). The elevation of the Historic Cutoff Structure is 170 feet above mean sea level (msl).

The Containment Structure

The Historic Cutoff Structure performed as intended. However, in 1973, the first year of unusually high water on the Mississippi following construction of the MKARNS, a new small headcut was noticed on the Arkansas River, running up through the isthmus west of the historic cutoff. Over the next two decades, the headcut grew when Mississippi stages at the mouth of the White River produced backwater high enough to push flow across the isthmus to the Arkansas River. The headcut channel came to be known as the Melinda Corridor. In 1989, the Containment Structure was authorized to try to control headcutting throughout the area. The Containment Structure actually consists of several separate structures designed to perform together. These include approximately 17,300 feet of soil-cement dike, a rock weir at LaGrues Lake, the Owens Lake Structure, and the Melinda Headcut Structure (see Figure 2). This system of structures was designed to reduce the amount of cross flow between the Arkansas and White rivers while allowing some inflow into Owens Lake to sustain the lake water. The Melinda Structure was constructed first to curtail the headcut moving north across the isthmus from the Arkansas River. The dike style Containment Structure stretching from the western terminus of the Historic Cutoff Structure west across Jim Smith, Owens and LaGrues lakes was constructed between 1989 and 1992. The Owens Lake Structure, part of the soil-cement dike containment system, began construction in the summer of 1991 and was completed by the spring of 1992. Crest elevation is elevation 145.0, three feet higher than that of Melinda Structure. In 2004, two structures were constructed in Jim Smith Lake to reduce the risk of a breach between the Arkansas and White rivers through that failure path. These structures were constructed of geotubes filled with sand and topped with soil and live willow fascines. One structure was on the south end of the lake near the Arkansas River, and the other was on the north end adjacent to the soil-cement structure.

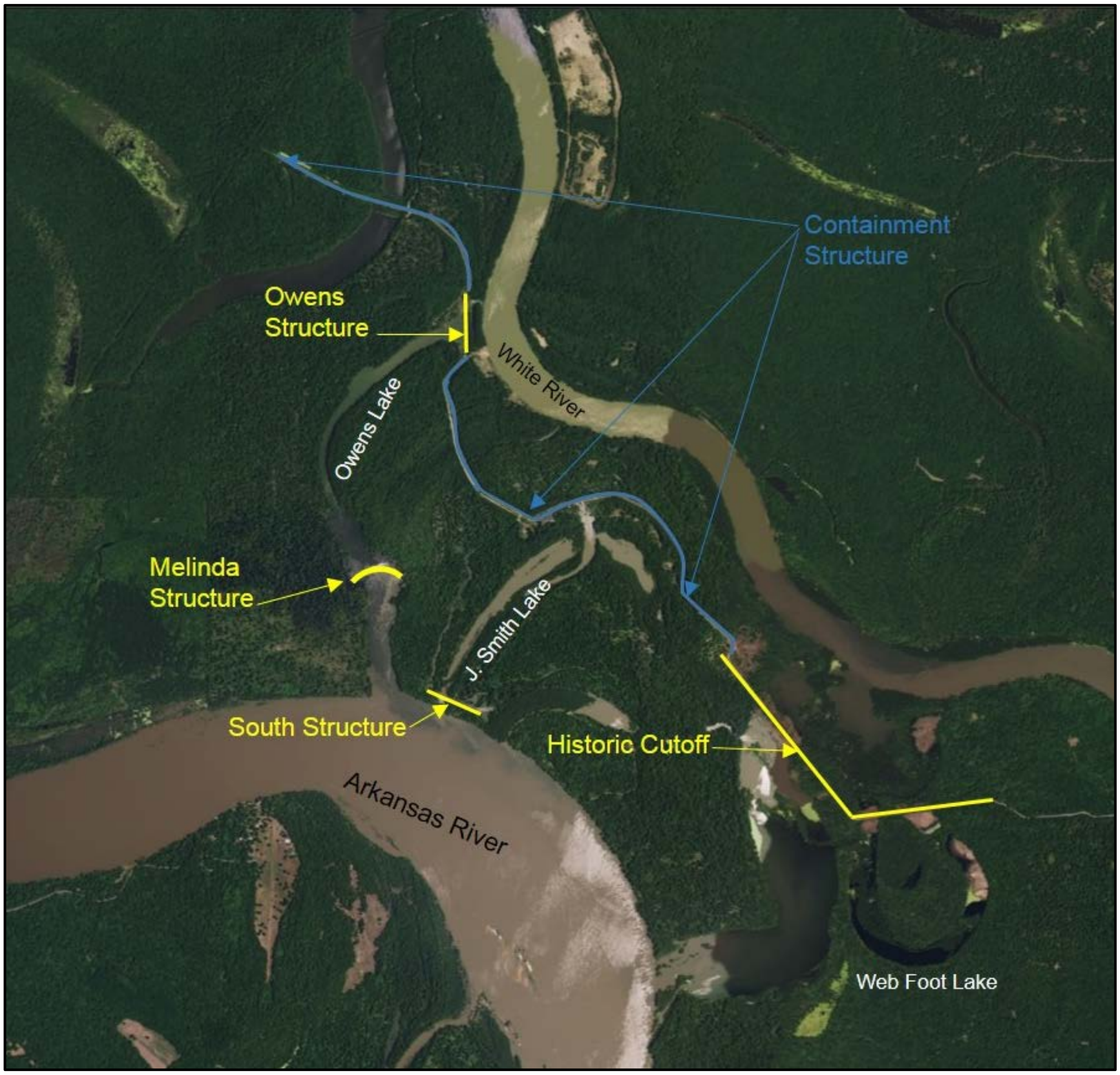


Figure 2: Previously constructed structures within the project area

History of Repairs to Structures

This section chronicles the various repairs that the above structures have required to control headcutting, erosion and flanking that could lead to failure of the containment system. The costs for the repairs is provided at the end of the section.

<u>Melinda Structure</u>

Completed in 1989, the Melinda Structure has been repaired numerous times since inception, due to damage to the structure and continued widening and deepening of the headcut corridor. The Melinda Structure was first damaged in 1990 as spring flooding inundated the area. Not only was the structure damaged, but extensive erosion occurred to the land between the White River and Owens Lake. The Melinda Structure was repaired by adding larger size rock on a flatter slope than the original construction slope, and adding a concrete cap to replace the damaged layers of soil-cement.

The Melinda Structure was again damaged in February of 1991 when half of the width of the structure failed on the Arkansas River side. Total failure occurred less than a month later before repairs could be made. The structure was re-built by adding larger rock at a still flatter slope and additional stone was added at the base to make it even wider.

By 1994, bank erosion was occurring at a significant rate around the Melinda Structure. In an effort to reduce the risk of the structure being flanked on the left descending bank line towards the Arkansas River, a revetment approximately 700 feet long was added to the structure.

A scour hole developed on the south side of the Melinda Structure. The hole grew to a depth of approximately 90 feet below the crest of the structure and in 1997 caused a slope failure adjacent to the crest of Melinda Structure. Stone was added to replace the displaced stone on the slope and additional work was identified to stabilize instability caused by the deep hole, however this work was not completed at the time.

In 2000, the scour hole was filled with random fill and capped with large rock (5 foot thickness of stone with maximum weight of 5,000 pounds) to better stabilize the Melinda Structure. The structure is still considered in poor condition because of displaced stone around the structure, cracked and displaced soil-cement and continued erosion surrounding the structure that could eventually flank it. The structure was damaged again in 2005, but the containment structure remained intact.

<u>Jim Smith Headcut Control Structures</u>

By 2002, the Arkansas River had migrated northward enough to capture Jim Smith Lake and the Containment Structure near the north end of Jim Smith Lake had to be repaired. In 2004, the two geotube structures were placed at either end of Jim Smith Lake in response. However, in February 2005, approximately 11 months after completion, both of the geotube weir structures on Jim Smith Lake were significantly damaged due to high water. In the same year, rock was added to the north end of Jim Smith Lake on a relatively flat slope to repair the damaged geotube structure and to better manage the high flow that crosses to the Arkansas River. The structure at the south end could not repaired at the time due to funding constraints.

The South Structure was repaired in January 2009 by adding rock on top of dredged fill. The slopes were constructed on a relatively flat slope (1 vertical: 10 horizontal). The compaction of the fill material combined with the fabric material between the dredged fill and rock provides a mostly impervious structure for the lake.

Cost of Repairs to Date

Table 1 below lists the costs associated with the repairs described in the section above. The actual cost at the time of repair is listed and those costs are also updated to 2016 dollars based on the USACE Civil Works Construction Cost Index System for levees and floodwalls.

Table 1: Historical Costs of Repairs to Structures within the Three Rivers Study Area. Note, years during which no repairs were made are not listed.

Year	Event	Construction Cost (adjusted to FY17 Dollars)
1990	Melinda structure repaired	$1,029,887
1991	Soil cement levee repaired	$2,265,752
1994	Melinda revetment constructed	$596,502
1998	Melinda slope failure repair	$695,971
2000	Melinda scour hole repaired	$3,163,600
2003	Geotubes installed	$2,498,509
2006	Geo tubes levees repaired	$2,194,408
2014	Melinda and Jim Smith soil cement repairs and flanking repairs	$10,515,347
	Total	**$22,959,976**
	Average Annual	**$850,369**

Funding for needed repairs in this section of the system cannot be guaranteed given the growing Operation, Maintenance, Repair, Replacement, and Rehabilitation (OMRR&R) needs throughout the system. Further, repairs on existing structures are not reliable in the long term and many structures will require extensive rehabilitation or replacement over the period of analysis for this study.

CHAPTER 2: AFFECTED ENVIRONMENT*

The purpose of this chapter is to describe the existing condition in the project area and the future condition without implementation of a project (the No Action condition forecast). These analyses will be described in terms of the following:

- Land Use
- Air Quality
- Climate
- Geologic Resources
- Water Resources
- Biological Resources
- Cultural Resources
- Recreation and Aesthetics
- Transportation
- Socioeconomics and Environmental Justice
- Hazardous, Toxic, and Radioactive Waste (HTRW)

Existing Condition

This chapter establishes a baseline for each of the following resources within the study area; land use, air quality, climate, geologic resources, water resources, biological resources, cultural resources, recreation and aesthetics, transportation, socioeconomics and environmental justice and hazardous, toxic, and radiologic waste.

Based on the environment as described, future without project conditions were projected for the study period of analysis (50 years beginning in 2025). The chapter concludes with descriptions of the future without project (no action) conditions, which will be used as a baseline for measuring the impacts and benefits of alternative plans.

Study Location and Description

The Three Rivers Study Area is located in a rural section of Arkansas and Desha counties, in southeast Arkansas (Figure 3). The study area boundary was developed in consultation with several resource agencies, including the U.S. Fish and Wildlife Service (USFWS), Arkansas Game and Fish Commission (AGFC), Arkansas Natural Heritage Commission (ANHC), Arkansas Natural Resources Commission (ANRC), and the National Park Service (NPS) and is intended to be large enough to capture long term impacts to the environment that may occur some distance from the footprint of the project due to changes a project could have on the hydrology of the region. . In contrast to the larger *study area*, the smaller *project area,* is limited to the area where construction will be proposed and direct impacts of the proposed project analyzed.

Land Use*

Land use within the region includes timber production, agriculture, and public lands. Public lands, as well as some private lands are managed for wildlife and recreation. Approximately 75 percent of the study area is covered by forest, 10 percent by permanent water, 5 percent by sandbars and old fields, 5 percent by levees/berms and roads, and 5 percent by agriculture.

Public Lands

Approximately 51, 095 acres of the study area (38%) is made up of public lands owned by USACE, AGFC, and USFWS (Figure 4). The predominate public lands within the project area is the Dale Bumpers White River National Wildlife Refuge, which is approximately 160,000 in size, with approximately 40,825 acres within the study area and the remaining acreage immediately north of the study area. The refuge was established in 1935 for the protection of migratory birds. Today, it offers boating, camping, fishing, hunting, wildlife watching, and hiking opportunities to the public. It is one of the most important areas for wintering waterfowl in North America.

The Trusten Holder Wildlife Management Area (WMA) contains approximately 10,268 acres in Arkansas and Desha Counties and is cooperatively owned and managed by AGFC, USACE and USFWS. Within the study area, AGFC owns 4,406 acres, USACE owns 911 acres, and USFWS owns 1,490 acres. The area was purchased in 1973 for the purposes of protecting prime bottomland hardwood tracts. The WMA is open to the public for recreational opportunities such as hunting and fishing, hiking, camping, and wildlife watching.

Private Lands

Private lands account for approximately 83,648 acres (62%) of the study area. Private lands are predominantly used for agriculture, timber and hunting purposes. Residences and commercial developments are uncommon within and adjacent to the study area. Agricultural crops such as rice, cotton, soybeans, winter wheat, and some corn are grown on private lands there were converted from previous bottomland hardwood forests.

Large private landowners within the study area include: Anderson-Tully Co. who owns approximately 42,000 acres (50.2%), Mozart Hunting Club owns 5,467 acres (6.5%), Montgomery Island Timber Co. owns 4,272 acres (5.1%), Yancopin Hunting Club owns 2,978 acres (3.6%), and individual landowners make up the remaining 28,931 acres (34.6%) (Figure 4).

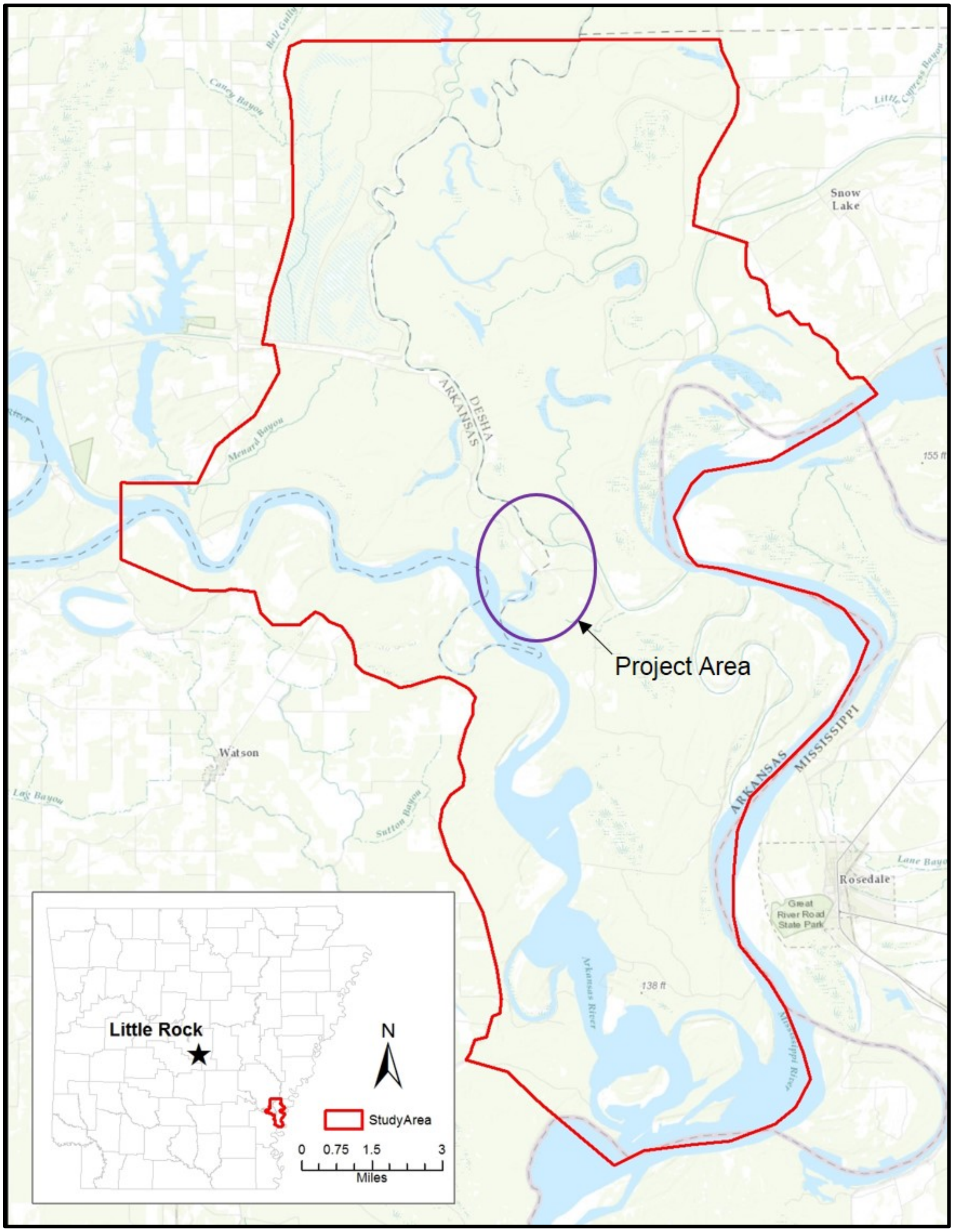


Figure 3: Three Rivers Study Area and Project Area Boundaries

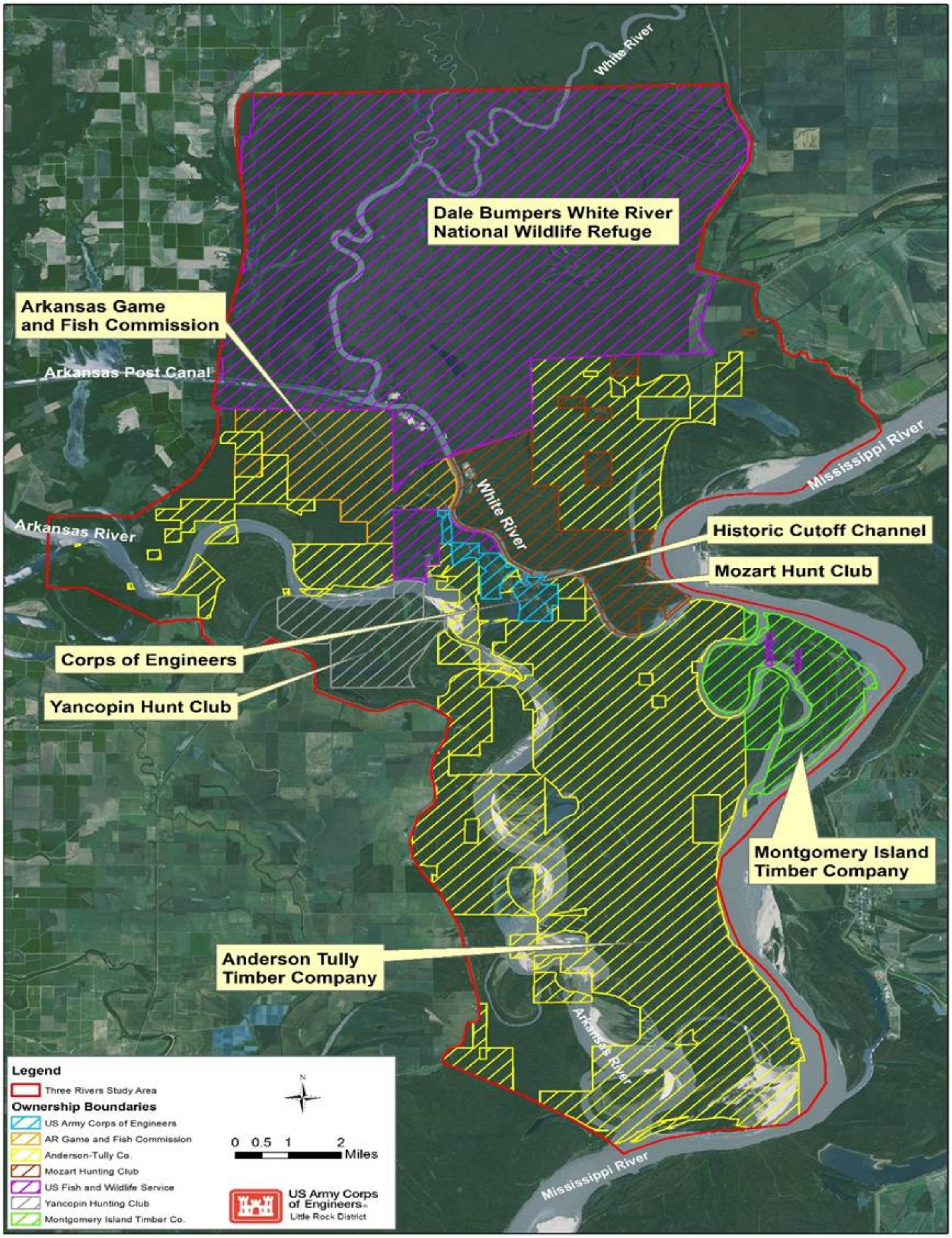


Figure 4: Property Ownership within the Study Area.

Air Quality*

The U.S. Environmental Protection Agency (EPA) has the primary responsibility for regulating air quality nationwide. The Clean Air Act (42 U.S.C. 7401 *et seq*.), as amended, requires the EPA to set National Ambient Air Quality Standards (NAAQS) for wide-spread pollutants from numerous and diverse sources considered harmful to public health and the environment. The Clean Air Act established two types of national air quality standards classified as either "primary" or "secondary." Primary standards set limits to protect public health, including the health of at-risk populations such as people with pre-existing heart or lung diseases (such as asthmatics), children, and older adults. Secondary standards set limits to protect public welfare, including protection against visibility impairment, damage to animals, crops, vegetation, and buildings.

EPA has set NAAQS for six principal pollutants, which are called "criteria" pollutants. These criteria pollutants include carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (O_3), particulate matter less than 10 microns (PM_{10}), particulate matter less than 2.5 microns ($PM_{2.5}$), sulfur dioxide (SO_2) and lead (Pb). If the concentration of one or more criteria pollutants in a geographic area is found to exceed the regulated "threshold" level for one or more of the NAAQS, the area may be classified as a non-attainment area. Areas with concentrations of criteria pollutants that are below the levels established by the NAAQS are considered either attainment or unclassifiable areas.

The study area is located within the Central Arkansas Intrastate Air Quality Control Region (40 CFR Part 81). The area is classified as being in attainment for all NAAQS. The study area is in a rural part of Arkansas with generally good air quality and no known sources of significant air pollution emissions.

Climate*

The climate of the study area is classified as "humid subtropical" and is characterized by long summers, relatively short winters, and a wide range in temperatures. Generally, there is a significant amount of precipitation in every month, and temperatures tend to be mild compared with the northern part of the country.

The average annual temperature in the study area is 63°F, with average annual high temperatures of 74°F and average annual low temperature of 52°F. The Study Area receives approximately 53 inches of rain, with August typically being the driest month of the year. The months in late spring and late fall to early winter are generally the wettest. Summer precipitation primarily occurs during rainstorms, where locally high rainfall amounts can occur over a short period of time. During the fall, winter, and early spring, precipitation events are usually less intense and of longer duration. The majority of the precipitation falls as rain; snow rarely occurs here. Although the study area receives precipitation throughout the year, droughts of short duration are frequent and are accentuated by high evaporation rates during the growing season.

Arkansas is frequented by severe weather, especially during the spring. Severe weather events often take the form of ice storms, severe thunderstorms, high winds, hail, lightening, heavy rainfall, and tornadoes. From 1950-2013, 1,714 (26+ per year) tornadoes have occurred statewide, generally tracking from southwest to northeast.

Geologic Resources

Geological resources are defined as the topography, geology, mining, and soils of a given area. Topography describes the physical characteristics of the land such as slope, elevation, and general surface features. The geology of an area includes bedrock materials and mineral deposits. Mining refers to the extraction of resources (e.g. gravel). The principal geologic factors influencing the stability of structures are soil stability, depth to bedrock, and seismic properties. Soil refers to unconsolidated earthen materials overlying bedrock or other parent material.

Geology*

The study area is located in the Mississippi River Alluvial Plain, a physiographic subdivision of the Gulf Coastal Plain Province. Deposits have been laid down by the Mississippi, Arkansas, White, and other streams and rivers traversing the area after the melting of the continental glaciers. The deposits are divided into two major classifications: 1) Quaternary Terrace and 2) Recent Alluvium. Generally these deposits grade from sand and gravel at their contact with the underlying Tertiary formation to heterogeneous deposits of sand, silt, and clay at the ground surface. The Quaternary deposits are generally at higher topographic positions and more firm due to their greater age. The surficial deposits of the Recent Alluvium have been divided into four categories: point bars, natural levees, backswamps, and channel fills. The four surface groups are generally not recognizable in the Quaternary deposits due to being reworked and deposited.

Topography*

There is approximately 75 feet of topographical relief in the study area. Topographical relief ranges from approximately 115 feet National Geodetic Vertical Datum (NGVD) in the southeast portion (bank of Mississippi River at River Mile 580) of the study area to approximately 190 feet NGVD in the northwest portion of the study area on top of the levee. It should be noted however, that the natural topographic relief in the immediate study area is much less at 45 feet with elevations ranging from 160 feet NGVD near Trusten Holder WMA to 115 feet NGVD at the bank of the Mississippi River.

Although relatively flat, the topography of the basin can be somewhat complex, with numerous current stream and river channels, old meanders, and oxbow lakes surrounded by one or more terrace levels or bottoms. The topography is usually one of three basic types:

- Braided-stream terrace: displays a characteristic dendritic drainage pattern;
- Meander belts: contain areas of past or present channel migration with numerous parallel, crescent-shaped ridges and swales; and
- Backswamps: flat areas that remained peripheral to channel migration and slowly filled with layers of fine sediments.

Minerals

The study area does not lie within one of the active oil and gas fields found in Arkansas. Sand is the only potential mining resource available in the study area; however, there are no existing or abandoned pits in the study area.

Soils*

Soils in the study area are for the most part hydric, and the spatial relationships of the various soil types and associations present further evidence of their fluvial (riverine) origin and influence. Soils in the study area are rich and fertile, which led to the drainage and clearing of most of the original forests for conversion to agricultural lands. Most of the soils have a high clay content, which results in their capacity to perch and pond water at the surface but also prevents most areas from contributing to significant groundwater recharge through infiltration.

*Prime Farmlands**

The majority of the study area (approximately 109,100 acres) has soils with prime farmland characteristics. Approximately 60,500 acres are classified as “All areas are prime farmland” or “Farmland of statewide importance,” and an additional 48,600 acres have been classified as prime farmland, but only if the land is drained or protected from flooding or not frequently flooded during the growing season. The prime farmland soils are found outside the riverbanks and behind levees, in areas that are not subjected to frequent ponding and have less than an 8 percent slope. The remaining 25,480 acres in the study area are classified as “Not prime farmland” which includes open water, levees, pits/borrows, riverwash, and soils with a slope greater than 8 percent.

Water Resources

Water resources include both surface water and groundwater resources; associated water quality; and floodplains. Surface water includes all lakes, ponds, rivers, streams, impoundments, and wetlands within a defined area or watershed. Subsurface water, commonly referred to as groundwater, is typically found in certain areas known as aquifers. Aquifers are areas with high porosity rock where water can be stored within pore spaces. Water quality describes the chemical and physical composition of water as affected by natural conditions and human activities. Floodplains are relatively flat areas adjacent to rivers, streams, watercourses, bays, or other bodies of water subject to inundations during flood events. A 100-year floodplain is an area that is subject to a one percent chance of flooding in any particular year, or, on average, once every 100 years.

<u>Hydrology</u>

Under pre-settlement conditions, there were complex hydrologic interrelationships between the tributaries and primary rivers within the ecosystem, and between the lower White River and the Mississippi and Arkansas rivers. All aspects of the hydrologic cycles of the Arkansas, White, and Mississippi rivers have been altered from historic conditions. The numerous development projects including lock, dam and levee construction, meander cutoffs, river training and dredging have each contributed to the alteration of stream gradients, flow regime, and/or sediment regime that characteristically maintained dynamic equilibrium of fluvial systems. These drainage patters have been altered to such an extent that they no longer resemble their natural state. The complex and interconnected hydrology of the three rivers can no longer exploit the numerous sloughs, bayous, channels, swales, oxbows and backswamps that historically provided conduits for the movement of the massive quantities of water flowing down the three rivers and converging in and near the study area.

Constriction of the floodplain by levees, containment structures, and river training reduces the extent of overbank and backwater flooding and created more extensive, prolonged, and deeper inundation than that in which the biotic components of the system evolved. Historically, the Mississippi River and its tributaries flooded millions of acres in the lower Mississippi River Alluvial Valley (MAV). Over 150 miles of flood control structures along the White River and extensive levee system along the Arkansas River have not only reduced the extent of overbank flooding, but have induced forest clearing. Because previously flooded bottomland hardwoods were no longer being flooded, farmers quickly cleared the lands and brought it into agricultural production. The varying distance of levees from the river channel along with elevated roadways and railroad embankments across the floodplain with limited bridge openings create “pinch” points that effectively increase flood heights above these features. These alterations to the floodplain affect all aspects of flood behavior including biogeochemical processes and physiological stress on vegetation and species associated with aquatic environments.

<u>Surface Water</u>

The study area falls within three Hydraulic Unit Code 8 watersheds: Lower Arkansas (08020401), Lower White (08020303), and Lower Mississippi-Helena (08020100). The dominant river in the Lower Arkansas watershed is the Arkansas River, the White River in the

Lower White watershed, and the Mississippi River in the Lower Mississippi-Helena watershed. According to Natural Resources Conservation Service soil survey mapping, approximately 18 percent of the study area is mapped as water. Various types of surface water are present within the study area. Lakes, oxbow lakes, shallow depressions, swales, chutes, sloughs, abandoned channels, flowing channels, and scour holes are present. Sandbars, point bars, rip-rapped banks, collapsing banks, and snags add to the diversity of water types within the area. The United States Geological Survey topographical maps indicate that approximately 5% of the area is covered by marsh/swamp.

The Arkansas River is one of the Mississippi River's largest tributaries. It flows 1,450 miles from the Rocky Mountains in Colorado, through Kansas, Oklahoma, and Arkansas. The drainage basin is approximately 160,500 square miles and includes portions of Missouri, New Mexico, and Texas in addition to the above-mentioned states.

The White River drainage basin covers approximately 27,765 square miles and is approximately 720 miles long. This river flows from the Ozark Highlands through the Mississippi River Alluvial Plain physiographic regions. The White River discharges into the Mississippi River at Mississippi River Mile 599.

The Arkansas and White rivers discharge into the Mississippi River in the alluvial Plain or Mississippi "Delta" physiographic region, occupying the lower Mississippi River basin. The alluvial plain of the Mississippi River stretches across portions of seven states beginning at the confluence of the Mississippi and Ohio rivers near Cairo, Illinois and extending southward to the Gulf of Mexico. This area encompasses approximately 24 million acres including parts of Illinois, Missouri, Kentucky, Tennessee, Arkansas, Mississippi, and Louisiana.

At Helena, Arkansas, near the confluence of the Arkansas, White, and Mississippi rivers, the mean annual flow of the Mississippi River is 480,000 cubic feet per second. Based upon the much larger flow in the Mississippi River compared to the Arkansas and White rivers, flow within the Mississippi River exhibits a major influence on the hydrology of the study area (U.S. Army Corps of Engineers 1990b).

Streams that discharge into or transverse through the study area include Mild Ditch, Sixmile Bayou, Honey Locust Bayou, Scrubgrass Bayou, Deep Bayou, Menard Bayou, Mayhorn Bayou, and Mixture Bayou.

Water levels vary among the seasons, with November to May being the wet months and July to October the dry months. There are approximately 120 small lakes and sloughs that are semi-permanently to permanently flooded. In addition, there are approximately 60 marsh/swamp areas that are expected to be temporarily to seasonally flood within the study area. Large lakes and oxbows within the study area include Goose Lake, Moon Lake, Alligator Lake, Swan Lake, Hole in the Wall Lake, LaGrues Lake, Lake Dumond, and Callie Lake.

*Wetlands**

Common types of wetlands present in the study area include: riparian forest, riparian shoreline, moist bottomland forest, flooded forest, shallow marsh, deep marsh, swamp, shrub swamp, shallow oxbow lakes, sloughs, and sandbars and mudflats.

National Wetland Inventory (NWI) maps indicate that a wide variety of riverine, lacustrine, and palustrine wetlands exist within the study area. NWI maps approximately 70 different wetland classifications in the study area. The palustrine system includes forested, emergent, scrub-shrub, and aquatic bed classes. The riverine system includes lower perennial and intermittent subsystems as well as open water, streambed, unconsolidated bottom, and unconsolidated shore classes. The lacustrine system includes limnetic and littoral subsystems as well as open water, unconsolidated shore, unconsolidated bottom, and aquatic bed classes. Water regimes include temporarily flooded, seasonally flooded, semi-permanently flooded, intermittently exposed, and permanently flooded (U.S. Fish and Wildlife Service 2015).

NWI maps depict wetlands using the USFWS (Cowardin) system of classification. The Cowardin system does not use hydric soils as a parameter and includes open water classifications. Approximately 85% of the study area is classified as wetland under the NWI classification system (U.S. Fish and Wildlife Service 2015).

Clean Water Act

The Clean Water Act (33 U.S.C. SS 1251 et seq.) requires Federal agencies to protect waters of the U.S. The regulation implementing the Act disallows the placement of dredged or fill material into water unless it can be demonstrated that there are no practical alternatives that are less environmentally damaging. The sections of the Clean Water Act that apply to this study include Section 401 regarding discharges to waterways and 404 regarding fill material in waters and wetlands.

The Clean Water Rule defines Jurisdictional Waters of the U.S. (WOTUS) as:

- Navigable waters,
- Interstate waters,
- Territorial seas,
- Impoundments,
- Tributaries to the traditionally navigable waters (water features with bed, banks and ordinary high water mark, and flow downstream, except for wetlands and open waters without beds, banks and high water marks, which will be evaluated for adjacency),
- Adjacent wetlands/waters (includes waters adjacent to jurisdictional waters within a minimum of 100 feet and within 100-year floodplain to a maximum of 1,500 feet of the ordinary high water mark), and
- Isolated or “other” waters, which includes specific waters as defined in the Final Rule and waters with a significant nexus within the 100-year floodplain of a traditional navigable water, interstate water, or the territorial seas, as well as waters with a significant nexus within 4,000 feet of jurisdictional waters.

The definition excludes ditches, groundwater, gullies, rills, non-wetland swales, and constructed components for MS4s and water delivery/reuse and erosional features.

The Arkansas and White rivers are considered navigable waters of the US and are, therefore, considered jurisdictional WOTUS. All tributaries within the study area are considered jurisdictional WOTUS due to their proximity to the navigable rivers and location within the 100-year floodplain. The majority of wetlands in the study area are also considered jurisdictional WOTUS.

<u>Groundwater*</u>

The study area overlies the Mississippi River Valley (MRV) alluvial aquifer. The aquifer consists of various geologic units mainly of unconsolidated and alternating layers of sands, gravels, silts, and clays. In this setting, fine-grained material impedes flow and serves as confining units, and coarse-grained material serves as aquifers. The MRV alluvial aquifer in terms of use is the most important aquifer in Arkansas. Nationally, the state ranks fourth in groundwater use, with 94 percent of all groundwater used coming from the MRV alluvial aquifer. The primary use of this aquifer is to support agricultural irrigation. Secondary water uses include aquaculture, flooding of fields to provide duck hunting habitat, public supply, industrial, and domestic (Kresse et al. 2013).

Major rivers, such as the Arkansas, White, and Mississippi rivers, may act as a source of recharge or serve as a regional drain depending on river stage. Natural groundwater flow paths may range from tens to hundreds of miles before encountering a major river, which acts as a hydrologic flow boundary and serves as a regional drain.

Purely by coincidence, the MKARNS on the Arkansas River has functioned for years as one of the most successful artificial recharge projects in the world. Water-level change data in the form of tables, maps, and hydrographs all indicate that the Grand Prairie groundwater supply has been augmented by the development of the navigation pools on the Arkansas River. The difference between river stage elevation and potentiometric surface of the groundwater system creates a hydraulic gradient in which water flows from the river to the MRV alluvial aquifer. The water moves into the aquifer through riverbank storage and floodplain percolation, then flows down-gradient toward the center of the cone of depression in the Grand Prairie near Stuttgart and DeWitt (outside the study area).

In 1998, the ANRC designated the Grand Prairie Area as a Critical Groundwater Area due to drastic water-level declines in the MRV alluvial and Sparta aquifers. The Grand Prairie Area is bounded by the Arkansas County boundaries in the most southern portion of the area, which also includes a portion of the study area, and extends northwest through portions of Jefferson, Lonoke, Pulaski, Prairie, White, and Woodruff Counties. Designation of Critical Groundwater Areas focuses resources, providing enhanced tax credits for conservation activities, focused educational programs, priority for federal programs and funding, and enhanced opportunities for locally-led groundwater conservation programs.

<u>Water Quality</u>

Section 305(b) of the Clean Water Act (CWA) requires states to assess the water quality of the waters of the state (both surface and groundwater) and prepare a comprehensive report documenting the water quality, which is to be submitted to the EPA every 2 years. In addition, Section 303(d) of the CWA requires states to prepare a list of impaired waters on which total maximum daily loads (TMDL) or other corrective actions must be implemented. Arkansas Department of Environmental Quality (ADEQ) is the agency in Arkansas responsible for enforcing the water quality standards and preparing the comprehensive report for submittal to EPA.

*Surface Water**

Surface water quality tends to be strongly influenced by land use. In general, surface waters in the study area tend to have relatively high levels of turbidity and suspended solids. In addition, dissolved oxygen levels tend to be low, and biochemical oxygen demand in surface waters tends to be relatively high.

Approximately 35.1 miles of the Arkansas River (Reach -001 of HUC 8020401), including the stretch through the study area, was included on the Draft 2016 303(d) list as an impaired waterbody without completed TMDLs (Category 5) (ADEQ 2016). Category 5 includes water bodies that are impaired, or one or more water quality standards may not be attained. Reach -001 of the Arkansas River is impaired as a result of dissolved oxygen, with an unknown source causing the impairment. The decreased dissolved oxygen has caused “nonsupport” of the “Fisheries Use” designated use category. The reach has a low priority ranking which indicates the lowest risk to public health or welfare and secondary impact on aquatic life.

The lower 30-mile portion of the Arkansas River, including the entire length found within the study area is designated as an Extraordinary Resource Water[1] (ADEQ 2016). This stream segment stretches from the Arkansas Post Lock and Dam to the mouth of the Mississippi River. Barge traffic is diverted out of the Arkansas River above the lock and dam to the White River through the Arkansas Post Canal. Thus, the lower 30-mile stretch receives little to no channel maintenance and remains free flowing. This portion of the Arkansas River is quickly becoming a favorite canoeing and camping destination. It offers excellent fishing and primary contact recreation opportunities.

Groundwater

In general, groundwater quality in the MRV alluvial aquifer is good when compared to EPA primary drinking water standards. Groundwater within the majority of the MRV alluvial aquifer is classified as calcium-bicarbonate water type. In addition, sodium, magnesium, chloride, sulfate, silica, and iron comprise the major constituents by weight. These constituents show a wide variability based on residence time of groundwater and flow paths. Levels of dissolved solids in the groundwater throughout most of the aquifer are low enough for the water to be suitable for most uses (Kresse et al. 2013)

Floodplains

The floodplain within the study area exhibits a complex pattern of abandoned channels, oxbow lakes, backswamps, natural levees deposits, meander scars, and active point bars which is typical of the ridge and swale alluvial geomorphic landform. The historic floodplain has been modified by an extensive system of levees and water control structures. The levees were constructed primarily to allow rich bottomland alluvial soils to be used for agricultural row crops such as rice, cotton, and soybeans.

Over 90 percent of the study area is mapped within the Federal Emergency Management Agency (FEMA) 100-year (Zone A) floodplains. Zone A indicates that the area is in a High Risk Area, with a one percent annual chance of flooding and a 26 percent chance of flooding over 30 years. Guidelines state projects in Zone A cannot have a cumulative rise in the Base Flood Elevation (BFE, 1% exceedance frequency) of more than 1.00 foot. Most of the study area also lies within the 2-year and 5-year floodplain.

Flood flows are attenuated by USACE navigation management operations during late winter and spring and extend into late summer and early fall. Usually the Arkansas and White rivers flood at the same time, but difference in flood stages of 16 to 25 feet have been observed. These differences are typically associated with precipitation events limited to either the White River or Arkansas River drainage areas.

[1] This beneficial use is a combination of the chemical, physical, and biological characteristics of a waterbody and its watershed, which is characterized by scenic beauty, aesthetics, scientific values, broad scope recreation potential and intangible social values.

Biological Resources

Biological resources include plants and animals and the habitats in which they occur. Biological resources are important because: (1) they influence ecosystem functions and values; (2) they have intrinsic value and contribute to the human environment; and (3) they are the subject of a variety of statutory and regulatory requirements.

The lower Arkansas and White rivers and their associated floodplain ecosystems are extremely valuable for their rich and diverse natural resources. Despite the numerous projects constructed, the area still retains much of its original character and is among the richest, most functional ecosystems left in the MAV. The lower White River basin contains the largest block of contiguous bottomland hardwood remaining on any tributary of the Mississippi River. The lower White River basin provides habitat for over 235 species of birds, 58 species of mammals, and 58 species of reptiles and amphibians. It is the most important wintering area for mallards in North America. The White and Arkansas rivers and associated floodplain aquatic habitats provide habitat for at least 24 families and 132 species of fish, and 37 species of freshwater mussels. It provides habitat for several federally listed species including the Ivory-billed woodpecker.

The study area contains resources of national and international importance. The study area holds several special designations. The lower White River basin has been designated as a Ramsar Wetland of International Importance and as an Important Bird Area by the Audubon Society. The lower Arkansas River is a state listed ecologically sensitive waterbody and is listed by the National Park Service on the Nationwide Rivers Inventory.

The following information summarizes the USFWS 2003 Final Coordination Act Report (CAR) and the USFWS 2016 Draft CAR, unless otherwise noted. For a more detail description including a comprehensive list of species and historic conditions of the ecosystem in the study area, refer to Appendix J.

<u>Modeling Efforts</u>

Hydrogeomorphic Approach (HGM) was used to assess wetland functions in the project area. Wetland functions assessed by the HGM approach include wetland wildlife habitat, nutrient cycling, plant community maintenance, and floodwater detention. It was assumed that impacts to wetland functions assessed using HGM, while not specific to any particular wildlife species, represent a measure of ecosystem health and thus value to wetland dependent wildlife.

The HGM approach first groups wetlands into regional subclasses based on functional similarities within a given hydrogeomorphic setting. Wetland functions for each subclass are assessed using field collected or other sources of information. The information comprises the variables that are then inserted into a simple logic model that describes the level to which each function is being performed by the particular wetland subclass. For example, vegetative data may be directly measured using standard forest sampling methods, while flood frequency data may be obtained from gage data, flood zone mapping or other sources. The HGM approach is similar to Habitat Evaluation Procedure (HEP) in that it generates a Functional Capacity Index (FCI) which is multiplied by the wetland area to calculate the amount of Functional Capacity Units (FCU) for each assessed function. These FCU can then be used to compare wetlands within the same regional subclass.

Detailed information associated with the HGM wetland analysis can be found in the Appendix I—HGM Analysis.

Aquatic Habitat

Aquatic habitats within the study area include the main stem of the White and Arkansas rivers, Menard Bayou, Honey Locust Bayou, Wild Good Bayou, Island 73 Chute, and oxbow lakes adjacent to the river system including Lake Dumond, Owens Lake, Garland Lake, John Smith Lake, Moore Lake, LaGrues Lake and Pelican Lake. These permanent and seasonal habitats available to fishes in the study area encompass a variety of riverine and floodplain habitat types including main channels, side channels, tributaries (i.e. sloughs, bayous, creeks), inundated flood plains (i.e. bottomland hardwood forest), and abandoned channel segments (i.e. oxbow lakes) with varying degrees of connectivity to the main channel.

Fisheries

At least 24 families and 132 species of fish are documented to inhabit the channel, tributaries, oxbow lakes, sloughs, and inundated floodplain of the lower White River. Fishery information for the Lower Arkansas River below Dam 2 is minimal; however, sampling efforts yielded captures of 42 species from 15 families.

The modern White River supports a sustainable commercial fishery for both fish and mussels, although at levels much lower than the peaks of the early 20th century. The commercial demand for wild freshwater fishes has declined somewhat over recent decades due in part to the advent of highly efficient aquaculture techniques and competition from foreign sources. The number of commercial fisherman and amount of fish taken annually from the river depends greatly on fishing conditions (i.e. water levels) and wholesale prices. The primary commercial fishes inhabiting the lower White River include blue catfish (*Ictalurus furcatus*), channel catfish (*I. punctatus*), flathead catfish (*Pylodictis olivaris*), smallmouth buffalo (*Ictiobus bubalus*), bigmouth buffalo (*Ictiobus cyprinellus*), black buffalo (*Ictiobus niger*), common carp (*Cyprinus carpio*), river carpsucker (*Carpiodes carpio*), longnose gar (*Lepisosteus osseus*), shovelnose sturgeon (*Scaphirhynchus platorynchus*), bowfin (*Amia calya*), and paddlefish (*Polydon spathula*). By far the most sought after and profitable commercial species are the catfishes (all three species) and the buffaloes (primarily smallmouth).

Mussels

The lower White River has historically supported considerable populations of freshwater mussels. Recent mussel surveys confirmed 37 native species of freshwater mussels inhabiting the White River from Newport to the confluence with the Mississippi River. The mussel fauna of the lower White River below Newport includes three endangered species (see Threatened and Endangered Species section below). Virtually nothing is known about mussel resources in the White River below the Arkansas Post Canal (River Mile [RM] 10) or in the Arkansas River below Dam 2. The closest known mussel bed to the study area in the White River is a major bed having a density above 10 individuals/m^2 located between RM 11 and RM 12.

Nine major and 11 minor mussel beds were located in the lower reach of the White River (RM 10-100). Major beds were typically located in substrates of sand, hard and soft clay, and gravel, with areas ranging from 200 to 10,300 m^2. Mean densities range from 5,924 ± 2,046 to 189,679 ± 36,127 individuals in major beds and 9 to 19 individuals in minor beds. The mapleleaf (*Quadrula quadrula*) was the dominant species in most major beds, and the threehorn wartyback (*Obliquaria reflexa*) and fragile papershell (*Leptodea fragilis*) also contributed to large precentages to the community makeup. Butterfly (*Ellipsaria lineolate*), washboard (*Megalonaias nervosa*), hickorynut (*Obovaria olivaria*), and pimpleback (*Q. pustulosa*) were also common in the major beds. The mapleleaf also dominated the species composition in the minor beds. Other common species discovered in minor beds include the fragile papershell, threehorn wartyback, washboard, hickorynut, and threeridge (*Amblema plicata*). The deertoe (*Truncilla truncata*), a species that has declined in recent years in the White River, was also found in minor beds. Currently, the non-endangered freshwater mussels of the White River support a commercial harvest.

Terrestrial Habitat

The character of the study area including plant community composition and vigor is controlled by the hydrology. Geomorphology and soils also play an important role in determining the plant communities present. Land cover in the study area is predominantly bottomland hardwood forest (BLH). The lower White River and lower Arkansas River basins inside the levees are also dominated by BLH. By contrast, lands outside the levees in the MAV portion of the river basins are primarily agriculture. The forest associations within the study area vary depending on the frequency and duration of flooding. Cypress-tupelo (*Taxodium distichum/Nyssa aquatic*) and scrub-shrub swamps are located in low lying areas permanently or semi-permanently flooded. Water hickory/overcup oak (*Carya aquatic/Quercus ovata*) associations are located in frequently flooded low lying areas. Somewhat more elevated areas, which are still influenced by overbank flooding, support American elm (*Ulmus americana*), ash (*Fraxinus spp.*), sugarberry (*Celtis laevigata*), sycamore (*Platinus occidentalis*), Nuttal oak (*Q. nuttallii*), willow oak (*Q. phellos*), and sweetgum (*Liquidambar styraciflua*). Infrequently flooded, poorly drained areas are vegetated with willow oak, water oak (*Q. nigra*), swamp chestnut oak (*Q. michauxii*), cherrybark oak (*Q. pagodifolia*), and shagbark hickory (*Carya ovata*). Black willow (*Salix nigra*) is common on elevated point bars and cottonwood (*Populus deltoids*), river birch (*Betula nigra*), and boxelder (*Acer nuegundo*) are found on natural levees. The difference between vegetative zones in the bottoms are scarcely visible, with vegetative community changes occurring at a matter of several inches to a foot difference in elevation.

The distribution of plant communities in the study area is directly and indirectly influenced by hydrology. Plant survival and reproduction are directly tied to the timing, depth, duration, and frequency of flooding. Sediment distribution and soil formation are influenced by flooding, which indirectly influences water relationships in plant communities. Consequently, changes in flood frequency, duration, or height could result in impacts to extensive areas, thus affecting habitat availability and overall wetland and ecosystem function.

Notable exceptions to the major land cover type found in the study area are the dredge disposal areas on both private land and on the White River NWR. Annual deposition of dredge material on the site maintains mostly unvegetated open sand with small areas of young willow. The sites are elevated approximately 30 to 50 feet above the White River floodplain and contain millions of cubic yards of dredge material.

Birds

Birds comprise the largest single group of vertebrates in the study area. At least 265 species of migratory and resident birds including 26 species of waterfowl, 31 species of wading birds, 15 species of shorebirds, and 129 species of songbirds have been documented in the lower White River Basin. One hundred twelve species of birds were identified during breeding bird surveys in the basin and BLH immediately south of the Arkansas River near the confluence of the White, Arkansas, and Mississippi rivers.

Avian species composition and abundance, as well as the habitats used by this large and diverse group vary widely with season. Waterfowl use both BLH and open flooded habitats primarily during the winter. Neotropical migratory songbirds use the BLH to meet breeding requirements and as a stopover during migration. Shore and wading birds use open water, mud flats, herbaceous wetlands, and wooded swamps for migratory, wintering, and breeding habitats. Grassland birds use remnant prairie grasslands and pastures. Thus, the breeding, wintering, and migration habitat provided by the BLH is one of the most important functions of the ecosystem.

The lower White River basin has long been renowned for its winter populations for waterfowl. Based on duck band recoveries, harvest records, and annual waterfowl surveys, the Cache River/Lower White River ecosystem is by far the most important wintering area for waterfowl in Arkansas and the single most important wintering area for mallards (*Anas platyrhunchos*) in North America. The area has been identified as one of six flagship areas identified in the North American Waterfowl Management Plan.

As a group, songbirds include the largest number of species (129) of birds using the Lower White River Basin. At least 65 species of songbirds breed in the basin. Many of the birds found in the area are further classified as neotropical migrants. These birds migrate from breeding areas in North America to wintering areas in Central and South America. Songbirds are also dependent on the extensive forests in the study area and the unbroken expanse of forest is vital to the maintenance of stable forest breeding bird populations in the MAV.

The Eastern wild turkey is the primary resident game bird in the ecosystem; a bird that was once distributed throughout the basin, but which is now generally confined to the larger blocks of forest. Turkey populations fluctuate dramatically with the incidence and timing of spring floods.

Mammals

Fifty-eight species of mammals are known or likely to occur in the lower White River Basin, including 12 species of bats and 24 species of rodents. Little specific information is available on mammals in the lower White and Arkansas River basins.

White-tailed deer (*Odocoileus virginianus*) are an important species from a public interest and use perspective. BLH provide quality habitat for deer, with potential carrying capacity reaching 1 deer per 10 acres or better. AGFC deer population objectives for WMAs in the study area range from 1 per 16 to 1 per 26 acres. Carrying capacity of BLH in the study area varies as a result of prolonged and/or deep flooding in some portions of the area and by their proximity to cropland.

Black bears (*Ursus americanus*) in the study area are descendants of the native black bear population that persisted on the Refuge when black bears were extirpated from the rest of the state making the refuge home to the only native black bear population in Arkansas. By 2001, the black bear population in and around the refuge was estimated at around 500 or more animals, with estimates of bear density on the southern portion of the refuge at one bear per about 300 acres.

The forested wetlands in the study area also support other game and non-game species. Mammals that occur within the study area include raccoon, beaver, river otter, mink, gray squirrel, fox squirrel, and red fox.

Reptiles and Amphibians

The lower White and Arkansas River basins provide habitat for approximately 58 species of reptiles and about 24 species of amphibians. Common amphibians include the marbled salamander (*Ambystoma opacum*), green frog (*Rana clamitans*), American toad (*Bufo americanus*), Woodhouse's toad (*B. woodhousei woodhousei*), and southern leopard frog (*R. utricularia*). Common reptiles include the five-lined skink (*Eumeces fasciatus*), the mud snake (*Farancia abacura reinwardti*), copperhead (*Agkistrodon contortrix contortrix*), and cottonmouth (*A. piscivorus leucostoma*). Common turtles include the three-toad box turtle (*Terrapene Carolina triunguis*), red-ear turtle (*Chrysemys scripta elegans*), map turtles (*Graptemys spp.*), soft-shell turtle (*Trionyx muticus*), and common snapping turtle (*Chelydra serpentine serpentine*). Another reptile that occurs in the area is the American alligator (*Alligator mississippiensis*). The Refuge is at the northern edge of its range; consequently, the alligator was always probably somewhat rare in the study area. Alligator snapping turtles (*Macroclemys temmincki*) have become increasing rare, but can still be found in the study area. Population trends of herptofauna in the lower White and Arkansas River basins are unknown; however, it is expected that population trends would be roughly proportional to loss or retention of the various habitat components upon which they depend.

<u>Threatened and Endangered Species*</u>

Wildlife species may be classified as threatened or endangered under the Endangered Species Act (ESA) and protection of the species is overseen by the USFWS. The purpose of ESA is to ensure that federal agencies and departments use their authorities to protect and conserve endangered and threatened species. Section 7 of ESA requires that federal agencies prevent or modify any projects authorized, funded, or carried out by the agencies that are "likely to jeopardize the continued existence of any endangered species or threatened species, or result in the destruction or adverse modification of critical habitat of such species."

Table 2 lists species that have been identified in the 2015 Planning Aid Report and in the USFWS Information for Planning and Conservation (IPaC) website. There are no candidate or proposed for listing species documented occurring in or near the study area or in Arkansas or Desha Counties, Arkansas. There is no critical habitat designated in or near the study area. For a more detailed discussion on the habitat requirements, historic and current occurrence, and threats to each species, refer to the Biological Evaluation prepared for this study (Appendix E).

Table 2: Threatened and Endangered Species listed as potentially occurring in the study area.

Species	Status	CAR	IPAC	Habitat	Occurrence in the Study Area
Birds					
Rufa red knot *Calidris canutus rufa*	T		X	Found primarily in intertidal, marine habitats, especially near coastal inlets, estuaries, and bays outside of breeding season. Stopover habitat includes river shorelines with muddy/sandy substrates.	Potential migratory resident, but presence has not been confirmed in or near the study area. Suitable habitat exists on the lower Arkansas and Mississippi rivers.
Ivory-billed woodpecker *Campephilus principalis*	E	X	X	Inhabits mature bottomland forest and cypress swamps with large hardwoods.	Suitable habitat exists and is within the potential range of occurrence as identified by USFWS. Surveys in and around the study area yielded no confirmation of occurrence.
Piping plover *Charadrius melodus*	T		X	Use wide, flat, open, sandy beaches with very little grass or other vegetation. Nesting territories often include small creeks or wetlands. Breed in northern US and Canada in the spring and summer and migrate south in the fall, wintering along the coast of the Gulf of Mexico or other southern locations.	Potential migratory resident, but presence has not been confirmed in or near the study area. Suitable habitat exists on the lower Arkansas and Mississippi rivers.
Interior least tern *Sterna antillarum athalassos*	E	X	X	Nest in small colonies on barren to sparsely vegetated sandbars along rivers, sand, and gravel pits, lake and reservoir shorelines, and occasionally gravel rooftops from April through August. Winter along the coastal areas of Central and South America and the Caribbean Islands.	Commonly observed during the summer along the Mississippi and lower Arkansas rivers. Nesting occurs throughout the study area on the Arkansas and Mississippi River, with the closest known site occurring on the Melinda Sandbar directly across the Arkansas River from the Melinda Channel. Commonly observed foraging along the lower White River but are not known to nest here.

Table 2 Threatened and Endangered Species listed as potentially occurring in the study area (continued).

Species	Status	PAL	IPAC	Habitat	Occurrence in the Study Area
Fish					
Pallid sturgeon *Scaphirhynchus albus*	E	X	X	Utilize main and secondary channels with silty bottoms and a natural hydrograph, and channel border habitats lacking flowing water which are removed from the main channel (i.e. backwaters and sloughs). Habitat preference has a diversity of depths and velocities formed by braided channels, sand bars, sand flats, and gravel bars. Habitat use varies with availability, life stage, and geographic location.	The southern portion of the study area is considered a high priority recovery area by USFWS. There is documentation of three radio-tagged individuals using the Arkansas River from the confluence with the Mississippi River upstream to Dam 2 in 2011-2012. There is no documentation of the species using the White River.
Mussels					
Pink mucket *Lampsilis abrupta*	E		X	Found in mud and sand and in shallow riffles and shoals swept free of silt in major rivers and tributaries.	Historically occurred throughout the White River. Recent occurrences are limited to sites approximately 145 and 211 river mile upstream of the study area. It is not known to inhabit the lower Arkansas River.
Scaleshell mussel *Leptodea leptodon*	E		X	Live in medium-sized and large rivers with stable channels, good water quality, and sand and gravel bottoms.	Closest known occurrence is on the White River approximately 246 river miles upstream of the study area.
Fat pocketbook *Potamilus capax*	T	X	X	Prefers sand, mud, and fine gravel bottoms of large rivers, in water ranging in depth from a few inches to eight feet.	Occurrence in the White River has been sporadic with no reports of live specimens since 1960s, except for a single live specimen in the main channel White River between river miles 11 and 12. The species could occur in the Arkansas River, but none have been documented.
Rabbitsfoot *Quadrula cylindrica cylindrica*	T	X	X	Prefer shallow areas with sand and gravel along the bank and next to shoals, which provide a refuge in fast-moving rivers.	Closest recorded occurrence is near St. Charles, AR approximately 47 river miles upstream of the study area. It is not known to occur from the lower Arkansas River.

E = Listed Endangered **T** = Listed Threatened

<u>Species of Concern</u>

On October 23, 2015, the ANHC provided a list of Species of Concern in the Three Rivers Study Area. The list identifies 23 species of concern and six Special Elements in the study area (Table 3).

Table 3. ANHC Elements of Special Concern in the Three Rivers Study Area (ANHC 2015).

Scientific Name	Common Name	Status		Rank	
		Federal	State	Global	State
Arthropods					
Cicindela lepida	Little white tiger beetle	--	INV	G3G4	S2S3
Macrobrachium ohione	Ohio shrimp	--	INV	G4	S1?
Birds					
Haliaeetus leucocephalus	Bald eagle	--	INV	G5	S3B, S4N
Limnothlypsi swainsonii	Swainson’s warbler	--	INV	G4	S3B
Riparia riparia	Bank swallow	--	INV	G5	S3B
Setophaga cerulean	Cerulean warbler	--	INV	G4	S3B
Sternula antillarum athalossos	Interior least tern	LE	SE	G4T2Q	S3B
Fish					
Acipenser fulvescens	Lake sturgeon	--	INV	G3G4	S2
Anguilla rostrate	American eel	--	INV	G4	S3
Atractosteus spatula	Alligator gar	--	INV	G3G4	S2
Cycleptus elongates	Blue sucker	--	INV	G3G4	S3
Erimyzon sucetta	Lake chubsucker	--	INV	G5	S3
Hiodon alosoides	Goldeye	--	INV	G5	S2
Mulgil cephalus	Striped mullet	--	INV	G5	S2
Platygobia gracilis	Flathead chub	--	INV	G5	SH
Polyodon spathula	Paddlefish	--	INV	G4	S3
Scaphirhynchus albus	Pallid sturgeon	LE	SE	G2	S1S2
Mussels					
Obovaria olivaria	Hickorynut	--	INV	G4	S3
Toxolasma lividum	Purple Lilliput	--	INV	G3Q	S3
Truncilla donaciformis	Fawnsfoot	--	INV	G5	S3

Table 3: ANHC Elements of Special Concern in the Three Rivers Study Area (ANHC 2015) (Continued).

Scientific Name	Common Name	Status		Rank	
Mammals					
Corynorhinus rafinesquii	Rafinesque’s big-eared bat	--	INV	G3G4	S3

Scientific Name	Common Name	Status		Rank	
Myotis austroriparius	Southeastern bat	--	INV	G4	S3
Reptiles					
Regina grahamii	Graham's crayfish snake	--	INV	G5	S2
Special Elements—Natural Communities					
Lower Mississippi River Bottomland Depression		--	INV	GNR	SNR
Mississippi River High Floodplain (Bottomland) Forest		--	INV	GNR	SNR
Mississippi River Low Floodplain (Bottomland) Forest		--	INV	GNR	SNR
Mississippi River Riparian Forest		--	INV	GNR	SNR
Willow Oak Forest		--	INV	GNR	S2
Special Elements--Other					
Colonial nesting site, swallows & swifts		--	INV	GNR	SNR

Key to Status and Ranks
LE= Listed Endangered under ESA
INV= Inventory Element, ANHC currently conducting active inventory work on these elements. Available data suggests these elements are of conservation concern.
SE= State Endangered, species is afforded protection under AGFC Regulation.
G2= Imperiled Globally, at high risk of extinction due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors.
G3= Vulnerable Globally, at risk of extinction due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors.
G4= Apparently Secure Globally. Uncommon but not rare; some cause for long-term concern
G5= Secure Globally. Common, widespread and abundant.
GNR= Not applicable.
T-Ranks= Given to global ranks when a subspecies, variety, or race is considered at the state level. Made up of a "T" plus a number or letter (1,2,3,4,5,H,U,X) with the same ranking rules as a full species.
S1= Critically imperiled in the state due to extreme rarity (often 5 or fewer populations), very steep declines, or other factors making it vulnerable to extirpation.
S2= Imperiled in the state due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors making it vulnerable to extirpation.
S3= Vulnerable in the state due to a restricted range, relatively few populations (often 80 or fewer, recent and widespread declines, or other factors making it vulnerable to extirpation.
S4= Apparently secure in the state. Uncommon but not rare; some cause for long-term concern due to declines or other factors.
SH= Of historical occurrence, with some possibility of rediscovery.
SNR= Unranked. The state rank not yet assessed.
Q= Indicates element's taxonomic classification as a species is a matter of conjecture among scientists.
?= Used to denote an inexact numeric rank.
B= Refers to the breeding population of a species in the state.

Migratory Birds

Birds are protected under the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act. The Acts prohibit any activity that results in take of migratory birds or eagles unless authorized by USFWS. The Acts do not provide any provisions for allowing take of migratory birds that are unintentionally killed or injured like ESA does.

The migratory bird species listed below are species of particular conservation concern that potentially occur in the study area. The USFWS published the *Birds of Conservation Concern (BCC) 2008* in December 2008. The goal of the BCC is to identify the migratory and nonmigratory bird species, beyond those already protected under ESA, that represent the highest conservation priorities. Bird species considered for inclusion on the BCC lists include nongame birds; gamebirds without hunting seasons; ESA candidate, proposed endangered or threatened species; and recently delisted species. The study area falls within the Mississippi Alluvial Valley -- Bird Conservation Region (BCR) 26. The USFWS IPaC website also lists migratory bird species potentially occurring in the study area.

A total of 25 BCC are identified for BCR 26 and IPaC lists 22 species in the study area, of which 14 species are listed on both lists (Table 4). Each of the species on either list has the potential to occur in the study area.

Table 4. Birds of Conservation Concern listed for Bird Conservation Region 26

Scientific Name	Common Name	Breeding Status in ROI	Included on List	
			BCC	IPaC
Ammodramus henslowii	Henslow's sparrow	NB	X	
Ammodramus leconteii	LeConte's sparrow	NB	X	X
Asio flammeus	Short-eared owl	B	X	X
Botaurus lentiginosus	American bittern	NB		X
Caprimulgus carolinensis	Chuck-will's-widow	B		X
Cistothorus platensis	Sedge Wren	NB	X	X
Coturnicops noveboracensis	Yellow rail	NB	X	
Dendroica cerulea	Cerulean warbler	B	X	X
Elanoides forficatus	Swallow-tailed kite	NB	X	
Euphagus carolinus	Rusty blackbird	NB	X	X
Falco peregrinus	Peregrine falcon	B	X	
Haliaeetus leucocephalus	Bald eagle	B	X	X
Helmitheros vermivorum	Worm eating warbler	B		X
Hylocichla mustelina	Wood Thrush	B	X	X
Icterus spurius	Orchard oriole	NB	X	X
Ictinia mississippiensis	Mississippi kite	B		X
Ixobrychus exilis	Least bittern	B	X	X
Ixobrychus exilis	Least tern	B		X
Lanius ludovicianus	Loggerhead shrink	B		X
Laterallus jamaicensis	Black rail	NB	X	
Limnodromus griseus	Short-billed dowitcher	NB	X	
Limnothlypis swainsonii	Swainson's warbler	NB	X	
Limosa fedoa	Marbled godwit	NB	X	
Limosa haemastica)	Hudsonian godwit	NB	X	

Scientific Name	Common Name	Breeding Status in ROI	Included on List	
			BCC	IPaC
Melanerpes erythrocephalus	Red-headed woodpecker	B	X	X
Oporonis formosus	Kentucky warbler	B	X	X
Passerella iliaca	Fox sparrow	NB		X
Passerina ciris	Painted bunting	B	X	X
Protonotaria citrea	Prothonotary warbler	B	X	X
Spiza americana	Dickcissel	B	X	X
Tringa solitaria	Solitary sandpiper	NB	X	
Tryngites subruficollis	Buff-breasted sandpiper	NB	X	
Vireo bellii	Bell's Vireo	B		X

B= Occurs in BCR during breeding period (plus non-breeding where species occurs year-round)
NB= Occurs in BCR only during the non-breeding period

Invasive Species

Executive Order 13112, *Invasive Species*, dated February 3, 1999, directs federal agencies to expand and coordinate their efforts to combat the introduction and spread of invasive species (i.e., noxious plants and animals not native to the U.S.). Invasive species are one of the most pervasive, widespread threats to indigenous biota. The introduction and establishment of invasive species can have substantial impacts on native species and ecosystems. Invasive species capable of spreading and invading into new areas are typically generalists that can easily adapt to new environments and are highly prolific and superior competitors and/or predators. Some are very specialized and more efficient and effective than their native competitors at filling a particular niche. They compete for resources, alter community structure, displace native species, and may cause extirpations or extinctions. Invasive species often benefit from altered and declining natural ecosystems by filling niches of more specialized and displaced species with limited adaptability to changing environments.

Fortunately the routine and long duration flooding keeps most invasive species in check within the study area.

Terrestrial Species

The frequent flooding of the Arkansas, White and Mississippi River floodplains has precluded invasion of most non-native plant species in the BLH habitats. At higher elevations in the uplands some invasive species, such as sesbania, Johnson grass, and shattercane, are now present. These species are typically known as "crop pests" occurring on open farm and moist-soil sites. Chinese privet and Japanese honeysuckle are widespread along forest edges and in reforestation sites and in some timber harvest stands. Other problem plants include mimosa, Chinaberry, and nonnative pine occasionally found in restored fields; exotic bamboo and kudzu are found in localized pockets. Forsythia, orange day lily, yucca, crimson clover, and non-native pines are found as ornamentals on private lands. None of these invasive species have been formally mapped nor are they being monitored within the study area.

Domestic swine are commonly introduced into the wild in Arkansas, creating populations of feral hogs. These hogs are also commonly captured and moved to unoccupied areas to create new hunting opportunities. AGFC has not completed any formal surveys for wild hogs in the study area; however, it appears from hunter reports that the greatest concentration appears to be on the Trusten Hold WMA. Feral hogs have not been able to gain a strong foothold in the study area most likely because of their susceptibility to long-duration flooding.

Beavers are native to Arkansas but were extirpated from the area in the early 1900s. They reestablished in Arkansas in the late 1900s and have since reached a level at which they are often considered a nuisance species. The beaver's natural behavior of building dams and the associated flooding of forested areas can provide beneficial wetland areas, but such extended flooding particularly during the summer months can change the vegetation composition leading to habitat conversion. On the NWR, there are over 500 beaver dams and roughly 6,710 acres in dead timber and wetland scrub/shrub habitat as a result of these dams. The current trend indicates that an additional 200-300 acres may be converted annually without increased beaver control efforts.

Several species of invasive birds, including Eurasian collared dove, European starling, and house sparrow, have been observed using the study area, but none have been observed nesting or using the BLH habitat.

Aquatic Species

The two primary aquatic plant species of concern in the study area are water hyacinth and didymo. When water hyacinth takes over boating and fishing become nearly impossible in covered areas, while dissolved oxygen concentration also decreases, which can lead to fish kills and a decline in the aquatic community. When a nuisance bloom of didymo occurs, large benthic mats of up to two-foot long stalks attach itself to the substrate. The mat can end up covering up to 100 percent of a streambed in some areas and reduce the availability of the area for aquatic invertebrates and fish spawning.

Four carp species have been identified within the study area. Species such as the common carp and grass carp are well established and the effects of their introductions have long since been assimilated into the ecosystem. Two other carps, the bighead and silver, are more recent introductions and have not yet fully established populations within and throughout the watersheds. As the densities and range of these species expand in the watersheds, there will likely be substantial effects to native species including outcompeting native fish species for resources, indirectly altering water quality, and significantly impacting prey populations.

Asian clams have been well-established in the study area and their effects assimilated into the surrounding ecosystems for many years. Zebra mussels, however, are a relatively new introduction and are currently not well or fully established within the watersheds. Limited navigation has aided in preventing and/or minimizing their establishment and upstream expansion within the White River and its tributaries. They are highly prolific and quickly dominate the benthic community, overwhelming native species in mass suffocation, competition for resources, and alteration of water quality.

<u>Fish and Wildlife Management Areas</u>

Fish and wildlife management areas are lands designated as habitat for fish and wildlife or for propagation of such species and where wildlife habitat maintenance or improvement is appropriate. Private or exclusive group use of these lands is not permitted. Vehicles are typically not permitted, unless using for a wildlife-dependent recreational activity. Fish and wildlife management lands are generally available for selected low-density recreation activities such as hiking, hunting, fishing, nature study, nature photography, wildlife observation, and other related activities. Public access to wildlife management lands are restricted at certain critical periods when wildlife would otherwise be adversely affected, such as during critical breeding, nesting, and spawning periods.

Public ownership by the USFWS, USACE, and AGFC of large portions of the study area, as discussed in the Land Use section above, and of adjacent lands to the north and west ensure sound and integrated management of the lands now and in the future. Professional staff, such as fish biologists, foresters, conservation officers, and wildlife biologists, conduct surveys, write management plans, and enforce game and natural resource laws/regulations.

Cultural Resources*

Cultural resources include buildings, structures, sites, districts, and objects eligible for or included in the National Register for Historic Places (NRHP), cultural items, Indian sacred sites, archaeological artifact collections, and archaeological resources. Details on the cultural history of the region and background research can be found in Appendix K.

Few significant archeological resources have been recorded in the study area and there are no known sites listed on, or eligible for listing on, the NRHP within the study area. This is likely due to the lack of surveys conducted in the area. However, a cultural resources survey was conducted for the existing containment structure in 1988. The survey found that no cultural resources would be impacted by the construction of the containment structure. The Arkansas State Historic Preservation Office (SHPO) concurred with this finding.

In December 2006, another letter was submitted to the SHPO and Quapaw Tribe of Oklahoma concerning the project alternatives described in the Ark-White Cutoff Study. SHPO analyzed historic maps and discovered that a historic plantation site was in the vicinity of the existing containment structure. However, little is known about this property.

Recreation and Aesthetics*

The lower Arkansas and White rivers and their associated floodplain ecosystems are extremely valuable for their rich and diverse natural resources. The area is one in which a person can truly “lose themselves” in nature due to the remoteness of the area (Arkansas Natural Heritage Commission 1992). Despite numerous USACE projects constructed, this area still retains much of its original character and is among the richest, most functional ecosystems left in the MAV.

According to the 2011 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation (U.S. Department of the Interior 2011), Arkansans are avid anglers, hunters, and wildlife watchers, and both Arkansans and Americans in general are avid users of “The Natural State’s” wildlife resources. The 2011 Survey found that 1.3 million Arkansas residents and nonresidents 16 years old and older fished, hunted, or wildlife watched in Arkansas. Of the total number of participants, 555,000 fished, 363,000 hunted, and 852,000 participated in wildlife-watching activities, which includes observing, feeding, and photographing wildlife. The sum of anglers, hunters, and wildlife watchers exceeds the total number of participants in wildlife-related recreation because many of the individuals engaged in more than one wildlife-related activity.

The forested lands within and surrounding the study area are very popular for area sportsmen and sportswomen. Private lands in the area consist of large, well-known hunting clubs. The area's public lands are heavily used by hunters during the fall and winter. Deer hunting remains the most popular, followed by waterfowl, squirrel, rabbits, furbearers, turkey, quail, feral hogs, and alligator. Furbearer species include opossum, raccoon, striped skunk, river otter, beaver, mink, muskrat, nutria, red fox, gray fox, coyote, and bobcat. Black bear hunting is permitted in the study area except on the Refuge.

The majority of private lands in the study area receive intensive waterfowl hunting pressure. While this varies year to year, it is a consistent activity and an important commercial endeavor for many of the local landowners.

The area's many oxbow lakes are popular spring and summertime destinations for anglers, especially during periods following overbank flooding. These floods provide hydrologic connections from the rivers, as well as inundating thousands of acres of bottomland forests – providing excellent spawning habitat for fishes. Most sought after species in these rich lakes include crappie, bass (largemouth and spotted), bluegill, red-eared sunfish, and catfish. Boat ramps have been installed on many of the larger lakes and at selected sites along the rivers to increase access for waterborne recreation and fishing.

Many outdoor enthusiasts are drawn to the Three Rivers region each year for activities including bird watching, hiking, camping, and boating. The Arkansas Department of Parks and Tourism is developing the Delta Heritage Trail State Park in the region. This 84.5-mile trail includes approximately six miles in the study area; located along the abandoned Missouri-Pacific railroad line. The trail section in the study area includes several water crossings, most notably the Benzal Bridge, which spans the White River, and the Yancopin Bridge that spans the Arkansas River. Plans for this trail include walking and biking routes, trail heads, and interpretative kiosks.

There are five campgrounds found within the Refuge in the study area, including: Jack's Bay Campground, Prairie Lakes Campground, Six Mile Campground, East Moon Lake Campground, and Alligator Lake Campground. The Trusten Holder WMA has five primitive camping areas located in Arkansas County.

Immediately downstream of the USACE Dam #2 and extending to the Arkansas River's confluence with the Mississippi River, the Arkansas River is designated by the State of Arkansas as an Extraordinary Resource Water and is on the National Rivers Inventory list as a potential Wild and Scenic River. This river reach draws outdoor enthusiasts interested in boating activities, particularly non-motorized boats.

Transportation*

Transportation refers to the movement of people, goods, and/or equipment on a surface transportation network that can include many different types of facilities serving a variety of transportation modes, such as vehicular traffic, public transit, and non-motorized travel (e.g., pedestrians and bicycles). The relative importance of various transportation modes is influenced by development patterns and the characteristics of transportation facilities. In general, urban areas tend to encourage greater use of public transit and/or non-motorized modes of transportation, especially if pedestrian, bicycle, and transit facilities provide desired connections and are well operated and well maintained. More dispersed and rural areas tend to encourage greater use of passenger cars and other vehicles, particularly if extensive parking is provided and/or transit systems are unavailable.

Highways, Roadways, and Railways

No federal or state designated highways occur within the study area. There are a limited number of paved and gravel roads that access the USACE locks and dams, various recreation areas, and private lands. There are hundreds of miles of dirt roads and trails that are used in operations and maintenance functions by the landowners, as well as, for providing access to the public on public lands to participate in recreational activities. During the winter, high water tables may cause some of the roads to be closed to vehicular travel.

The Missouri-Pacific railroad crosses the study area at White River Mile 7.7 and the Arkansas River near the town of Medina. The rail line has been abandoned and is now owned by the Arkansas Department of Parks and Tourism.

Navigation

Commercial commodity transport occurs on federal navigation projects on three rivers in the study area, MKARNS, White River, and Mississippi River. There are no public ports on the Mississippi River in or near the study area.

The MKARNS consists of a series of lock and dam structures maintained and operated by USACE. The system begins at the Mississippi River, at the mouth of the White River, at the Montgomery Point Lock and Dam at White River navigation mile 0.5 and continues approximately 10 miles up the White River. At that point, the approximately 10 mile long Arkansas Post Canal connects the White River to the Arkansas River. There are two locks and dams on the canal, Norrell Lock (Lock 1) and Lock 2. Wilbur D. Mills Dam (Dam 2), on the Arkansas River just downstream of the mouth of the Arkansas Post Canal maintains navigation depth on the Arkansas River upstream of Dam 2. The rest of the MKARNS outside the study area consists of a series of five more locks and dams on 90 miles of the Arkansas River. The MKARNS navigation channel is maintained at 9 feet. In 2005, Congress authorized construction of a 12-foot navigation channel along the entire length of the MKARNS, but funding has been limited. Therefore, the 12-foot navigation channel will not be maintained until a complete funding package is provided by Congress. There are two public ports on the MKARNS outside the study area, including Pine Bluff and Little Rock. In addition to the locks and dams, channel stabilization structures, and routine dredging are required to maintain the MKARNS navigation channel. Commercial navigation on the MKARNS is generally feasible year-round.

On the White River upstream of the MKARNS, a 190-mile navigation channel 125 feet wide and 8 feet deep, when the water level is at 12 feet at the Clarendon gage, is maintained by the USACE Memphis District to August. Between August and Newport, approximately 57 miles, a 100 foot wide channel with minimum depth of 4.5 feet at a gage reading of 3.5 feet at Newport is maintained. There are no structures on the White River navigation project, and no public ports. The navigation channel is maintained solely through dredging and snagging. The Memphis

District also maintains nine harbors along the White River. Commercial navigation on the White River is dependent on river stage, and is currently feasible to Newport during only 57 percent of the year (Arkansas Waterways Commission 2012). When the navigation channel is maintained, commercial navigation to August is usually available year-round.

Traffic on the MKARNS has trended up since the project's inception. There have been years in which tonnage declined and where commodities have trended up or down since construction of the MKARNS, but in general activity has increased and the types, origin and destination of major commodities has been relatively stable.

Socioeconomics and Environmental Justice*

Socioeconomics is defined as the basic attributes and resources associated with the human environment, particularly population, demographics, and economic development. Demographics entail population characteristics and include data pertaining to race, gender, income, housing, poverty status, and educational attainment. Economic development or activity typically includes employment, wages, business patterns, an area's industrial base, and its economic growth.

The study area comprises portions of Arkansas and Desha counties in Southeastern, Arkansas, and with the exception of a few small nearby communities, the study area is sparsely populated and the nearest communities are at least several miles from the current project area where existing control structures reside, and include Watson (Desha County) and Gillette (Arkansas County).

Data from the 2010 Census, the U.S. Bureau of Labor Statistics, and the 2014 American Community Survey for population, employment, were used to summarize socioeconomic conditions in these counties. As shown in Table 5, both Arkansas and Desha counties have small populations relative to other areas of the state (15,341 and 20,749 respectively), and in both counties population has fallen significantly since the 2000 Census – a 20 percent reduction in Desha County and a 10 percent decrease in Arkansas County. The nearest population centers to the project site are the City of Gillette (Arkansas County) and the City of Watson. Gillette is roughly 15 miles away (straight line distance), and Watson is about 11 miles (straight line distance). Both are sparsely populated, and have also seen their numbers declines since year 2000.

Table 5. Existing Population Levels and Trends in the Study Area (US Census Bureau 2014)

Region	2000 Population	2010 Population	2014 Population	Percent change (2010-2014)	Density (persons/sq mi.)
State of Arkansas	2,673,400	2,872,684	2,933,369	2.1%	51
Desha County	15,341	13,008	12,264	-20%	20
Arkansas County	20,749	19,019	18,594	-10%	21
Gillette (Arkansas	288	211	197	-32%	N/A
Watson (Desha	819	692	687	-16%	N/A

Key income indicators (per capita income and median household income) for counties in the project area vary with lower values characteristic of rural counties and higher values for urban counties (Table 6). With exception Arkansas County, median household incomes and per capita incomes in each area are lower than state level values. The distribution of employment by occupation category in most counties tends to follow national and state allotments.

Table 6. Existing Employment and Income near the Study Area (US Census Bureau 2014)

County	Per capita income	Median household income	Total civilian workforce	Distribution of workforce by sector				
				Management business, science, & arts	Natural resources, construction, & maintenance	Production transportation	Sales & office workers	Service
United States	$28,155	$53,046	141,864,697	36%	18%	25%	9%	12%
State of Arkansas	$22,170	$40,768	1,245,432	31%	17%	24%	11%	17%
Desha County	$19,882	$28,680	4,960	28%	17%	20%	14%	20%
Arkansas County	$23,045	$39,633	8,681	28%	17%	20%	11%	24%
Gillette	$16,913	$25,500	49	22%	27%	6%	22%	22%
Watson	$19,222	$35,624	289	37%	7%	26%	18%	12%

<u>Environmental Justice</u>

Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations,* addresses concerns over disproportionate environmental and human health impacts on minority and low-income populations. The impetus behind environmental justice is to ensure that all communities, including minority, low-income or federally recognized tribes, live in a safe and healthful environment and that no group of people including racial, ethnic, or socioeconomic, should bear a disproportionate share of the negative consequences resulting from the execution of federal, state, local, and tribal programs and policies. The goal of fair treatment is not to shift risks among populations, but to identify potential disproportionately high and adverse effects and identify alternatives that may mitigate these effects.

The purpose of Environmental Justice is to analyze whether the demographics of the affected area differ in the context of the broader region; and if so, do differences meet CEQ criteria for an Environmental Justice community (population <50% minority or minority population is meaningfully greater than the minority population percentage in the geographic analysis). With the exception of Desha County, minority populations do not make up more than 50 percent of the overall population, nor are there any predominate minority communities within the study area. In Desha County, Black or African American citizens make up 47.8 percent of the population at the county level; however, most of the county's residents live in communities along State Highway 165, which runs along the western boundary of the county and are approximately 15 to 20 miles from the project area (Table 7).

Table 7. Racial Composition, Poverty Indicators near the Study Area (US Census Bureau 2014).

Region	Racial composition (%)						Poverty indicators (%)		
	White	African American	Native American or Indian	Asian	Hispanic or Latino	Other or two or more races	Unemployed	Below poverty line	Under age 17
United States	56.1	12.6	0.9	4.8	16.3	9.3	6.2	15.4	23.7
State of Arkansas	70.6	15.4	0.8	1.2	6.4	5.6	5.1	15.8	24.2
Desha County	43.5	47.8	3.0	0.3	4.4	1	14.2	0.3	25.9
Arkansas County	69.1	24.5	0.2	0.5	2.7	3	8.2	0.2	23.7
Gillette	66.8	29.9	0.0	0.0	1.2	2.1	0.0	0.2	7.6
Watson	81.2	15.2	0.3	1.0	1.6	0.7	2.0	0.2	19.5

Because children may suffer disproportionately from environmental health risks and safety risks, Executive Order 13045, *Protection of Children from Environmental Health Risks and Safety Risks,* was issued on April 21, 1997 to help ensure that federal agencies' policies, programs, activities, and standards address environmental health and safety risks to children.

Table 8 displays the number of children adjacent to the study area. There are no schools or parks in the study area.

Table 8. Number of Children near the Study Area (US Census Bureau 2015).

	Persons Under 5 (%)	Persons Under 18 (%)
State of Arkansas	6.4	24.4
Desha County	6.7	25.6
Arkansas County	6.6	23.1
Gillette	5.7	22.1
Watson	0.0	22.8

Hazardous, Toxic and Radioactive Wastes (HTRW)*

No large industrial areas are located within or immediately adjacent to the study area. There are no known significant sources or generators of hazardous or toxic substances present within the study area. Herbicides, insecticides, fertilizers, and fungicides are non-point source substances used in the production of agricultural crops in the region.

Barges that use the navigation system transport various products that include fuels, industrial chemicals, fertilizer, and other substances that are considered hazardous or toxic substances. Examples of products transported include benzene, toluene, caustic soda, methanol, ammonia, gasoline, jet fuel, fuel oil, petroleum coke, asphalt, and fertilizer. Annually, approximately 1.3 million tons of fertilizer, 565,000 tons of industrial chemicals, and 755,000 tons of refined petroleum products are transported by barge through the navigation system.

Other products transported include metallic ore, lumber, scrap steel, pulp and paper, sand/gravel/clay, glass, cement, appliances, coal, and grain. Supplies for and/or products from food processing, oil and gas, and aerospace also are transported (U.S. Army Corps of Engineers 1990a).

As part of the Corps Operations and Maintenance of the MKARNS, dredging occurs in order to maintain the required depths for navigation. All sediments that have been dredged from the river are tested for known contaminants and to date none have been found in this area.

FUTURE WITHOUT-PROJECT CONDITION*

The Future Without-Project Condition (FWOP) is synonymous with the "No Action Alternative" as required under the National Environmental Policy Act (NEPA). The No Action Alternative is the most likely condition expected to occur in the future in the absence of the proposed action or any action alternatives. In this case, no long-term environmentally sustainable solutions to the critical problem affecting the continued safe and economic use of the MKARNS would be recommended for congressional authorization and funding. During high-water events, the existing containment structure would remain susceptible to overtopping. Under the No Action Alternative, USACE would continue repairing existing structures on a regular basis, as failures are identified. As part of the No Action Alternative, it is assumed that the current failures, including the sink holes, would be repaired and are assumed to be in place accruing economic and environmental impacts and benefits. These actions would be conducted under the USACE OMRR&R authority. Other activities in the area, including National Wildlife Refuge management activities, navigation, and recreation activities, would continue in the future in a manner consistent with the existing condition.

In the absence of Federal action to provide a long-term solution, the probability of an uncontrolled flow (cutoff) between the Arkansas and White rivers would continue to increase. Formation of a cutoff would result in the loss of navigation reliability in the MKARNS. The Ark-White Cutoff Study determined that a 1,000-foot wide cutoff could form along the Jim Smith Lake corridor (approximately 130 acres) and the Owens Lake/Melinda Corridor (approximately 70 acres) (Figure 5).

The FWOP includes the following assumptions:

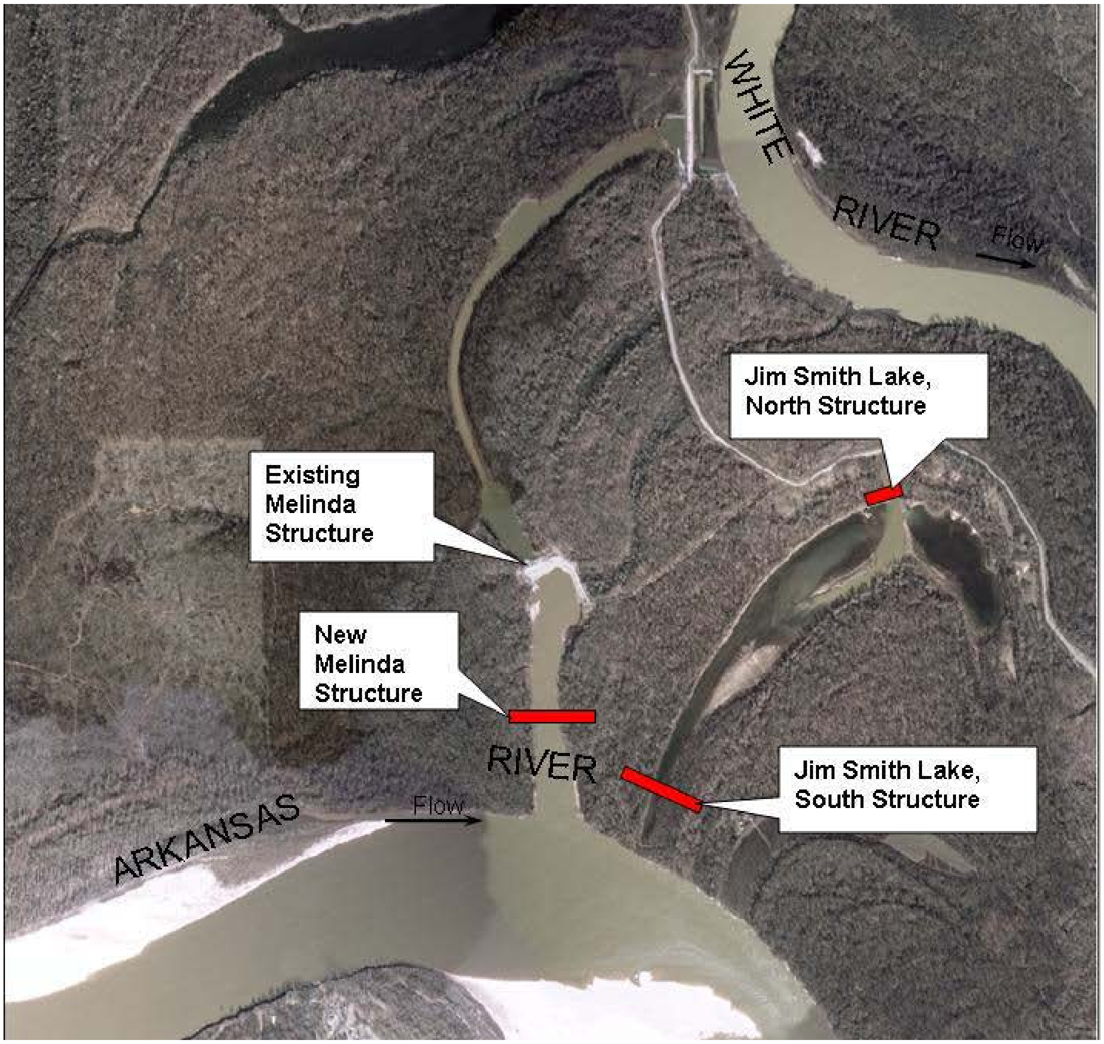
- USACE would attempt to keep the probability of a cutoff forming to less than 30 percent. Historically, the approach has been to reduce the probability of a cutoff forming by constructing a headcut containment levee and structures in LaGrues Lake, Owens Lake and the Melinda Structure, followed by repair after significant damage.
- The probability of a cutoff (breach of the existing headcut containment levee system) is based on a Monte Carlo Simulation model of risk that used judgement from a panel of experts. Each expert provided their opinion of the probability of a cutoff given a range of specific combinations of head differentials and duration and given the condition that USACE would conduct OMRR&R when necessary. This elicitation was completed during the Ark-White Cutoff Study and was carried forward for this study.

- The probability of a cutoff increases over time because future repairs are assumed to be in the same scope of historical repairs, which have not returned the structures or conditions preventing a cutoff to their original integrity.
- An existing structure would not degrade to less than 70 percent of the designed structural integrity. The structure would be designed to a one percent structural failure risk, but the overall risk of a cutoff would be dependent on the integrity of other structures in the study area.
- Independent of a potential cutoff developing, headcutting would continue in areas already experiencing land loss. It is assumed that new structures would need to be constructed in order to prevent new failure paths from developing into high risk corridors.

Figure 5: Potential Cutoff Paths Forming under the No Action Alternative

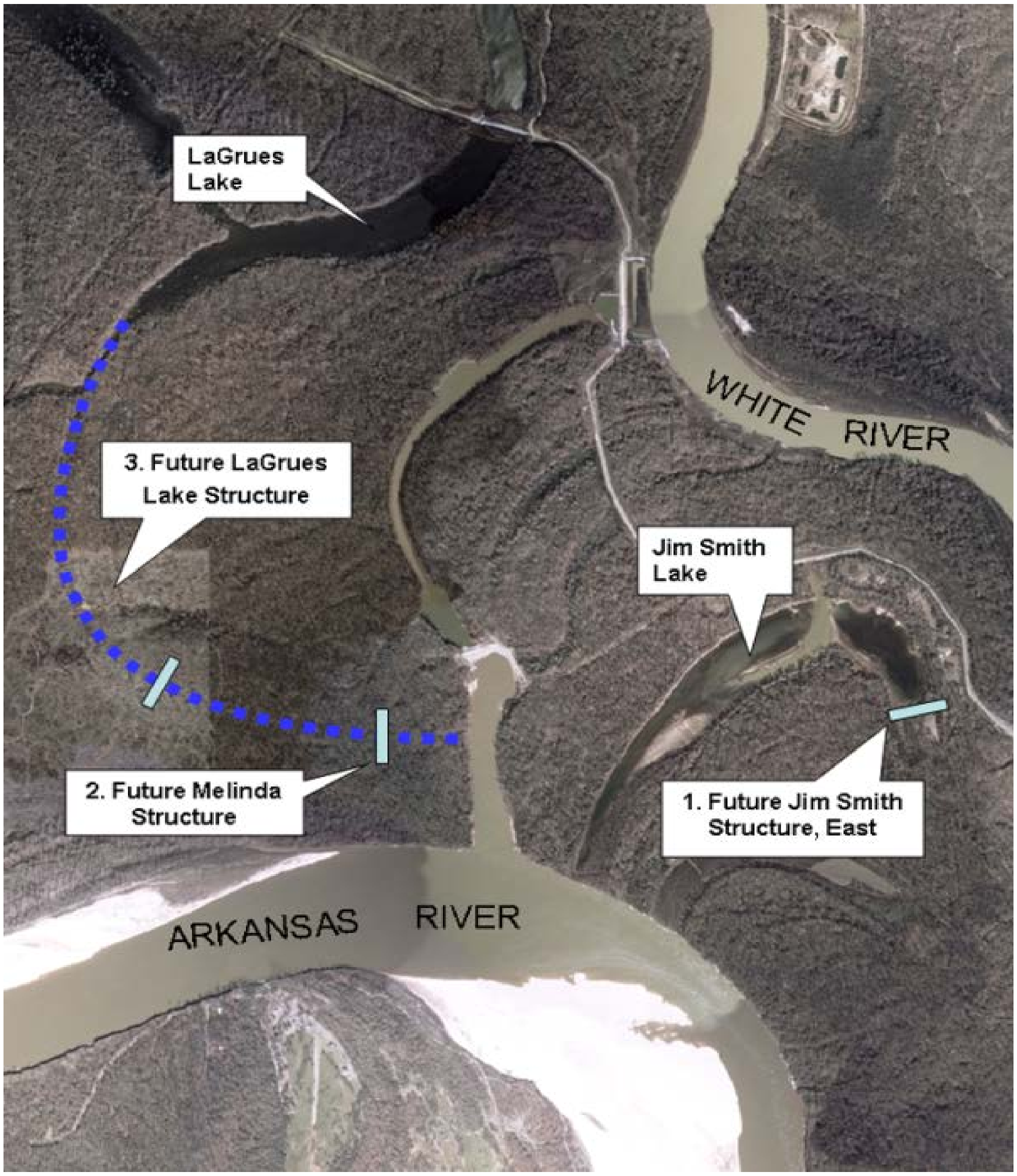
Repair, rehabilitation, and replacement is expected to occur as needed and be limited to structures in the Owens Lake Corridor (Owens Lake and Melinda Structures), and the Jim Smith Lake Corridor (portion of soil-cement dike and both North and South Structures of Jim Smith Lake). The Melinda Structure would be the first structure that would require replacement due to its current deterioration and instability and need for frequent repairs. Due to the existing Melinda Structure's poor condition, a new weir would need to be constructed towards the Arkansas River (Figure 6). For purposes of this analysis, if a new structure were constructed, it would have a 9-foot top width at elevation 142 and constructed of either rock or gabions (wire baskets filled with small rock and staked like blocks). As well, a temporary cofferdam surrounding the structure would need to be constructed if the gabion option is preferred in order to construct the structure in dry conditions. Extra soil material from excavation would be placed on top of the rock at Jim Smith Lake South Structure and be seeded with turf grass species.

Figure 6: Potential Reconstruction of the Melinda Structure Required under the No Action Alternative



USACE forecasts that three new structures would need to be constructed to prevent new failure paths from developing (Figure 7). Two of these structures are projected to be located along a line between the mouth of the Melinda Channel and LaGrues Lake Structure to prevent flanking of the Melinda Structure and progression of headcutting toward the LaGrues Lake Structure. The third structure is located east of Jim Smith Lake near the end of the historic cutoff structure to prevent a channel from developing adjacent to the containment levee. Construction of these structures is based on the progression of the Melinda Headcut.

Figure 7: Potential New Structures to be Constructed under the No Action Alternative



Land Use

Land use in terms of ownership is not anticipated to change from the existing condition. Private land owners may sell property, but it is likely that the transfer would be to another non-government entity. Lands supporting timber would be harvested in the future, creating an open space in the forest. It is likely that agricultural and other private lands would continue to be managed in a similar manner to the existing condition. Management of the NWR, WMA, or USACE lands would largely remain unchanged.

Under the No Action Alternative, cutoffs, headcuts, and new failure pathways would alter the type of land available in the future. Land use would gradually convert from bottomlands to open water and/or dry channels as headcuts develop. The Ark-White Cutoff Study estimated that 156.0 acres of land would be converted, which includes land use changes with continued maintenance, reconstruction of the Melinda Structure, three new future structures, and future headcutting.

If a breach of the existing containment structure were to occur, the previous study estimated a loss of approximately 200 acres of BLH that would be converted to open water and/or dry channels with the creation of a cutoff through Owens Lake and Jim Smith Lake. After new structures are installed to close the breach, land use conversion is not anticipated to return to existing conditions by the end of the planning horizon.

Air Quality

Under the FWOP, air quality within the study area is not anticipated to change from the existing condition and is expected to remain good into the future. Access road, site clearing, and transportation and movement of personnel and equipment on new and existing dirt roads would generate fugitive dust and emissions of particulate matter (PM). Operation of heavy equipment during construction, transportation vehicles, and other motorized machinery for construction would result in the emission of fossil fuel combustion exhausts and the release of nitrogen, oxides of Sulphur, ozone, carbon monoxide, and particulates. Construction emissions, including fugitive dust, would be short-term lasting only as long as it takes to complete each structure. Temporary impacts could be realized during four separate periods of time at an unknown point in the future. There are no anticipated long-term impacts under the FWOP condition.

Overall, implementation of the FWOP is expected to have minor adverse impacts on air quality but is not expected to impact or contribute to any areas not meeting NAAQS. Construction would be short in duration and limited to a small disturbance area.

Climate

Analysis of climate data from as long ago as 1880, show that the Earth's surface temperature has increased by more than 1.4°F over the past 100 years, with much of the increase taking place over the past 35 years (National Research Council 2012). Warming temperatures are often attributed to an increase in greenhouse gas (GHG) emissions, particularly carbon dioxide, which increased 80 percent between 1970 and 2004 (IPCC 2007).

To model future climate change, scientists utilize various general circulation models (GCM). Climate change analysis becomes more complex for the future than the past because there is not one time-series of climate, but rather many future projections from different GCMs run with a range of carbon dioxide emissions scenarios (IPPC 2007). It is important not to analyze only one GCM for any given emission scenario, but rather to use ensemble analysis to combine the analyses of multiple GCMs and quantify the range of possibilities for future climates under different emissions scenarios. Human population growth and related GHG emissions and changes in land cover have been modeled under various scenario in order to project future trends for global temperature and precipitation.

Predicted GHG Emissions Changes

In May 2008, the Center for Climate Strategies (CCS) completed a GHG emissions inventory and reference case projection to assist in understanding past, current, and possible future GHG emissions in Arkansas (CCS 2008). The report found that GHG emissions are rising faster than those of the nation as a whole. As is common in many states, the electricity and transportation sectors have the largest emissions, and their emissions are expected to continue to grow faster than in other sectors. As well, the study found that from 2005 to 2025, emissions associated with electricity generation to meet both in-state and out-of-state demand are projected to be the largest contributor to future emissions growth, followed by emissions associated with the transportation sector. Other sources of emissions growth include the residential, commercial, and industrial fuel use sectors, the transmission and distribution of natural gas, and the increasing use of hydrofluorocarbons and perfluorocarbons as substitutes for ozone-depleting substances in refrigeration, air conditioning, and other applications.

In 2008, Arkansas completed a Climate Action Plan with assistance from the CCS. Arkansas' plan focuses exclusively on the reduction of GHG, including a comprehensive set of sector-based policies and measures. Its design is consistent with the national climate proposal passed in the U.S. House of Representatives and supported by the Obama Administration, but includes more specific listings and provisions for specific sector based policies and measures, and was less specific on the design of national market based mechanisms.

Predicted Temperature Changes

The Nature Conservancy's climate wizard is a widely accepted, interactive web tool that incorporates data from IPCC climate models and can be used to assess how climate has changed over time and to project what future changes are likely to occur in a given area. It uses a non-parametric quantile-rank approach that maps out the 0 (minimum), 20, 40, 50 (median), 60, 80, and 100^{th} (maximum percentiles). The following information is from the Climate Wizard for changes in mean temperature and precipitation for Arkansas using an ensemble of GCMs and the three more widely accepted emissions scenarios (A2, A1B, and B1) for 50 years into the future.

Global temperatures are expected to increase 3 to 12°F by 2100, while projections for the US Southeast show a temperature increase of 4 to 8°F over the same time period (IPCC 2007). In Arkansas, average annual temperatures by mid-century (2050) are expected to increase under each emissions scenario. The most significant increase is predicted under the moderate emissions scenario (5.1°F). Under this scenario, the change in temperature is more widespread across the state. Under the high emissions scenario, an average increase of 4.9°F is anticipated, with a higher increase in the northwest part of the state. Even with a dramatic decrease in emissions under the B1 scenario, the average annual temperature is predicted to increase by 3.6°F.

Major consequences of warming include a significant increase in the number of hot days (above 95°F) each year and an overall decrease in freezing events and frosts. More heat and less cooling are expected to result in more heat-related deaths, more vector-borne illness and a major shift in plant species (EPA 2016). Plant growing seasons would likely become longer and the types of plants that can survive would being to change.

Predicted Precipitation Changes

Global predictions for precipitation changes into the future point to an overall decrease. However, the Climate Wizard projects slight increases or decreases in Arkansas depending on the emissions scenario used. The average change in precipitation for Arkansas by mid-century is predicted to be +1.65%, -0.79%, and +1.74% under the A2, A1B, and B1 scenarios respectively. Under each scenario, the southern portion of the state would see the greatest decrease in precipitation (not in the study area).

Though there is uncertainty among the scenarios in projected precipitation amounts, rising temperatures will account for an increased rate of evapotranspiration and a decrease in available water (Kunkel et al. 2013, Carter et al. 2014). Further, climate change models project that precipitation will be produced in fewer and heavier rainfall events. If so, this could lead to a decrease in aquifer recharge because more rainfall would be lost to runoff and could also result in an increase in both drought and flooding events. The southeast region is thus predicted to see a significant reduction in water availability (Carter et al. 2014).

Extreme Weather Events

The changing climate is likely to increase inland flooding, particularly in communities along major rivers and in the study area. Since 1958, the amount of precipitation falling during heavy rainstorms has increased by 27 percent in the southeast, and the trend toward increasingly heavy rainstorms is likely to continue. The risk of flooding along the Mississippi River may also increase because the Midwest, which drains into the river, is also becoming wetter. Both annual rainfall and stream flows in the Midwest are increasing, and that trend is likely to continue (EPA 2016).

Although climate change is likely to increase the risk of flooding, droughts are also likely to become more severe. Droughts are likely to be more severe, because periods without rain will be longer and very hot days will be more frequent. Droughts pose challenges for water management and river transportation. If the spring is unexpectedly dry, reservoirs may have too little water during the summer resulting in the inability to maintain reliable and safe navigation depths, narrowed navigation channels, and forced lock closures. If droughts become more severe, restrictions on shipping may be implemented (EPA 2016).

<u>Habitat Change</u>

Terrestrial Habitats

Higher temperatures and changes in rainfall are unlikely to substantially reduce forest cover in Arkansas, although the composition of those forests may change. Habitats that are drought-tolerant (e.g. glades and barrens, dry upland forests, and open woodlands/savannas) could fare better under future projected climate scenarios. These conditions are projected to cause an increase in the frequency and intensity of wildfires, thus potentially expanding these communities and improving habitat conditions for association of species of greatest conservation need (AGFC 2015).

Changing climate conditions may cause existing tree species to expand northward and be replaced by species from the south. Mesic forests would be more at risk to compositional changes due to drier conditions (AGFC 2015). Some of the species associated with these forests, such as sugar maple, would be expected to decrease (Brandt et al. 2014). The dominance in these communities would shift to more tolerant species, such as sweetgum, white oak, and red maple. Forests in general would experience a reduction in forest productivity, in basal area and canopy cover if trees are stressed by higher temperatures and more droughts. Climate change is also likely to increase the damage from insects and diseases. But longer growing seasons and increased carbon dioxide concentrations could more than offset the losses from those factors (EPA 2016).

Bottomland systems could be negatively impacted by the reduction of water coverage and altered hydrology. Forest cover in this system would be expected to increase with extended periods of dry weather and reduced water coverage. Seasonal/herbaceous wetlands and ephemeral ponds would especially be at risk for contraction and reduced habitat quality. In agricultural areas, such as the Mississippi Alluvial Plain, flood events could introduce herbicide and pesticide run-off into wetlands. Flood events would also increase sedimentation in wetlands and streams (AGFC 2015).

With overall warmer temperatures, conditions would be favorable for more non-native plant species from sub-tropical regions to invade communities (AGFC 2015). This would be especially true in areas where native species decline. Invasive non-native species would be an increased threat to all terrestrial habitats.

Aquatic Habitats

Aquatic systems could see substantial impacts from a changing climate. A reduction in available water, either due to decreased precipitation or increased evapotranspiration, would result in reduced stream flows and altered hydrology under the scenario in which there is a slight decrease in precipitation (AGFC 2015). Under the increase in precipitation scenarios, there would be at a minimum a temporary increase in aquatic habitat where conditions allow (i.e. river training has not occurred).

Warmer air temperatures would result in increased water temperatures and reduced dissolved oxygen (Meyer et al. 1999). Warmer temperatures can also increase the frequency of algal blooms, which can be toxic and further reduce dissolved oxygen. Summer droughts may amplify these effects, while periods of extreme rainfall can increase the impacts of pollution on streams, such as increased sedimentation, turbidity, nutrient loading and agricultural run-off (EPA 2016).

<u>Impacts from FWOP Actions</u>

Under the FWOP, actions would involve relatively small-scale construction activities and renovation projects occurring over a range of inconsecutive years. These activities would primarily generate GHG emissions as a result of construction equipment operations and other mobile source activities. There are no apparent carbon sequestration impacts that would result under the FWOP, thus the total direct and indirect impacts would be constrained to very small increases in GHG emissions to the atmosphere as a result of construction activities. These small increases would be far below the 25,000 metric ton per year threshold for discussion of GHG impacts (CEQ 2014). In years in which activities are implemented, emissions would incrementally contribute to global emissions for the very limited period of time, but are not themselves of such magnitude as to make any direct correlation with climate change.

Geologic Resources

Under FWOP, the geology and minerals of the study area are not anticipated to change. Because soil types in the study area are highly susceptible to erosion, future headcutting and excessive erosion and instability upstream, in oxbow lakes, and in tributaries is expected. Soils in the path of the headcut progression would be buried, removed, or inundated resulting in soils and landforms in these areas that would be permanently altered. During headcutting, an excessive amount of sediment is released into the river system, the instability will extend downstream as the newly eroded sediment aggrades in flatter valley reaches.

Active headcutting will continue to the point that it must be stopped to prevent new failure pathways from developing into high risk corridors. Re/construction in at least four areas in and around the existing Melinda Structure would be required to mitigate headcutting. Construction activities, including clearing, grading, backfilling, equipment traffic, and restoration of access roads, could adversely affect soil resources. Potential impacts could include temporary and short-term soil erosion, loss of topsoil, short- to long-term soil compaction, permanent increases in the proportion of large rocks in the topsoil, and soil horizon mixing. At the immediate site of the new structures, permanent long-term changes to soils would occur from compaction and conversion to impervious surfaces. At these locations, soil productivity would be lost. As well, the new structures would alter the existing topography by increasing the elevation of the site.

During re/construction of the four structures, soils would be disturbed and the topsoil and several inches of subsoil would be removed to construct the access road and any staging areas. During removal, there is a chance that shallow soil horizons could be mixed, resulting in the blending of soil characteristics and types. This blending would modify physical characteristics of the soil structure, texture, and rock content, potentially leading to a loss of soil productivity and reduced reclamation potential. Compaction due to construction activities, such as grading of the access road, would reduce aeration, permeability, and water-holding capacity of the soils. An increase in surface runoff can be expected, potentially leading to erosion. After heavy precipitation events, particularly if overbank flooding occurs, additional soil impacts from water erosion may occur. When water saturated segment(s) on the access road become impassable, vehicles may still be driven over the road. Consequently, deep tire ruts would develop. Where impassable segments are created from deep rutting, unauthorized driving may occur outside the designated access roads. Wind erosion would be expected to be a minor contributor to soil erosion with the possible exception of dust from vehicle traffic during construction.

Upon completion of the structures, the topography of the area would be permanently altered to a higher elevation than under the existing condition.

Water Resources

<u>Hydrology</u>

The FWOP alternative would have no impact on the frequency or duration of flooding within the floodplain when compared to the existing condition; however, the hydrology of the project area has already been severely altered and it is anticipated that the FWOP would not slow or reverse altered hydrologic conditions. It is anticipated that there would be no impact on lake recharging or connectivity. Continued channel instability would be expected.

However, reconstruction of the Melinda Structure as part of the No Action would result in changes to the flows exiting the Melinda Corridor. To determine the effects the structure location has on the Melinda Corridor, the velocities were first established at various cross-sections along the corridor with the structure in its current position. The structure was then replaced approximately 1,000 feet downstream (as anticipated under the No Action). Both locations were also analyzed to determine what effects the change may have on the Arkansas River as well. The velocities from both situations were computed at each cross-section from January 1981-October 1991. Figure 8 displays the results from the unsteady flow analysis in the Melinda Corridor just upstream of the Arkansas River. Figure 9 shows the variation in velocities on the Arkansas River at the Arkansas—Melinda Corridor intersection. The negative flows along the Melinda corridor, flows heading upstream, were small and considered throughout the analysis.

The resulting velocities from Figure 8 were only taken when the corridor was flowing. The reconstruction produced lower velocities in the Melinda corridor 95 percent of the time. The average percent difference in velocities between the existing condition and reconstruction was calculated to be 3.4 percent with a standard deviation of 4.2 percent. Therefore, the probable percent difference in velocity at the Melinda corridor just upstream from the Arkansas River may range from -0.8 to 7.7 percent. The negative percent difference signifies that the reconstruction produced greater velocities than the existing condition.

The variations in the Arkansas River velocities at the Arkansas—Melinda Corridor intersection were slight. The reconstruction produced lower velocities within the Arkansas River approximately 61 percent of the time when compared to the existing condition. The average percent difference was found to be 0.1 percent with a standard deviation of 0.4 percent, yielding a range of -0.3 to 0.5 percent difference.

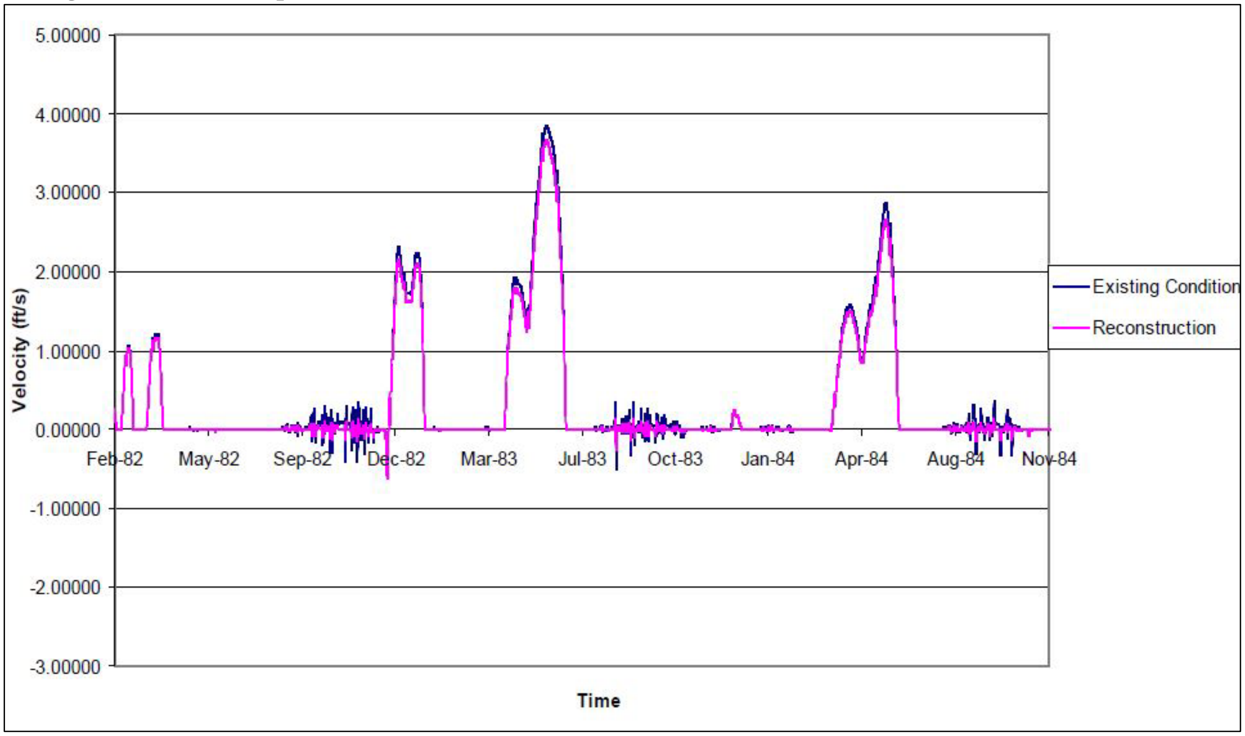


Figure 8: Melinda Corridor Velocities

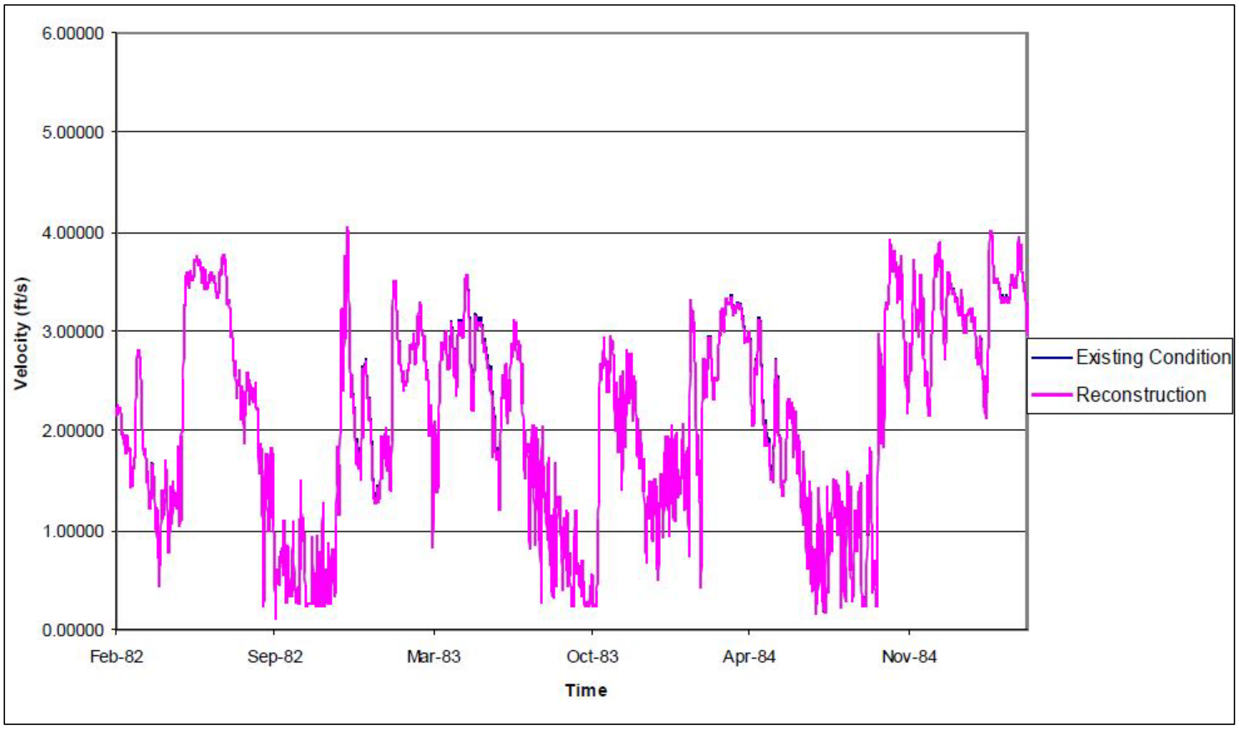


Figure 9: Arkansas River Velocities

<u>Surface Water</u>

As described in the FWOP Land Use, approximately 156.0 acres of land would be converted to open water or dry channel. Both situations would at a minimum, temporarily increase the amount of surface water available in the study area. Re/construction of the four structures would limit the increase in surface water over the existing condition. In the event of a breach, an increase in surface water would be expected until the breach is closed off and/or the area dries out.

Jurisdictional Waters of the US

Under the FWOP, no structures would be placed in a navigable WOTUS; however, re/construction of the four structures would benefit the Arkansas and White rivers by reducing the potential for a breach that would lead to temporary conditions that are not conducive to navigation. The structures would be placed within jurisdictional WOTUS and wetlands. Repair of existing structures would be covered under Nationwide Permit #3 “Maintenance”. WOTUS and jurisdictional wetlands would be directly impacted through re/construction of the four structures. Impacts include filling in the WOTUS or wetland at the immediate site of each structure, temporary decreased wetland and water quality, and temporary interruption of hydrologic and wetland functioning within the construction footprint at each structure. Additional Section 404 compliance would be required prior to implementing new construction actions under the FWOP alternative. No indirect or long-term impacts to wetland functions are projected to be incurred under the FWOP.

In the event of a breach, nearly 200 acres of jurisdictional wetlands would be converted to open water and or dry channel beds. After the breach is closed off, wetlands would return to wetlands; however, by the end of the planning horizon, the wetlands would be an earlier successional stage of bottomland hardwoods. It is not anticipated that bottomland hardwoods would return to existing conditions within the planning horizon.

<u>Groundwater</u>
Under the FWOP, groundwater resources would not be impacted. Historic recharge is anticipated to continue similar to the existing condition despite re/construction of the four structures.

<u>Water Quality</u>
As described in the FWOP Geology section, soils in the study area are highly susceptible to erosion leading to bank instability. Bank instability and erosion frequently results in excessive sediment inputs into stream channels. Sediment increases the turbidity of a stream and may adversely affect aquatic life and fisheries through sediment deposition in pools, spawning gravels, and stream-bottom habitat for aquatic invertebrates, and by restriction of light penetration necessary for photosynthesis by aquatic plants. Excessive sediment inputs may also alter the stream channel morphology and change the composition of aquatic habitats and associated fish and macroinvertebrate communities.

Construction activities associated with re/construction of the four structures can modify the existing aquatic habitat, increasing runoff and the rate of in-stream sediment loading, and increase turbidity. Clearing and grading of streambanks, in-stream trenching and backfilling, and trench dewatering can introduce sediment directly or indirectly into the water column causing temporary increases in total suspended solids and increased sedimentation.

Additionally, accidental spills and leaks of hazardous materials associated with equipment; the refueling or maintenance vehicles; and the storage of fuel, oil, and other fluids can have immediate effects on surface water and could contaminate a waterbody downstream of the release point. Impacts associated with the spills or leaks of hazardous liquids would be avoided or minimized by restricting the location of refueling (at least 100 feet from a waterbody) and storage facilities and by requiring cleanup in the event of a spill or leak. The contractor would prepare a Spill Prevention, Control, and Countermeasure Plan to minimize the potential for surface water impacts associated with an inadvertent spill of hazardous materials.

<u>Floodplains</u>
Under the FWOP, there would be only minor changes to the floodplains in the immediate area of the structures. This change has not been modeled due to the relatively minor increase. Increases outside the immediate structure site throughout the study area are not anticipated.

Biological Resources
The Ark-White Cutoff Study estimated approximately 156 acres of direct impacts from construction of up to three new structures, reconstruction of the Melinda Structure, and habitat loss associated with future headcutting, although impacts could actually be lower once the structures have been designed. The direct project construction footprint is projected to cause a loss of all wetland functions immediately, to where future headcutting would result in a loss of wetland functions gradually over time as the area converts to open water or dry channel. Under the FWOP, there would be no change in existing hydrologic conditions. No indirect impacts to wetland functions or waterfowl habitat are projected to be incurred under the FWOP. At least one of the new structures and a portion of the reconstructed Melinda Structure would be constructed on refuge property, and therefore, are subject to compatibility requirements.

The FWOP impacts were incorporated into the Hydrogeomorphic Approach (HGM) analysis conducted for the Ark-White Cutoff Study. For the analysis, it was assumed that all of the impacts are direct and total (i.e. all functions lost for all impacted areas). Because much of the existing forest in the impact area is not in a mature, fully functional condition, the Functional Capacity Units (FCU)s lost are less than the total number of acres impacted, meaning the FCU values for all functions were less than 1.0.

Most of the impact is in the Riverine Backwater subclass, reflecting the small amount of acreage in the Flats class within the impact area, and the relatively poor condition of the impacted Flats forests (Table 9). Under the FWOP, Riverine Backwater would realize a total loss (all functions) of 840 FCUs and a total loss (all functions) of 4 FCUs in the Flats wetland class. While these totals are useful for understanding the magnitude of change associated with the alternative, the standard recommendation is to mitigate for the most-impacted function, thereby assuring that all other functional losses have been over-compensated. Therefore, mitigation for the Riverine Backwater class would be based a loss of 134 FCU for the “Remove Elements and Compounds” function and any of the four functions with a loss of 1 FCU for the Flats class. Mitigation needs under this alternative would be refined further prior to re/construction of the four structures.

Table 9. Change in Functional Capacity Units (FCUs) for Riverine Backwater and Flats wetlands under the FWOP alternative.

	Change in FCU							
Wetland Class	**Detain Floodwater**	**Detain Precipitation**	**Cycle Nutrients**	**Export Organic Carbon**	**Remove Elements and Compounds**	**Maintain Plant Community**	**Provide Wildlife Habitat**	**Total (all functions)**
Riverine	-120	-115	-114	-116	-134	-121	-121	-840
Flats	0	-1	-1	0	0	-1	-1	-4

During construction activities, it is anticipated that there would be a temporary decrease in aquatic habitat quality due to increased sedimentation from work being done in and near open water. During this time, it is anticipated that listed, special status, and non-listed fish and mussels, although to a lesser degree, would avoid the construction area. Fish and mussels that do not or cannot avoid the area are susceptible to mortality caused by heavy equipment using the area. The quality of the habitat is expected to return to existing conditions when construction operations cease, at which time it is also anticipated that fish and mussels would resume their pre-construction use of river-side areas. Construction of the new structures would prevent fish migration into areas behind the structures that were accessible under the existing condition.

Construction-related activities are anticipated to impact listed, special status, and non-listed species, if they occur as a resident, migrant or incidental, within or near the project area. Impacts include habitat removal and/or fragmentation from re/construction of the four structures and associated access road creation and habitat avoidance because of increased noise, dust generation, and vibrations. Losses of slow moving species (mammals and herptofauna) are anticipated along the access roads and within the construction footprint. Faster moving species are expected to be able to avoid injury or death while crossing access roads and by avoiding the construction area. In general, most wildlife species would become habituated to the on-going work including adapting to the habitat changes; however, species with a low tolerance to activities are anticipated to be displaced for the duration of activities. The level and duration of the impacts is dependent on the final design of each structure, type of equipment used, duration of construction activities, and plans for restoration activities, if required. However, it is anticipated that once construction is complete, construction-impacts to wildlife would cease.

For listed species, ESA Section 7 Consultation would be completed prior to any ground disturbance activities. With the level of impact anticipated, the FWOP is not anticipated to rise to the level of "jeopardy."

As with any ground-disturbance activity, the probability of introducing, spreading, and/or establishing new populations of invasive, non-native species, particularly plant species, exists. Contractors would be required to clean all equipment prior to entering the construction area to avoid the spread of invasive into the project area.

If a breach of the existing containment structure were to occur, the previous study estimated a loss of up to 200 acres of BLH with the creation of a cutoff through Owens Lake and Jim Smith Lake. There would be a temporary increase in aquatic habitat until the cutoffs are closed off by construction of the new structures. Impacts during construction of the structures to close off the cutoff would be similar to those described for re/construction of the four structures.

Continued channel adjustment in the lower Arkansas River and erosion in the study area is expected to occur with resultant loss of terrestrial habitat. New sandbars formed as the Arkansas River moved across its floodplain would provide habitat for endangered Least Terns and would eventually develop into willow bars, cottonwood forests, and finally riverfront hardwood communities.

Cultural Resources

Under the FWOP condition, there would be no change in cultural resources. However, as stated in the Geologic Resources section, the soil types in this area are highly susceptible to erosion, which may lead to future head-cutting, excessive erosion and instability upstream, in oxbow lakes, and in tributaries which could impact cultural resources that have yet to be identified. Additionally, prior to re/construction of the four structures, cultural resources would again be considered under Section 106; and, if required, additional field work completed prior to implementation of the undertaking to avoid, minimize or mitigate any adverse effects to significant cultural resources in the areas of potential effect.

Recreation and Aesthetics

Under the FWOP, recreation opportunities would be temporarily lost in the immediate vicinity of the construction footprint while construction-related activities are underway. Impacts could be realized during four separate periods of time at an unknown point in the future. During this period of construction, recreationists may experience an increase in noise from operation of equipment that could impact their ability to seek solitude or may reduce the success of wildlife-dependent recreation activities. During the temporary reduction, similar recreation opportunities would remain available on adjacent lands. Public access to the NWR and WMA would be maintained during construction. Recreation would resume in a manner similar to the existing condition after construction is complete.

The aesthetic value of the area suffers each time there is any intrusion in the natural environment by man-made structures. The primary issue associated with visual resources is the degree of visible change that may occur in characteristic landscapes, viewsheds, and areas with high scenic value. Construction activities can introduce differing elements of form, line, color, and texture into the landscape through construction or placement of constructed features such as roads, structures, equipment, or manipulation of vegetation. Effects can also result when actions change scenic integrity or result in conditions that produce unattractive landscapes.

Impacts associated with the FWOP on aesthetics include visibility of constructed structures and temporary roads. Vegetation clearing to construct the structures and temporary access roads and the structures themselves would present an obvious contrast in color with the surrounding vegetation. The cleared areas and structures may be visually prominent at foreground and middleground distance zones. These areas would be most obvious immediately after construction. The structures have the greatest potential to permanently alter visual conditions, while impacts from the access roads would be temporary, but could remain on the landscape for a decade or more. Impacts from temporary roads would decrease as the disturbed surface began to blend in color, form, and texture as natural reclamation occurs. Final structure height will play a significant role in determining the level of long-term visual impacts. Based on preliminary designs, visual disturbance is anticipated to be limited to those who travel by foot through the area or by watercraft on the White or Arkansas Rivers. The height of each of the structures is low enough that the surrounding BLH forest masks the structure from areas further away.

Short-term impacts may occur where construction-related equipment, activities, and dust would be visible to observers. Impacts would be anticipated in years in which re/construction of the structures are implemented, so there could be up to four independent periods of visual disturbances.

Under the FWOP, re/construction of the four structures and associated construction-related activities could have adverse impacts on the aesthetic value of the area; however, the level of impact, by nature, is subjective and difficult to quantify.

Transportation

Under the FWOP, additional temporary roads would be constructed to access the locations of the four structures. The access roads would be closed to the public during and after construction. The roads would not be maintained after construction is done and allowed to naturally restore. Access road(s) to the new structures may be reopened if future repair is required; however, after work is complete the road would again be allowed to naturally restore.

In the event of a breach of the existing containment structure, existing roads in the flow path would be washed out and remain inundated until flood waters recede and a close-off structure is constructed.

<u>Navigation</u>

Absent global or national catastrophe (economic or natural), the U.S. and world economies and populations will continue to grow as will interstate and international commerce. More people and economic activity translate into more demands on U.S. transportation infrastructure including inland waterways including the MKARNS. Traffic projections developed for the study assume continued growth for inbound and outbound commodities on the rivers. For each major commodity group in the baseline, growth rates from secondary sources drive forecasts of future traffic. From 2016 through 2075, tonnage in the project area is expected to grow from about 9.5 million tons per year to 17.5 million (76% increase) at a rate of 1.03 percent per year. Additional information on projected traffic rates and commodities can be found in the Appendix A.

Re/construction of the structures under the FWOP condition would be designed in such a way that the structures would not induce dangerous cross currents that would affect safe navigation of the MKARNS; therefore, the FWOP, in the absence of a breach, would have no impact on navigation.

If a breach of the existing containment structure were to occur, it is estimated that on average 109 of the 220 days required for repair and closure would be non-navigable with a standard deviation of 41 days. Given the hydrologic dynamics of the river system, the estimated number of non-navigable days is not consecutive. The number of non-navigable days per year were calculated to occur when either water surface elevation in the entrance channel was less than 105.5 feet or flows through the cutoff exceed 50 percent of upstream White River flows.

Navigation between ports upstream of the study area is likely to continue; however, any traffic coming from/going to the Mississippi River would be halted during the closure periods. In the event of an extended period of closure, shippers would respond in a number of ways including, but not limited to: holding shipments until the MKARNS is opened, rerouting through other waterways, or shipping cargo by truck or rail. Under the FWOP, if a breach occurs, adverse impacts to navigation would be expected.

See Appendix A for more detailed information on the impacts to navigation from a breach.

Socioeconomics and Environmental Justice

Socioeconomics

Socioeconomic impacts are assessed in terms of direct effects on the local economy and population, and related indirect effects on other socioeconomic resources within the study area or adjacent to the study area, in this case Arkansas and Desha Counties. Socioeconomic impacts would be considered significant if the alternative resulted in a substantial shift in population trends or notably affected regional employment, earnings, or community resources such as schools.

Construction activities would be expected to directly affect the local economy through a temporary increase in economic activity in the construction sector. Temporary increases in employment, income, business activity, and local tax revenues would be anticipated in years in which re/construction of the structures are implemented, so there could be up to four independent periods of temporary increase. No permanent change in population or demand on local public services would be expected.

No negative impacts associated with reduced recreation, in particular hunting and fishing opportunities, are anticipated as public access to the NWR and WMA would be maintained.

In the event of a breach, adverse impacts to socioeconomics could be expected due to the inability of barges to navigate the MKARNS (see Future without Project Condition—Transportation section).

Environmental Justice

Environmental justice impacts are assessed in terms of directs effects on overburdened populations (i.e., minorities, Indian tribes, low-income residents, and children) within or adjacent to the study area. Environmental justice impacts would be considered significant if impacts related to the various resource sections analyzed would result in disproportionate impact to the identified populations.

Desha County has been identified as an Environmental Justice population. Most of the communities are greater than 10 miles from the project areas and therefore it is very unlikely that implementation of re/construction of the four structures would impact these communities. Although recreational opportunities, particularly hunting and fishing, would be temporarily reduced in the immediate project area, similar opportunities are available in adjacent public lands. No access to public lands or associated recreational areas would be impacted.

Because there are no schools or parks in the vicinity of the project area, nor are there any children residing in or near (>2 miles) the project area, implementation of the no action is not anticipated to disproportionally affect children.

Hazardous, Toxic and Radioactive Wastes (HTRW)

Because there are no existing HTRW sites, there would be no change under the FWOP.

CHAPTER 3: PLAN FORMULATION

The risk of a cutoff forming between the White River and the Arkansas River is caused by water stage differences (i.e., head differentials) that occur when one or both rivers are above their bank. When one or both rivers are out of bank, the flood waters tend to flow overland across the isthmus along several paths of least resistance. The primary source of overtopping flows is the Mississippi River. When water elevation on the Mississippi reaches a certain level, it forces backwater into the White River, and this water would overflow across the isthmus into the Arkansas River since the Mississippi backwater response time is shorter on the White than on the Arkansas. Occasionally, flooding results in flows from the Arkansas River to the White River. As flood waters move overland, the ground surface erodes as the headcutting process takes place. Eventually a new water course, or cutoff, may form that would redirect part or all of one river's flow to the other river.

While the USACE constructed the existing containment structure system in the project area (which is the in the isthmus) to address potential uncontrolled flows between the rivers, subsequent cutoffs have been developing due to head differentials between the two rivers. This geomorphic process continues to threaten the MKARNS and the costs to maintain and repair existing structures is increasing and becoming more frequent. If a cutoff forms, navigation through the study area would cease for extended periods due to dangerous cross currents during high flows, and draft constraints during low flows. In addition, sediment deposition would increase dredging requirements, and an estimated 200 acres of bottomland hardwood forest would be lost as it is converted to open water.

Plan formulation is based on a 50 year period of analysis based on expected the lifecycle of the structures proposed. The period of analysis is considered to be 2025 through 2075, allowing time for construction of proposed structures after project authorization. Benefits will not begin to accrue until the proposed structures are completed.

Study Problems and Opportunities

<u>Problems</u>

1. Due to overtopping and erosion, existing containment structures require expensive OMRR&R.
2. A breach in existing containment structures and subsequent formation of a cutoff would impact navigation due to dangerous cross currents and or closure of the navigation channel to accommodate repairs.
3. Construction of existing containment structures has impaired the function of the oxbow lakes within the project area.
4. A breach of the existing containment structures would result in the loss of approximately 200 acres of bottomland hardwood forest ecosystem.

<u>Opportunities</u>

1. Reduce the risk of breach in this portion of the system and overall OMRR&R costs resulting from overtopping and erosion.
2. Reduce the risk of navigation closures due to a breach and cutoff.

3. Restore, to the extent practicable, functionality of impaired oxbow lakes in the study area, and;
4. Reduce the risk of damages to sensitive bottomland hardwood ecosystem resulting from the formation of a cutoff.

Planning Goal and Objectives

The goal of the study is to formulate a means to ensure long term sustainable navigation on the MKARNS. Specific objectives over the period of analysis are to:

1. Reduce OMRR&R costs for structures in the project area.
2. Reduce the risk of breach of the containment structures in the project area.
3. Restore hydrologic connectivity to oxbow lakes in the study area.
4. Reduce the risk of damages to the bottomland hardwood forest ecosystem in the isthmus.

Special Considerations During Planning

The project area is adjacent to the Dale Bumpers White River National Wildlife Refuge, (the Refuge), which was established in 1935. A portion of Refuge lands intersects the existing containment structure footprint and a portion of any proposed construction resulting from the Three Rivers Study would also take place on Refuge land (Figure 10). The Refuge contains approximately 160,000 acres of prime bottomland hardwood habitat the floodplain of the lower White River adjacent to the navigation channel. The Refuge is a small part of a larger expanse consisting of over 500,000 contiguous acres of bottomland hardwood forest ecosystem, of which over 250,000 acres have been recognized by the Convention on Wetlands of International Importance (Ramsar Convention). The bottomland hardwood forest frequently floods and is highly affected by changes in land and water elevations.

The USFWS manages the Refuge, pursuant to the National Wildlife Refuge System Improvement Act of 1997 (16 U.S.C. 668dd-6689ee), reviews and issues compatible use permits for construction on Refuge land. Because of the proximity of the forest ecosystem to the navigation channel and containment structures, modifications to the structures could impact the forest, through changes in hydrology resulting from containment structure placement and function. For this reason, plan formulation took into consideration the changes to hydrology that could result from a given measure; and, where practicable, providing environmental benefits to the bottomland hardwoods, wetlands, and oxbow lake functions in the isthmus and in the Refuge while preserving the integrity and long term dependability of the navigation entrance channel to the MKARNS.

The PDT has engaged in extensive and on-going consultation with USFWS personnel from the Refuge and from the USFWS Arkansas Field Office in Conway, Arkansas as well as staff from the AGFC and ANHC. Interagency coordination has ensured stakeholder concerns were identified and considered throughout the plan formulation process. As a result, the PDT has specifically designed project alternatives that meet navigation objectives and has ancillary ecosystem restoration benefits or, at a minimum do not significantly alter forest hydrology in the study area.

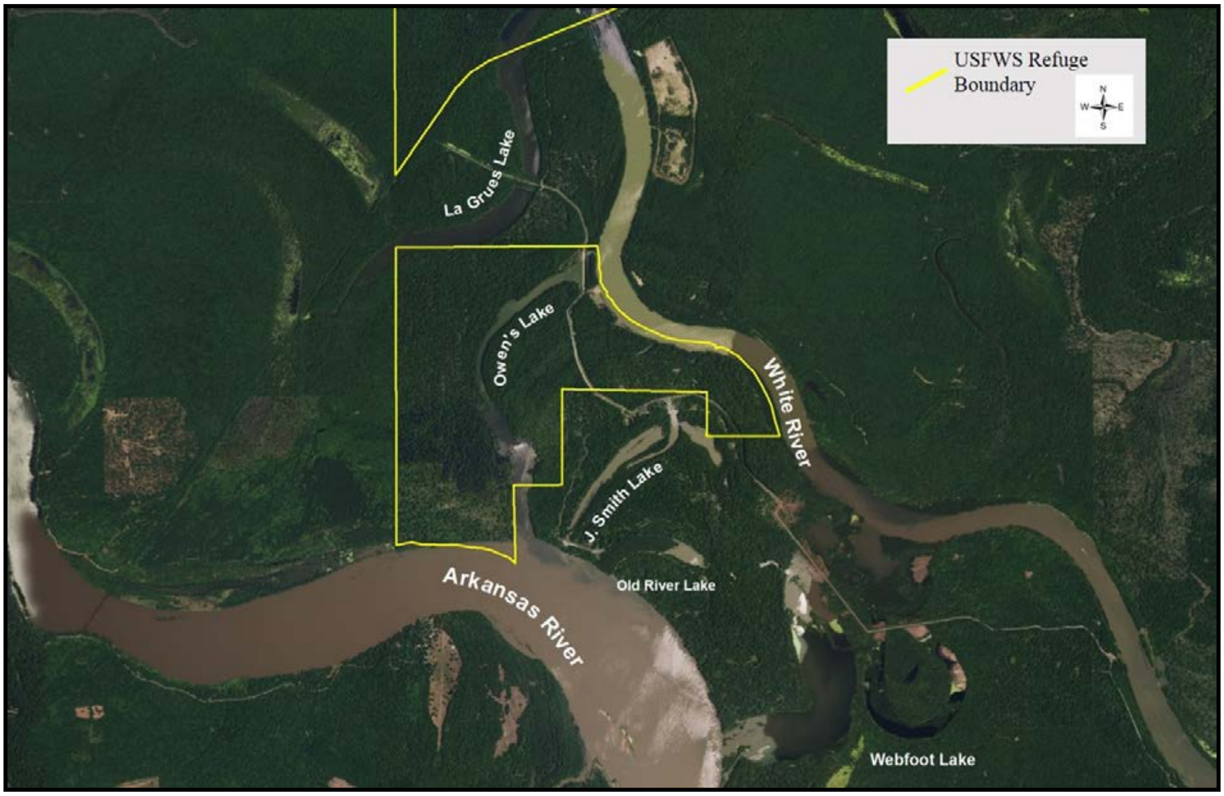


Figure 10. USFWS Refuge boundary in relation to the project area.

Development and Screening of Measures

Plan formulation began with a review of measures considered during the 2009 Ark-White Study. These measures were screened again and further developed with a focus on the goals, problems and opportunities of the current study.

Measures Carried over from the Ark-White Study

The 2009 Ark-White Study developed a wide array of measures that would address problems that could lead to a breach and cutoff in the study area. Measures from the Ark-White Study include:

1. No Action: As required by NEPA, the No Action Alternative is the most likely condition expected to occur in the future in the absence of the proposed action or any action alternatives. In this case, no long-term solutions to the critical problem affecting the continued safe and economic use of the MKARNS would be recommended for congressional authorization and funding. The No Action alternative was considered in the Ark-White study and carried forward throughout formulation to ensure any plan considered for selection would be better than taking no action as a result of the study.

2. Restore Natural Historic Hydrology with a Relief Structure. Release flows to the Arkansas River to raise the river and decrease head differentials. This plan effectively restores the natural hydrology and Historic Cutoff channel that was closed in the early 1960s. Decreased head differentials would also reduce erosive forces and the need to maintain the Melinda and Jim Smith Lake structures. This could be accomplished by an

active gated structure similar to the others on the navigation systems, or a passive weir structure.

3. Modify Owens Lake - Melinda Corridor. Reconfigure and enlarge existing containment structures and channels, including stabilizing banks, for prolonged stability and increased conveyance as needed to withstand head differentials.

4. Combine Measures 2 and 3. Construct Melinda Corridor enhancement (Measure 3) that could be coupled with a controlled opening of the Historic Cutoff (Measure 2) for increased efficiency at reducing head differentials and periods of potential navigation closures due to cross currents.

5. Combine Measure 2 and Remove Soil-cement Dike. Construct a gated or weir structure as described in Measure 2 and remove a large portion of the existing soil-cement dike. The premise would be to balance stages of the Arkansas and White rivers while restoring the area to better mimic its historical condition. If Measure 1 balanced river stages, the need for the existing soil-cement dike would decrease. Owens Lake Structure and approximately 1,000 feet of the structure north of Jim Smith Lake would remain to prevent possible erosion in this high risk area (i.e., risk of cutoff formation).

6. Raise or Extend Existing Soil-cement Dike. Raise the existing soil-cement dike and the Owens Lake Structure to an elevation where head differentials are low enough to minimize or eliminate damage by effectively separating the Arkansas and White rivers. The Owens Lake Structure overtops where flow is confined in the Owens Lake Melinda channel corridor until the White River exceeds an elevation of 150 feet. At this elevation, the entire structure submerges and flow usually comes from the White and flows into the Arkansas with great force, depending on the Arkansas River's stage. Raising the dike would further divide the White and Arkansas rivers and reduce the regularity of the White overtopping the structure and resultant erosive forces while it flows toward the Arkansas River. When the dike overtops, head differentials would likely decrease and a deeper plunge pool on the Arkansas River side would help absorb erosive energy. The dike would be extended upstream along an existing road adjacent to the White River and connect to high ground near Lock 2 to minimize damage when flow is directed around the ends of the dike.

7. Operational Changes. Create an operation plan that equalizes surface water elevations on the White and Arkansas rivers (i.e., non-structural approach to minimizing head differentials).

8. Construct Dam on the lower Arkansas River. The dam would raise water levels on the Arkansas River, thereby reducing head differentials between the White and Arkansas when the Arkansas would normally be lower. However, this measure would require additional levee systems and the dam would need to be larger than most of the dams currently operating on the Arkansas River.

9. Setback Levees. Expand the width of the Arkansas, White and Mississippi River floodplains to decrease river stages and head differentials by allowing water to spread over a larger area. This would also create wetland habitat.

10. Stabilize Riverbanks to Allow Cross Flow Overbank Spillage. Stabilize banks on the Arkansas River to prevent further bank migration toward the White River and allow overbank flow from the White River.

11. Non-overflow Dike. Raise and extend the existing soil-cement dike to prevent 100-year frequency Mississippi River stages from overtopping and separating the Arkansas and White rivers. The elevation would be approximately 170 feet (20 feet higher than the existing soil-cement dike).

12. Shorten Stream Distance on Arkansas River from the Melinda Corridor to mouth. If the Arkansas were to be modified to move its mouth upstream closer to the mouth of the White River, the influence of the Mississippi River would be similar on both the Arkansas and White rivers; and thus, head differentials would significantly decrease. Today, the mouth of Melinda Corridor is approximately 17 miles upstream from the mouth of the Arkansas, which is 20 miles downstream of the mouth of the White. The Arkansas is typically lower than the White during high Mississippi River stages because of the distance from the Mississippi and the Mississippi's stream slope.

13. Grade Control Structures. Grade control structures are weir-type structures, such as the Melinda and Owens Lake structures, that help minimize surface water elevations and help control water surface slopes and water velocities, and thus erosion.

14. Additional Structures near Jim Smith Lake. Jim Smith Lake provides an unobstructed path between the soil-cement dike and the Arkansas River. Additional structures would slow water velocities and erosive forces and could significantly reduce the chance of a cutoff.

15. Allow Multiple Smaller Flow Paths (Historic, Melinda, and LaGrues corridors). Remove a portion of the existing soil-cement dike to allow more flow from the White River to cause a rise in the Arkansas River, thereby reducing head differentials. This measure is similar to restoring natural historic hydrology, but would release water to the Arkansas River at a significantly lower rate.

16. Long-term Research and Monitoring. Research and monitoring would allow technology and additional experience managing the area to help make a more informed decision to resolve regional bank instability and headcutting in the watersheds of the White, Arkansas and Mississippi rivers that are threatening ecosystems, navigation, recreation, flood damage reduction and watershed protection.

The Ark-White team initially screened the above measures based on technical, environmental and economic completeness, effectiveness, efficiency and acceptability. Thirteen of the 16 measures were screened out for the following reasons:

Measure 3: Modify Owens Lake - Melinda Corridor (additional weirs / replacement). This alternative would not stand alone as a long-term solution; and thus, it is incomplete. Additional structures would be needed near Jim Smith Lake in addition to the three new structures described in the without project condition. In spite of these structures, there would still be significant OMRR&R costs for existing containment structures and a high risk of structure failure and cutoff formation.

Measure 4: Combination of Measure 2 and 3. Although the Alternative 2 restoration structure would reduce flows through the Melinda Corridor, the Melinda Corridor would need to pass at least its original capacity of flow in order for the Alternative 2 structure to be reduced. Because the channel is already undersized for the flow capacity, the structures would have to be significantly enlarged. The total cost of the reduced Alternative 2 structure and enlarged Melinda Corridor structures was expected to cost more than the original Alternative 2 structure. Therefore, this alternative was eliminated as it was not technically feasible nor economically efficient.

Measure 5: Combination of Measure 1 and Removing Soil-cement Dike. This alternative was carried forward into the second round of screening in the Ark-White Study, but was eventually screened due to high construction costs compared to the net benefits gained.

Measure 7: Operational Changes. A hydraulic investigation concluded that the Arkansas River could not be raised during low flows because of the navigation pool upstream of Dam 2. The investigation involved researching flood wave travel times from regulated projects to the study area. Existing White River dams are over 220 miles upstream, and Arkansas River dams are not designed to store significant amounts of water above what is necessary to maintain navigation pools. Any operational changes on the Arkansas and White rivers were deemed insignificant compared to a relatively high Mississippi River that controls water surfaces in the study area when erosion occurs. Therefore, this alternative was eliminated because it would not be effective.

Measure 8: Dam on the lower Arkansas River. This alternative would involve damming water at least 10 feet above the Arkansas River's top bank which would require levee modification, real estate acquisition among other inherent requirements of constructing a large structure. Increased flooding would threaten bottomland hardwood stress and mortality; and as a result, this alternative was eliminated due to the significant issues with environmental acceptability and high financial costs (i.e., low economic efficiency).

Measure 9: Setback Levees. The land area needed to affect river stages was not economically feasible considering high real estate costs, loss of crop production due to inundated land, and substantial expenses of reconstructing the levees.

Measure 10: Stabilize Riverbank to allow Cross Flow Overbank Spillage. A geomorphic study by the Corps of Engineers Engineering, Research and Development Center recommended that bank stabilization was not needed to protect existing containment structures. In addition, environmental stakeholders objected to this alternative, and it was deemed incomplete as a long-term technical solution because the hydrologic conditions that would cause a cutoff would not change.

Measure 11: Non-overflow dike. Measure 11 was eliminated as it was deemed environmentally unacceptable due to the changes in hydrology that would reduce groundwater recharge in wetlands and increase flood elevations. Flooding impacts to the Mississippi River would also have to be evaluated. A lower dike was considered to significantly reduce risk (refer to Alternative 6) because medium-size Mississippi floods cause generally cause problems as opposed to large floods approaching the 100-year frequency.

Measure 12: Shorten Stream Distance on Arkansas River from Melinda to Mouth. This measure would significantly alter wetlands and aquatic habitat, both directly by clearing a path for the channel and indirectly by increasing sedimentation and bank erosion throughout the downstream reach of the Arkansas. In addition, headcutting and erosion would move from the Ark-White area to the Mississippi/Arkansas area. The Arkansas would tend to flow into its former, natural, channel. This alternative was eliminated because of the unacceptability of the significant environmental impacts of creating long channel, changing hydrology.

Measure 13: Grade control structures. This measure is similar to Alternative 3 but on a larger scale over the entire study area. It was eliminated because many structures would be needed to prevent erosion and the structures could transfer the erosion to another location. Therefore, this alternative was deemed incomplete.

Measure 14: Additional structures in Jim Smith Lake. This measure was eliminated as a stand-alone alternative that would not address other headcutting action presently being observed in Owens Lake, Melinda Channel, Jim Smith Lake, and LaGrues Lake and was therefore considered incomplete.

Measure 15: Allow multiple smaller flow paths (Historic, Melinda, and or LaGrues). This measure is similar to the restoration structure of Alternative 2, but would release water to the Arkansas at a significantly lesser amount. The Alternative 2 structure and the Melinda Corridor were estimated and designed to pass at least 120,000 and 40,000 cfs, respectively. Notches in the existing soil-cement dike would negligibly increase these flows and would therefore not reduce head differentials between the Arkansas and White. Therefore, it was eliminated because it was ineffective.

Measure 16: Long-term research and monitoring. This alternative was incorporated into the No Action Plan. It was screened from further consideration because it would not provide a long-term solution as defined by planning objectives.

Upon reviewing this screening rationale, the Three Rivers Study team decided that the above measures would not be carried forward for the current study. The remaining measures were included in the Three Rivers analysis. In addition, the Three Rivers team added a measure that would allow for multiple openings of the existing structures. This is similar to Measure 3 and 4 from the Ark-White study, but is not limited to the structures in the Melinda corridor and Historic Cutoff.

Thus, the three measures carried forward, plus the No Action Alternative, for the Three Rivers Study are:

1. No Action (as required under the NEPA)
2. Open Historic Cutoff (from Measure 2 from the Ark-White Study)
3. Raise and extend/realign the soil cement dike (from Measure 6 from the Ark-White Study)
4. Allow multiple flow paths (Historic Cutoff, Owens/Melinda, LaGrues, and or Jim Smith);

Failure Path Analysis

To begin developing alternatives to address the risk of a cutoff, major failure paths across the isthmus had to be identified. The Ark-White Study identified four main failure pathways: 1) the Melinda Channel Owens Lake corridor, 2) the Melinda Channel – Owens Lake slough, 3) the LaGrues Lake corridor and 4) the Jim Smith Lake corridor. Since completion of the Ark-White

Study, new nick points have developed and the Arkansas River has meandered further. As a result, the Three Rivers Study team identified seven potential failure paths across the isthmus, including four identified by the Ark-White study. Probable failure paths were determined based on the current primary flow path between the Arkansas and White rivers, the hydraulic resistance of each pathway, the pathway exhibiting the most damage from existing flows between the two rivers, and the area with the potential to experience the greatest head differential as coupled with high flow rates. As of 2016, the probable failure paths in order of likelihood of failure based on the above variable are:

1. Melinda Channel Owens Lake Corridor caused by flanking and rupturing of the Owens Lake Control Structure and the Melinda Structure.
2. Jim Smith Lake Corridor stemming from the Arkansas River's House Bend's east by east-west movement, which is captured by the lake effectively making the Jim Smith Lake corridor the shortest, most damaged, and least hydraulically resistant flow path between the two rivers.
3. Historic Cutoff where two sink holes have appeared along the Historic Structure, one in 2014 and one at the end of 2016. The appearance of the sink holes indicates a growing seepage path through the Historic Structure. As the seepage path erodes away soil under the structure, the structural stability of the soil is compromised and collapses in on the seepage path. When soil loss gets large enough, sink holes would appear at the surface. If this continues unchecked, the Historic Cutoff structure could collapse.
4. Jim Smith Lake Historic Cutoff Corridor caused by a lengthy headcut and nick point moving through the woods from the Historic Cutoff toward Jim Smith Lake.
5. LaGrues Lake Corridor with elements of the Owens Lake and or Melinda outflow channel included in the failure path resulting from a nick point that has developed moving along a swale toward LaGrues Lake.
6. Melinda Channel Owens Lake Slough caused by a breach through the containment structure where it is built to elevation of 152 feet.
7. Webfoot Lake where nick points have developed along the east side of Webfoot Lake. A resulting head cut would move across Big Island and connect to the White River about 2 miles upstream of its confluence with the Mississippi.

Hydrologic and Hydraulic Design Criteria

Given the measures considered most effective and knowing the highest risk failure path (Melinda Channel Owens Lake Corridor), six design criteria were used by engineering as they developed alternatives from the measures to capture the various conditions that can lead to and result from a breach:

1. Velocity of flows across the isthmus;
2. Magnitude of head differentials;
3. Duration of head differentials;
4. Location of overtopping;
5. Change in hydrology in surrounding bottomland hardwood forest, and;

6. Safe and reliable navigation.

The goal in formulating alternatives was to maximize NED benefits while reducing maximum head differentials, reducing isthmus velocities, reducing the duration of the extreme values during overtopping events, and controlling the location of overtopping events. More detail on how these criteria were modeled and measured can be found in Appendix B.

Velocity: The Hydrologic Engineering Center River Analysis System (HEC-RAS) program produces georeferenced gridded hydrologic velocity maps of an area. These maps were used to pinpoint locations in the isthmus where scour is most likely to occur. Identification of these potential scour locations increases the effectiveness of alternative formulation by identifying measures that target those problem areas.

Controlling the location(s) of overtopping events would include armoring the relief channel(s) against erosion and could consist of multiple step-down structures to minimize the damaging head differentials across each structure. Severe damage has not been observed for events with head differentials less than four feet so reducing the head differential to less than four feet or minimizing the duration of those damaging head differentials defined the threshold for preventing head cutting erosion across the isthmus.

Environmental benefits for terrestrial and aquatic habitat health, form, and function is directly related to the timing and location of flooding duration. For aquatic habitat, several stage duration analyses were performed at selected locations to determine potential changes in oxbow recharge, fish passage capabilities, and in-channel changes across the alternatives. Terrestrial habitat and bottomland hardwood health is dependent on overland flooding duration and the location of the flooding. In addition to the elevation duration analysis, HEC-RAS was used to develop "Percent Time Inundated" grids, based on the growing season starting on 15 March ending on 15 November for each possible alternative. An alternative's effects on the duration of flooding in the Refuge with respect to existing conditions helped to pinpoint locations that would experience the greatest change in hydrology for each alternative.

The final consideration is the impact of cross-currents on navigation. The specific configuration of an alternative could have a significant effect on the safety of the shipping lane. A two-dimensional mathematical model can provide velocity details in-channel, but variables like tow boat capabilities, barge number and configuration, and ship captain experience need to be investigated further for those alternatives that have a potential of producing dangerous cross-currents. A ship tow simulator would need to be completed in future phases of this study to minimize or eliminate impacts of dangerous cross-currents.

Alternative Formulation

The measures carried forward to develop alternatives are:

1. Open Historic Cutoff (Measure 1 from the Ark-White Study)
2. Raise and extend existing soil-cement dike (Measure 6 from the Ark-White Study)
3. Allow multiple flow paths (Historic Cutoff, Owens/Melinda, LaGrues, and or Jim Smith);

Alternative development began with an engineering analysis of the erosional properties of soils in the project area to first determine the velocities the soils could tolerate to reduce the risk of erosion. Flows of two feet per second was determined to be the upper threshold, so any alternative that resulted in faster flows was screened as not sustainable. HEC-RAS was used to determine changes in head differentials, duration of those differentials and changes in hydrology that may impact the bottomland hardwood forest. Appendix B details the modeling effort, assumptions, and outputs.

<u>No Action Alternative</u>

The No Action Alternative, or the Future Without Project Condition, defines the most likely future conditions that would exist in the study area if action is not taken as a result of this study. For the purposes of this study, it is assumed that USACE would continue to perform periodic OMRR&R as needed on existing structures to maintain the authorized navigation system and construct new containment structures as headcutting in the study area develops. In addition, No Action Alternatives includes quantified systemic risks and consequences if a cutoff forms.

<u>Alternative 1: Containment Structure at Elevation 157 with an Opening at the Historic Cutoff</u>

This alternative was first formulated using Measure 2 as a stand-alone alternative; however it quickly became evident that realignment of the containment structure alone would be enhanced (i.e., more effective in reducing head differentials and the risk of a cut-off) by opening the Historic Cutoff. For this reason, an opening at the Historic Cutoff was added for completeness. The final alternative consists of a new containment structure built to an elevation 157 feet msl. This elevation was optimized during the Ark-White study as the alternative elevation that maximized risk reduction in terms of a cutoff forming, and the PDT believed it serves as a logical elevation for planning purposes for the current study. The elevation may be further optimized in the Pre-Construction Engineering and Design (PED) phase of the study. The new containment structure would be approximately 2.5 miles long and begin on natural high ground just south and west of the existing Melinda Structure located on the south side of Owens Lake. It would continue east and cross south of the existing Melinda Weir and then head northeast and connect to the existing soil cement containment structure north of Jim Smith Lake. It would then follow the existing containment alignment and terminate at the Historic Cutoff Containment Structure. In addition to the realigned containment structure, this alternative includes a relief channel through the Historic Cutoff Containment Structure (Figure 11). Scales of the relief structure width were analyzed and an opening ranging from 500 feet to 1,000 feet wide, at elevation 145 feet, was found to be effective. This is the current elevation that the White and Arkansas rivers exchange flows through the Melinda Corridor. The relief structure would further reduce damaging head differentials across the isthmus, but may introduce cross-currents into the shipping lane for widths larger than 500 feet that could cause problems for navigation. The width would be optimized during PED via a ship tow simulation. The Melinda Structure would be demolished under this alternative to reduce turbulence on the toe of the new containment structure. Removal of the Melinda Structure would also allow the lobes of Owens Lake to reconnect creating open water habitat. The Structure on the north end of Owens would be altered to prevent water from backing into Owens Lake, which could damage the surrounding bottomland hardwood habitat.

This alternative would incorporate the use of existing and natural high ground in the project area, which would result in minimal disturbance to terrain and to natural hydrology of the land. It would also provide an opportunity to restore form and function to oxbow lakes in the isthmus while providing a long-term solution for reducing the risk of a cutoff forming between the

Arkansas and White rivers by reducing the frequency, duration, location, and damaging head differentials of overtopping events.

Figure 11: Alternative 1 containment structure alignment.

Alternative 2: Multiple Opening Alternatives

This alternative would use the existing footprints of oxbow lakes in the isthmus and the Historic Cutoff as multiple relief openings (Figure 12). Several step-down structures would be placed in Owens Lake, the Historic Cutoff, and possibly Jim Smith Lake that would facilitate the exchange of water at an environmentally optimized elevation. Scales of elevations were analyzed and a range between 115 feet and 135 feet was found to be effective. Not all structures would be opened to the same elevation as each other in this alternative. Optimization would occur during the PED phase. This alternative would restore some of the pre-Historic Cutoff Containment Structure hydrology between the Arkansas and the White Rivers and would restore some historic ecological conditions. The Arkansas River carries a larger sediment load than the White, therefore a sediment transport model would be needed to identify changes in deposition and scour in both rivers. This alternative would provide a long-term solution for reducing the risk of a cutoff by minimizing the duration and controlling the location of damaging head differentials during overtopping events. More investigations would be needed to determine the effects of cross-currents on navigation.

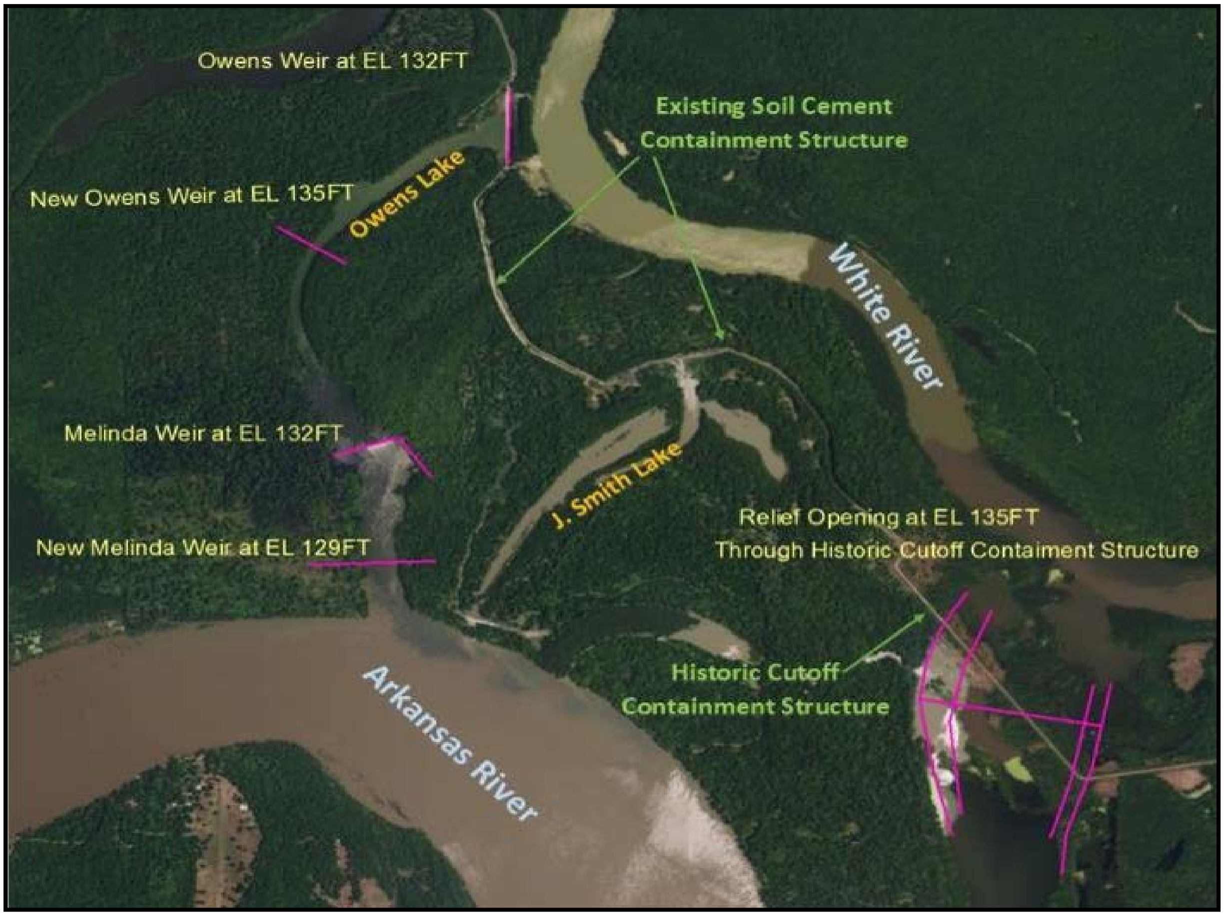


Figure 12: Alternative 2 feature locations.

Screening Alternatives against the Design Criteria

Once the basic alternatives were developed, they were compared to the No Action to ensure they produced more desirable conditions that the No Action. The six design criteria identified above were used to make that comparison and determine the effectiveness of each plan to address the problems identified in the system.

<u>No Action Alternative</u>

The No Action Alternative is the most likely condition expected to occur in the future in the absence of implementation of any action alternative as a result of this study. In this case, the No Action scenario means that no long-term environmentally sustainable solutions to the problem affecting the continued safe and economic use of the MKARNS would be recommended for congressional authorization and funding. During high-water events, the existing containment structure would remain susceptible to overtopping and failure. The No Action Alternative fails to decrease isthmus velocities (criterion 1), fails to minimize head differentials nor the duration (criteria 2 & 3), and does not control the location of overtopping (criterion 4). Under the No Action Alternative, USACE would continue repairing existing structures on a regular basis and construct new structures as needed, as failures are identified. As part of the No Action Alternative, it is assumed that the current failures, including the sink holes, would be repaired and are assumed to be in place accruing economic and environmental impacts and benefits. Other activities, including management activities on the Refuge, navigation, and recreation would continue in the future in a manner consistent with the existing condition. In the absence of Federal action resulting from this study, approximately 156 acres (120 function capacity units) of bottomland hardwood forest and wetland habitat would be lost due to future headcutting and structure construction. Direct impacts would be associated with structure construction (new and existing) and or maintenance of structures and scouring across the isthmus should structures be overtopped or fail. Indirect impacts would be associated with head cutting, which would lead to a change in wetland class or function of the affected area.

Alternative 1: Containment Structure at elevation 157 with an Opening at the Historic Cutoff

Alternative 1 combines Measure 2, raising and or extending the containment structure and Measure 1, opening the Historic Cutoff. Alternative 1 consists of a newly constructed containment structure at an elevation of 157 feet above mean sea level (msl). This structure would be approximately 2.5 miles long (see Figure 11). The new structure would begin on natural high ground just south and west of the existing Melinda Structure located on the south side of Owens Lake. It would continue east and cross the Melinda Headcut south of the existing Melinda Structure. From there, it would head northeast and connect to the existing containment structure north of Jim Smith Lake. It continues to follow the existing containment alignment terminating at the existing Historic Cutoff Containment Structure. Because this layout takes advantage of natural high ground, in most locations it would only rise some five to seven feet above the ground surface, and would be no more than 12 feet above the ground surface at its highest point. This alternative includes an opening at the Historic Cutoff. The optimal width of the opening would be determined during design, but would be at elevation 145 feet regardless of the width. The addition of the historic cutoff reduces, or at least does not increase, the maximum head differential across the isthmus allowing USACE to control the location of future overtopping events and decreases the duration of the head differential (criteria 2, 3 & 4), which provides for safe navigation (criterion 6). It would decrease isthmus velocities (criterion 1). Further, the opening would restore the function of Webfoot Lake and reduce erosion on the east side of the lake, which has existing nick points that may lead to future head cutting. In addition to the containment structure, the existing Melinda Structure would be demolished in place (the debris would be pushed into the deep scour hole at the top of the head cut) as part of Alternative 1. This reduces the turbulence of the water against the toe of the new containment structure increasing its resiliency. Removal of the structure would also allow Owens Lake to reconnect to its former southern limb, returning open water function to the oxbow element of the flooded bottomland hardwood ecosystem that has been severely degraded by the construction, operation and maintenance of the MKARNS. Finally, the alteration to eh structure at the north end of Owens Lake to prevent water from backing up into the lake could provide limited fish passage between the White and Owens Lake. Overall, the current hydrology in the surrounding bottomland hardwood forest would not be changed (criterion 5). Navigation would continue with no change in the current operation of the MKARNS.

Alternative 2: Multiple Opening Alternatives

Alternative 2 is based on measure 3 and allows for multiple flow paths through existing structures within the project area (see Figure 12). Multiple step down structures would be put in place in Owens Lake, La Grues Lake, the Historic Cutoff, and Jim Smith Lake that would facilitate the exchange of water. Three elevations were considered for the various structures, 115 feet, 125 feet and 135 feet. The structures would not necessarily be taken down to the same elevation, and the final elevation for each structure would be optimized during PED. This alternative would provide a long-term solution for reducing the risk of a breach between the Arkansas and White Rivers by minimizing the duration, magnitude of damaging head differentials and controlling the location of overtopping events (criteria 2, 3, and 4). Navigation would continue with no change in the current operation of the MKARNS, but more investigation, like a ship tow simulator, would need to be performed to determine the effects of cross-currents on navigation under this alternative (therefore cannot determine if it meets criterion 6). Overall, the current hydrology in the surrounding bottomland hardwood forest would not be changed (criterion 5).

Economic Analysis

The period of the economic analysis is 50 years and ends in 2075. This assumes: the feasibility study would be complete in June 2018; project receives Congressional authorization in 2019; PED would begin in 2019 and require 3 years to complete. The; and construction requires three years. Thus, the base year in which project benefits begin to accrue is 2025. The current FY2017 discount rate of 2.875 percent applies to annualized figures.

Project benefits stem from a comparison of without project condition costs to the costs of constructing and operating alternative plans. Differences between the economic costs of an alternative and the economic costs of the without project condition would be either a positive cost savings (if costs of an alternative are less than the cost of the without project condition), or a negative cost savings (if costs of an alternative are more than the cost of the without project condition). Benefits (i.e., avoided costs) consist of repairs and rehabilitation costs for existing containment structures (Jim Smith and Melinda) and costs of new containment structures expected over the 50-year period.

Data and methodology for determining the probability of a cutoff forming, and costs of future maintenance, operation and rehabilitation of existing structures and the cost of new containment structures come from the 2009 Ark White Study (updated to FY2017 prices levels). Projections of future commodity flows are updated based recent commodity flow data and macroeconomic conditions in the region, the U.S. and on a global level. Similarly, estimated transportation cost savings of shipping on the MKARNS versus least cost alternative routes and potential shipper response to navigation closures are based data and research conducted in 2016 and 2017. Appendix A contains detailed economic assumptions, data, and analysis.

<u>No Action Alternative</u>

The No Action Alternative, or Future without Project Condition assumes that the USACE would continue to perform ad hoc repairs to containment structures as they have in the past, and build new structures to prevent new cutoffs from forming. Two types of economic costs occur in the Future without Project Condition. Some occur regardless of whether a cutoff forms, and some ensue only if a cutoff forms. New containment structures, and repairs and rehabilitation to existing structures would take place whether or not a cutoff forms given that the analysis assumes USACE would continue to keep the rivers separated in the same manner as it has in the past. Remaining costs accrue only if existing containment structures fail and a cutoff forms and consist of:

1. Loss of commercial navigation resulting in higher transportation costs;
2. Costs of the emergency contingency plan to close a cutoff and restore navigation;
3. Increased dredging costs due to increased sediment deposition near a cut-off; and,

4. Costs to repair damaged infrastructure at the Montgomery Point Lock and Dam.

Costs associated with a cutoff are stochastic in nature; and thus, an important component of the study involved estimating the likelihood of a cutoff forming in the future. This probability is based on a joint frequency analysis using expert elicitation from a panel of hydrologists and engineers, and empirical hydrologic data for the Arkansas and White rivers. Historical data generated by District hydrologists and engineers provided the frequency at which head differentials occur and the frequency of their duration. These estimates were then combined with the expert panel's probability estimates of a cutoff developing, to produce a probability that a cutoff would occur given frequencies and duration of head differential. Estimated costs of a cutoff including lost navigation benefits are weighted by the annual probability of a cutoff forming (i.e., risk times consequence). In addition, team economists generated a stochastic range for benefits (i.e., avoided costs) using historical data, professional judgement and statistical modeling techniques.

Appendix A discusses any additional assumptions. Notable assumptions associated with the No Action Alternative are:

1. If a new cutoff forms, it would be the same size as the historic cutoff.
2. A new cutoff would have a streambed elevation equal to that of the White and Arkansas rivers.
3. If a cutoff occurs, USACE would close the cutoff with a structure made of sheet pile, stone and soil cement.
4. A cutoff channel would be open for 220 days after a breach occurs until USACE could access the area and survey and evaluate conditions, and then design, and implement a project to close the cut-off.
5. Conditions would be intermittently un-navigable due to cross currents and draft constraints until the cutoff is closed (estimates based on historical hydrologic data indicate that conditions after a cutoff formed would be unnavigable for about 30 consecutive days immediately after the event followed by an average of 110 intermittent days of unnavigable conditions).
6. Seventy-five percent commercial barge traffic through the study area routes to least cost alternative modes and routes during the 220-day period.
7. The USACE would not allow existing containment structures to degrade to less than 70 percent of their designed structural integrity.
8. The USACE would reconstruct existing containment structures when structure integrity decreases to 70 percent.

As summarized in Table 10, total annualized costs that would or could emanate under the without project condition range from $17.1 million (95 percent exceedance) to $29.3 million (5 percent exceedance) with a midpoint of $21.9 million (50 percent exceedance). Reductions in any of these costs via a project alternatives are NED benefits. Benefits for proposed alternatives consist of the No Action costs avoided through implementation of a plan. Since the cost of taking no action as a result of this study are about $22.0 million, this dollar amount serves as the benefits realized for both of the alternatives under consideration.

Table 10: Annualized Costs and Lost NED Benefits Associated with the No Action Alternative

Type of Cost	$ Millions	95% Exceedance	5% Exceedance
Costs without Cutoff			
New structures	$959,000	$85,000	$2,456,000
Rehabs and repairs to containment structures	$1,017,000	$564,000	$2,838,000
Costs with Cutoff and Navigation Closures			
Repairs and dredging	$3,136,000	$2,828,000	$3,418,000
Lost transportation cost savings	$16,842,000	$13,580,000	$20,575,000
Total	$21,954,000	$17,057,000	$29,287,000

With-Project Condition

Alternative 1: Containment Structure at Elevation 157 with an Opening at the Historic Cutoff

Costs for Alternative 1 primarily include construction of the containment structure and opening the Historic Cutoff. The containment structure takes advantage of high ground where possible, which reduces materials requirements. Construction include expenses for excavating and opening the Historic Cutoff to allow flows at an elevation of 145 feet (reduced from its current elevation of 170 feet) and assumes a 1,000 foot opening. An opening of this size would require excavation of soil and placement of stone plus sheet pile to stabilize and armor against erosion flanking and seepage (see Appendix C for quantities associated with this alternative). In addition, costs for mitigation and real estate are approximations and are based on Ark-White study costs (updated to FY2017 price levels). Mitigation costs would be updated as the mitigation plan is developed after the Agency Decision Milestone (June 2017); mitigation requirements are expected to be minimal. As is the case with the No Action Alternative, the PDT considered failure risk of the final array of alternatives. The methodology used to evaluate failure risk of alternatives is identical to the methodology used to estimate the probability of cut-off forming in the without project condition (i.e., joint probability analysis via expert elicitation and historic hydrologic data), and relies on analysis from the Ark-White Study. Benefits for project alternatives are adjusted accordingly. Table 11 summarizes estimated costs and benefits for Alternative 1.

Table 11 Costs and Benefits for Alternative 1 (rounded to nearest thousand)

Total Capital Outlays	
Construction	$126,156,000
Mitigation	$200,000
Real Estate	$300,000
Interest During Construction	$11,197,000
Total Investment	$137,853,000
Annualized Costs:	
Interest	$3,963,000
Amortization	$1,268,000
OMRR&R[ab]	$511,000
Total Annualized Costs	$5,742,000
Annualized Benefits: (Stochastic Range in Parenthesis – 95% and 5% Exceedance)	
Navigation NED Benefits	$16,668,000 ($12,951,000 to $22,237,000)
OMRR&R Savings	$5,058,000 ($3,930,000 to $6,748,000)
Total Cost Savings	$21,726,000 ($16,881,000 to $28,985,000)
Benefit to Cost Ratio	3.8 (2.9 to 5.0)
Net Annualized Benefits	$15,984,000 ($11,139,000 to $23,243,000)

[a] Operations, Maintenance, Repair, Replacement, and Rehabilitation
[b] Includes costs of repairing and rehabilitating existing containment structure, costs of new containment structures, costs of repairing cutoff, increased dredging costs and lost navigation NED benefits.

<u>Alternative 2: Multiple Opening Alternatives (M115-135)</u>
As with Alternative 1, costs for Alternative 2 primarily include excavation and armoring associated with modifying existing structures to allow multiple flow paths. However, construction costs, as shown in Table 12, are more extensive than Alternative 1. This is due to the multiple locations requiring excavation and the much large scale of excavation needed for the Historic Cutoff. In Alternative 2, the opening at the Historic Cutoff would be about 3,500 feet long and the elevation would reduce from its current height of 170 feet to 115 feet. Alternative 2 requires more stone and additional linear feet of sheet pile when compared to Alternative 1 (see Appendix C for quantities). As with Alternative 1, mitigation and real estate costs estimates are based on the Ark-White study costs updated to FY2017 price levels, and would be refined as the mitigation and real estate plans progress after the Agency Decision Milestone. Table 12 displays costs and benefits for Alternative 2.

Table 12: Costs and Benefits for Alternative 2 (rounded to nearest thousand)

Total Capital Outlays	
Construction	$184,242,000
Mitigation	$200,000
Real Estate	$300,000
Interest During Construction	$16,352,000
Total Investment	$201,094,000
Annualized Costs:	
Interest	$5,782,000
Amortization	$1,850,000
OMRR&R[a]	$747,000
Total Annualized Costs	$8,379,000
Annualized Benefits: (Stochastic Range in Parenthesis – 95% and 5% Exceedance)	
Navigation NED Benefits	$16,668,000 ($12,951,00 to 22,237,000)
OMRR&R Savings	$5,058,000 ($3,930,000 to $6,748,000)_
Total Cost Savings	$21,726,000 ($16,881,000 to $28,985,000)
Benefit to Cost Ratio	2.6 (2.0 to 3.5)
Net Annualized Benefits	$13,347,000 ($8,502,000 to $20,606,000)

[a] Operations, Maintenance, Repair, Replacement, and Rehabilitation
[b] Includes costs of repairing and rehabilitating existing containment structure, costs of new containment structures, costs of repairing cutoff, increased dredging costs and lost navigation NED benefits.

Table 13 compares the costs and benefits of each Alternative, including the No Action plan. Alternative 1 (Containment Structure at Elevation 157 feet with a Relief Channel through Historic Cutoff at Elevation 145 feet) has the greatest net benefits of the three alternatives and is the NED plan. The width of the relief channel has yet to be determined, but further investigation and optimization after the Agency Decision Milestone and during PED would optimize the width for that opening, which may decrease construction costs (costs are currently based on the maximum opening size).

While Alternative 1 is similar to the recommended plan from the 2009 Ark White study, which the USFWS deemed incompatible with the mission of the Refuge. The 2009 plan consisted of raising the entire length of the existing soil cement containment structure and the Owens Lake Structure, and extending the structure from just east of LaGrues Lake, following the White River upstream some 6 miles to Lock 2. Alternative 1 differs from the 2009 plan in that this alternative would have a smaller footprint for the structure that would minimize disturbance to natural hydrology in the bottomland hardwood forest without impacting efficacy of reducing head differentials and thus the risk of failure and subsequent cutoff formation. The current design has significantly fewer direct environmental impacts than the 2009 design and would require less environmental mitigation. Further, the current design provides an opportunity to restore structure and function to at least two oxbow lakes in the isthmus, while also preventing new headcuts from forming at Webfoot Lake, a problem not identified in the 2009 study. The ancillary oxbow restoration is above and beyond avoiding, minimizing, or mitigating for impacts, something the former design did not provide. Finally, Alternative 1 would only require approximately 0.63 miles of containment structure to be built on Refuge land and total long-term impacts from construction are anticipated to be less than 10 acres.

Table 13: Benefits and Costs for Alternative Analyzed (rounded to nearest thousand)

	No Action	Alternative 1	Alternative 2
Construction, Real estate and Interest	-	$137,653,000	$200,894,000
Mitigation	-	$200,000	$200,000
Total Investment	-	$137,853,000	$201,094,000
Annualized Costs	$21,954,000[a]	$5,742,000	$8,379,000
Annualized Benefits	$0	$21,727,000	$21,727,000
Net Benefits	$0	$15,985,000	$13,348,000
Benefit Cost Ratio	0	3.8	2.6

[a] Includes costs of repairing and rehabilitating existing containment structure, costs of new containment structures, and potential costs (i.e., risk time consequence) in the event of cutoff formation including costs of repairing cutoff and damages to Montgomery Point infrastructure, increased dredging costs and lost navigation NED benefits.

National Economic Development Plan

The National Economic Development (NED) Plan is the alternative which provides the greatest net benefits to the nation. Alternative 1 has net benefits of $15,985,000, while those for Alternative 2 are only $13,348,000. Therefore Alternative 1 is the NED plan.

CHAPTER 4: FUTURE WITH-PROJECT CONDITIONS*

The purpose of this chapter is to describe the future condition forecasted with implementation of Alternative 1 and with implementation of Alternative 2. As in Chapter 2, these analyses will be described in terms of the following:

- Land Use
- Air Quality
- Climate
- Geologic Resources
- Water Resources
- Biological Resources
- Cultural Resources
- Recreation and Aesthetics
- Transportation
- Socioeconomics and Environmental Justice
- Hazardous, Toxic, and Radioactive Waste (HTRW)

Land Use

Land use outside of the project area is not anticipated to change from the existing condition. Implementation of either alternative would negate the potential land use changes (BLH conversion to open water and/or dry channels) due to erosion and future headcutting or from a breach.

Under Alternative 1, approximately 25 acres of BLH would be permanently converted to a structure dressed in crushed stone and/or soil cement. It is unlikely that trees would regrow within the footprint of the containment structure. Work completed at the historic cutoff and at the existing structure in Owens Lake would not change land use from the existing condition, except to allow water to flow through more frequently than in the past. Debris removed from the historic cutoff would be placed in an area approximately 20 acres in size. This area is void of vegetation under the existing condition and would continue to be void of vegetation into the future. Removing the existing Melinda Structure would remove the structure from the landscape and allow the area to convert to open water. As the area dries out and the existing scour hole fills in over time, the open water could convert to BLHs.

Under Alternative 2, approximately 15 acres of permanent and seasonal open water would be converted to a permanent concrete structure. Construction of the structures would result in the areas behind each structure converting to permanent open water or BLH depending on the location of the structure (e.g. north side of Melinda Structure would become seasonally wet rather than permanently wet, area between the two Owens Weirs could convert to BLH over time but would be dependent on seasonality and permanence of water in the area).

Air Quality

Implementation of Alternative 1 and 2 would yield similar impacts to the FWOP condition. Both alternatives would have a longer single duration of criteria pollutant emissions compared to the

FWOP; however, both alternatives would have only have one duration of construction rather than up to four separate periods of construction as is the case with the FWOP.

Implementation of Alternative 1 or 2 is expected to have minor adverse impacts on air quality but is not expected to impact or contribute to any areas not meeting NAAQS. Construction would be short in duration and limited to a small disturbance area.

Climate

Implementation of Alternative 1 and 2 would yield similar impacts to the FWOP condition. Both alternatives would have a longer single duration of GHG emissions compared to the FWOP; however, both alternatives would have only have one duration of construction rather than up to four separate periods of construction as is the case with the FWOP.

GHG emissions would incrementally contribute to global emissions for the very limited period of time during construction, but are not themselves of such magnitude as to make any direct correlation with climate change.

Geologic Resources

Implementation of either alternative would negate the potential impacts to soils caused by erosion and future headcutting or from a breach. Impacts from construction of either alternative would be similar to the FWOP condition, in that temporary and short-term soil erosion, loss of topsoil, short- to long-term soil compaction, permanent increases in the proportion of large rocks in the topsoil, and soil horizon mixing would be expected. There are no anticipated changes to geology or mineral resources from implementation of either alternative.

<u>Alternative 1</u>

Implementation of Alternative 1 would result in approximately 25 acres of permanent changes to soils as a result of conversion to impervious surfaces or regular maintenance that prevents restoration of the area (e.g. access roads). At these locations, soil productivity would be lost. As well, the containment structure would alter the existing topography by constructing the structure to elevation 157 feet. The greatest elevation change occurs near the Melinda headcut with an increase of 12 feet over the existing condition. For the most part, the new structure is only seven feet higher than the existing elevations, while areas near the Jim Smith Lake natural berm (south side of the proposed alignment) would be lower than the natural berm. Removal of the existing Melinda Structure would reduce the elevations at the structure to match that of the surrounding environment, returning the topography to historic pre-structure conditions. Lowering the Historic Cutoff to elevation 145 would alter the existing topography by reducing the elevation closer to historic conditions.

Construction of the containment structure crosses lands classified as “Prime Farmland of Statewide Importance” (approximately 60% of disturbance) and land classified as “Not Prime Farmland” (approximately 40% of disturbance). Approximately half of the Prime Farmlands would be permanently converted to impervious surface and no longer meet the criteria of Prime Farmlands. Other actions associated with Alternative 1 are not anticipated to change the status of farmlands in the project area from that of the existing condition. Consultation with Natural Resource Conservation Service (NRCS) will be completed after the ADM.

<u>Alternative 2</u>

Implementation of Alternative 2 would result in approximately 18 acres of permanent changes to soils that are converted to impervious surface, including changes from construction of the new structures and addition of permanent access roads. Access roads would minimally alter the topographic elevations over that of the existing condition. At this time, access roads would not have an aggregate surfacing, so long-term soil erosion from wind and water is anticipated. Periodic maintenance of the road will likely be required to improve conditions and mitigate tire rutting and/or loss of surface substrate.

Like Alternative 1, the historic cutoff would be reduced under this alternative. Impacts would be similar to those anticipated for Alternative 1, except that the opening would be significantly larger. The elevation of the existing Melinda Structure and existing Owens Lake Structure would be reduced to elevation 132. The reduction in elevation would more closely match the surrounding elevations than under the existing and FWOP conditions; however, both structures would still remain as prominent topographic features on the landscape. Two new structures, one halfway between the Owens Lake and Melinda Structures and the other south of the Melinda Structure, would be constructed at elevation 135 and 129 feet, respectively. Both of these structures would increase the topography of the area and become prominent on the landscape.

The location of the new structures are classified as “Not Prime Farmlands;” therefore, there would be no impact from constructing the structures at the immediate site. However, construction and operation of the access road would occur in lands classified as “Farmlands of Statewide Importance” or “All Areas are Prime Farmland.” Construction within these areas could potentially alter the classification of prime farmlands by mixing soil horizons and creating compact surfaces. Consultation with NRCS will be completed after the ADM.

Other actions associated with implementation of Alternative 2 are not anticipated to change the status of farmlands in the project area from that of the existing condition.

Water Resources

Water resource impacts are categorized by the hydrologic changes related to frequency and duration of flooding within the floodplain and changes to recharge or “connectivity” between the lakes and river channels.

<u>Hydrology</u>

Modeled Changes in Flooding Frequency and Duration

Flooding Duration Maps were developed for each alternative and compared to the existing condition. Changes in flood duration were specifically looked at for the growing season which was defined as 15 March to 15 November (245 days) for the period of record (2000-2014). Maps showing the changes in average annual days of inundation can be found in Appendix B.

Alternative 1

Under Alternative 1, flooding duration and frequency would not change from the existing condition throughout most of the study area (Table 14). See Appendix B for figures depicting the specific location of changes throughout the study area. Most of the change occurs between the river banks, except for an area in the project area. Through this area, construction of a new containment structure at 157 feet south of the Melinda Headcut structure would result in a single outlet to the north over the Owens Lake Structure. Flood durations increase to the point of potentially changing habitats within the eastern half of Owens Lake. To mitigate this increase, Alternative 1 incorporates water passage through the Owens Lake Structure at a lower elevation. After incorporating this change, hydrology changes reduce to near existing conditions.

Table 14. Change in Flooding Duration (Percent of the Study Area)

Alternative 1	-7 Days (Drier)	No Change	+ 7 Days (Wetter)
500-foot opening	0.71%	98.65%	0.64%
1,000-foot opening	0.65%	98.72%	0.63%

Alternative 2

This alternative would minimize the duration and magnitude of head differentials and control the location of overtopping during such events. The overall hydrology of the study area would be changed from existing conditions depending upon the elevation of the structures. Some flood events could be shorter in duration due to increased flows across the isthmus into the Arkansas River. Alternatively, flood and duration in some portions may increase due to lowered connection elevations and reverse flows from these changes. See Appendix B for figures depicting the specific location of changes in inundation under Alternative 2

Specific Changes to the National Wildlife Refuge

A major concern when the Ark-White Cutoff Study was completed surrounded the potential inundation changes that would occur on the White River NWR. Table 15 shows the changes expected within the specific landform, microsite regions of the refuge. Under Alternative 1, there would be no change in the average annual days inundated. Under Alternative 2, seven of the nine landform, microsites will experience fewer (1 to 8 days) average annual days of inundation when compared to the existing condition. These changes would not be consecutive, rather the change would occur in one or two day increments during each flooding event. Because of this, it is unlikely that 8 fewer days of inundation spread across the growing season would cause the habitat to change.

Table 15. Change in Seasonal Inundation within the NWR Based on Refuge Landform, Microsite, and Elevation.

	Average Annual Days Inundated	Change in Average Annual Days Inundated (-) Drier (+) Wetter				
Landform, Microsite based on Elevation	Existing	Alt 1 w/ 500 ft opening	Alt 1 w/ 1,000 ft opening	Alt 2 at Elev. 115	Alt 2 at Elev. 125	Alt 2 at Elev. 135
PVL2 Flats <147.5 ft	50	0	0	-4	-4	-4
PVL2 Flats >147.5 ft	13	0	0	-8	-8	-8
HPS Ridges <145 ft	42	0	0	-2	-2	-2
HPS Ridges >145 ft	20	0	0	-4	-4	-4
HPS Natural Levees <145 ft	55	0	0	0	0	0
HPS Natural Levees >145 ft	13	0	0	-7	-7	-7
HPS Flats <142 ft	66	0	0	0	0	0
HPS Flats >142 ft	43	0	0	-3	-3	-3
Three Rivers back swamp final	73	0	0	0	0	-1

<u>Surface Water</u>

The frequency, duration, and timing of lake connectivity to the White and Arkansas rivers in the project area should not change significantly with implementation of either alternative. Under Alternative 1, the incorporation of an opening in the Historic Cutoff Closure Structure, which approximates the elevation and capacity of existing flow paths across the isthmus, should result in little change to existing hydrology and therefore lake connectivity. The exception to this is at Owens Lake, which currently receives flows above 145 feet from the White River over the Owens Lake structure and above 140 feet from the Arkansas River over the Melinda Headcut Structure. The construction of a new containment structure at 157 feet south of the Melinda Headcut structure would result in a single outlet to the north over the Owens Lake Structure. This would affect the vegetation communities in the area immediately adjacent to Owens Lake and also affect the frequency and duration of fish passage into and out of the lake. Although not designed in detail, Alternative 1 incorporates water passage through the Owens Lake Structure at a lower elevation to mitigate some of the floodplain disconnect. As well, removing the existing Melinda Headcut Structure would reconnect the two limbs of Owens Lake restoring the Owens Lake connectivity.

Under Alternative 2, high velocity flows would continue to pass through the Owens Lake/Melinda Channel corridor and serve as a conduit for flows between the White and

Arkansas rivers. Constructing the structures would further exacerbate the Owens Lake disconnect between the two limbs that is created by the Melinda Headcut Structure. Under this alternative, construction of the structures would further segment Owens Lake.

Clean Water Act

Implementation of Alternative 1 would result in the existing containment structure being placed within approximately 20.0 acres of jurisdictional wetlands and approximately 5.0 acres of WOTUS across the Melinda Channel. Impacts include filling in wetlands and WOTUS at the immediate site of the structure. During construction surrounding wetlands and WOTUS may experience temporary decreased wetland and water quality, and temporary interruption of hydrologic and wetland functioning within the construction footprint along the containment structure and at the Historic Cutoff. After construction is complete, hydrology and water quality within the wetlands and WOTUS, where temporary impacts would occur, would return to baseline conditions. As well, this alternative would remove the existing Melinda Structure, which is currently placed in the channel of a WOTUS. Removing this structure would restore connectivity to Owens Lake. Opening up the historic cutoff would also reduce the elevation of the current structure closer to historic conditions, although not completely restore this portion of the WOTUS.

Section 401 and 402

Any project that involves placing dredged or fill material in waters of the U.S. or wetlands, or mechanized clearing of wetlands requires a water quality certification from the state agency as delegated by EPA. The Arkansas Department of Water Quality (ADEQ) Water Division performs all state certifications under Section 401 and 402 of the Clean Water Act. USACE will pursue a Short Term Activity Authorization, which allows instream work that may cause a water quality violation in waters of the state or disturbance to any part of surface water tributaries, from ADEQ after the ADM. Because construction disturbance exceeds one acre, a National Pollutant Discharge Elimination System (NPDES) permit would also be pursued and would need to be issued prior to construction.

Section 404

All actions associated with Alternative 1 were designed in such a way to reduce the impacts on the environment and is the least environmentally damaging when compared to the FWOP or Alternative 2. Alignment of the containment structure relied on connecting high ground along the shortest path that met the objectives of the study. In the Ark-White Cutoff Study, the original containment structure design was nearly 12 miles long, to where, Alternative 1 has a containment structure that is about 2.5 miles long. Removing the Melinda Structure and modifying the Historic cutoff reduced potential impacts created by constructing only the structure.

Implementation of Alternative 2 would result in very similar impacts to the FWOP and Alternative 1, in that structures would be placed within approximately 15 acres of WOTUS. Temporary impacts to jurisdictional wetlands and WOTUS are anticipated. Impacts associated with placing structures in these waters are the same. The difference here is that hydrology is expected to change, although not significantly, with implementation of this alternative. Most of the impacts will be to WOTUS and to a much lesser degree in wetlands than is seen in Alternative 1.

See Appendix D for the Section 404(b)(1) analysis.

Executive Order 11990

EO 11990 directs Federal agencies to take action to avoid adversely impacting wetlands wherever possible, to minimize wetlands destruction, to preserve the values of wetlands, and to prescribe procedures to implement the policies and procedures of the Executive Order.

Implementation of Alternative 1 would adversely impact vegetated wetlands, specifically bottomland hardwood forests. Long-term direct impacts of approximately 25 acres include filling in wetlands to construct the containment structure. An additional 25 acres are anticipated to be temporarily impacted due to construction activities. Wetlands are anticipated to return; however, by the end of the planning horizon, the wetlands would be an earlier successional stage of bottomland hardwood forest and not fully mature. Wetland impacts would be appropriately mitigated with coordination from state and Federal agencies. As described in the Section 404 section above, the alternative was designed in such a way to minimize impacts to wetlands to the extent practicable and even has environmental ancillary benefits that improves wetlands outside the construction footprint; therefore, this alternative is the most compliant with EO 11990.

Alternative 2 would have only temporary impacts on wetlands, during construction.

<u>Groundwater</u>

Implementation of either alternative would have no impact on groundwater resources.

<u>Water Quality</u>

Implementation of either alternative would negate future water quality impacts from erosion associated with headcutting and a breach. Construction activities associated with construction of the new structures in either Alternative 1 or 2 could increase runoff, the rate of in-stream sediment loading, and turbidity, potentially decreasing water quality. Additional impacts associated with construction would be the same as the FWOP condition.

<u>Floodplains</u>

Because the project area is within the FEMA Zone A, any alternatives considered cannot have a cumulative rise in the Base Flood Elevation (BFE, 1% exceedance frequency) of more than 1.00 foot. Implementing Alternative 1 with either a 500-foot or 1,000-foot opening or Alternative 2 would not cause a floodplain rise to exceed the allowable 1.00 foot cumulative rise. The 100-year floodplain inundation map for Alternative 1 had less than one-tenth of a foot difference in water surface elevation (see Appendix B).

HEC-RAS modeling of the two alternatives indicates that the 2- and 5-year floodplain inundation map would have minimal change from the existing condition. Under Alternative 1 with either opening, floodplains mapped almost identical to the existing conditions, while Alternative 2 would have only slight increases (Table 16, Figure 13, and Figure 14). These changes are so minor as to be considered insignificant and discountable.

Table 16: Flood Frequency Analysis

	Study Area			HEC-RAS 2D Area		
Alternative	**5-year floodplain in Study Area (acres)**	**Difference in 5-year floodplain in Study Area (Existing Condition, acres)**	**Study Area 5-year floodplain Percent change**	**5-year floodplain in RAS 2D area (acres)**	**Difference in 5-year floodplain in RAS 2D Area (Existing Condition, acres)**	**RAS 2D Area 5 year floodplain Percent change**
Existing 5-year floodplain	127,090	0	0.0%	527,779	0	0.0%
C157HC145_500ft_5yr	126,910	180	0.1%	527,760	19	0.0%
C157HC145_1000ft_5yr	126,989	102	0.1%	527,722	57	0.0%
M135	122,268	4,822	3.8%	504,864	22,915	4.3%

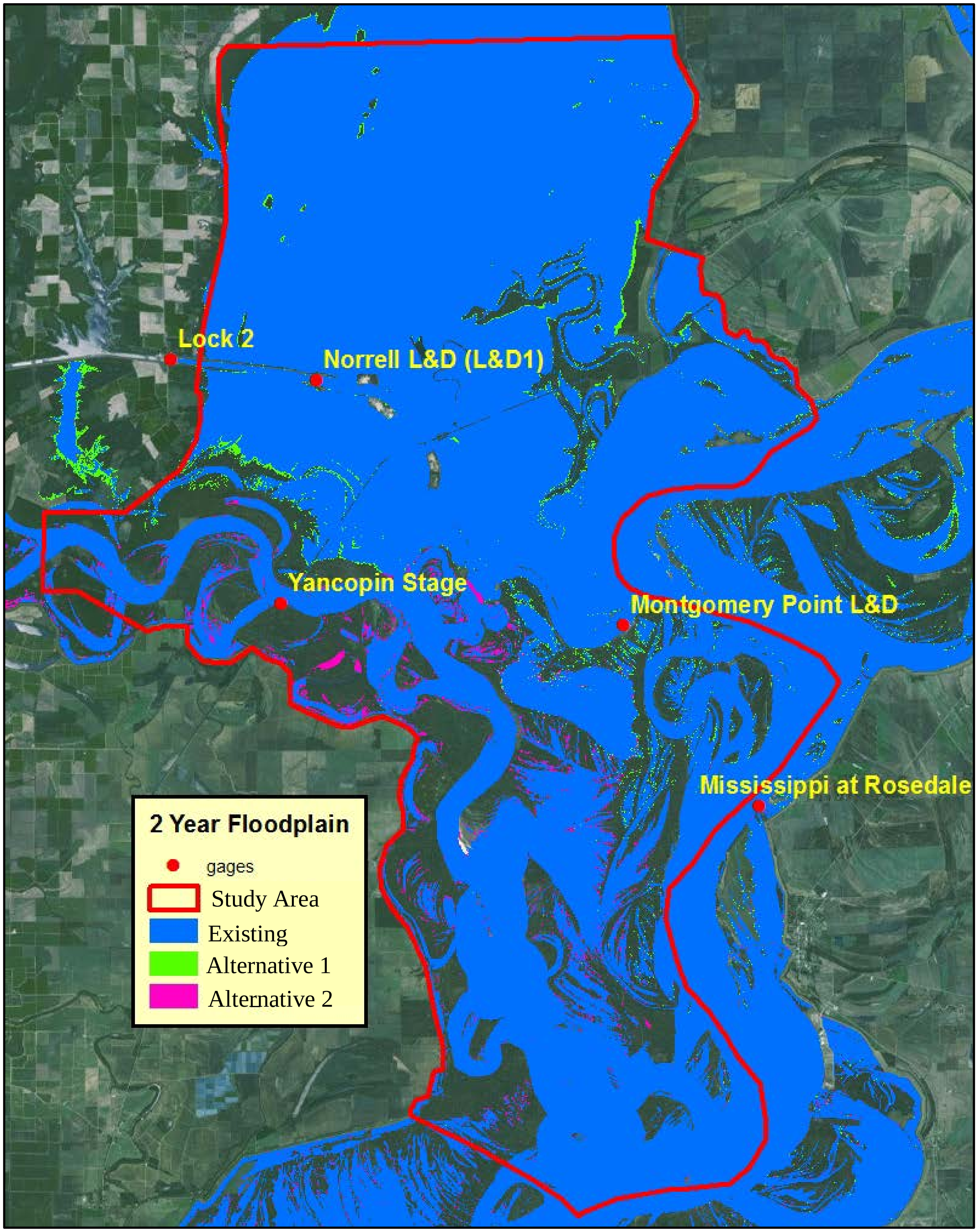


Figure 13: 2-year Floodplain Inundation under the Existing Condition and Alternatives 1 and 2.

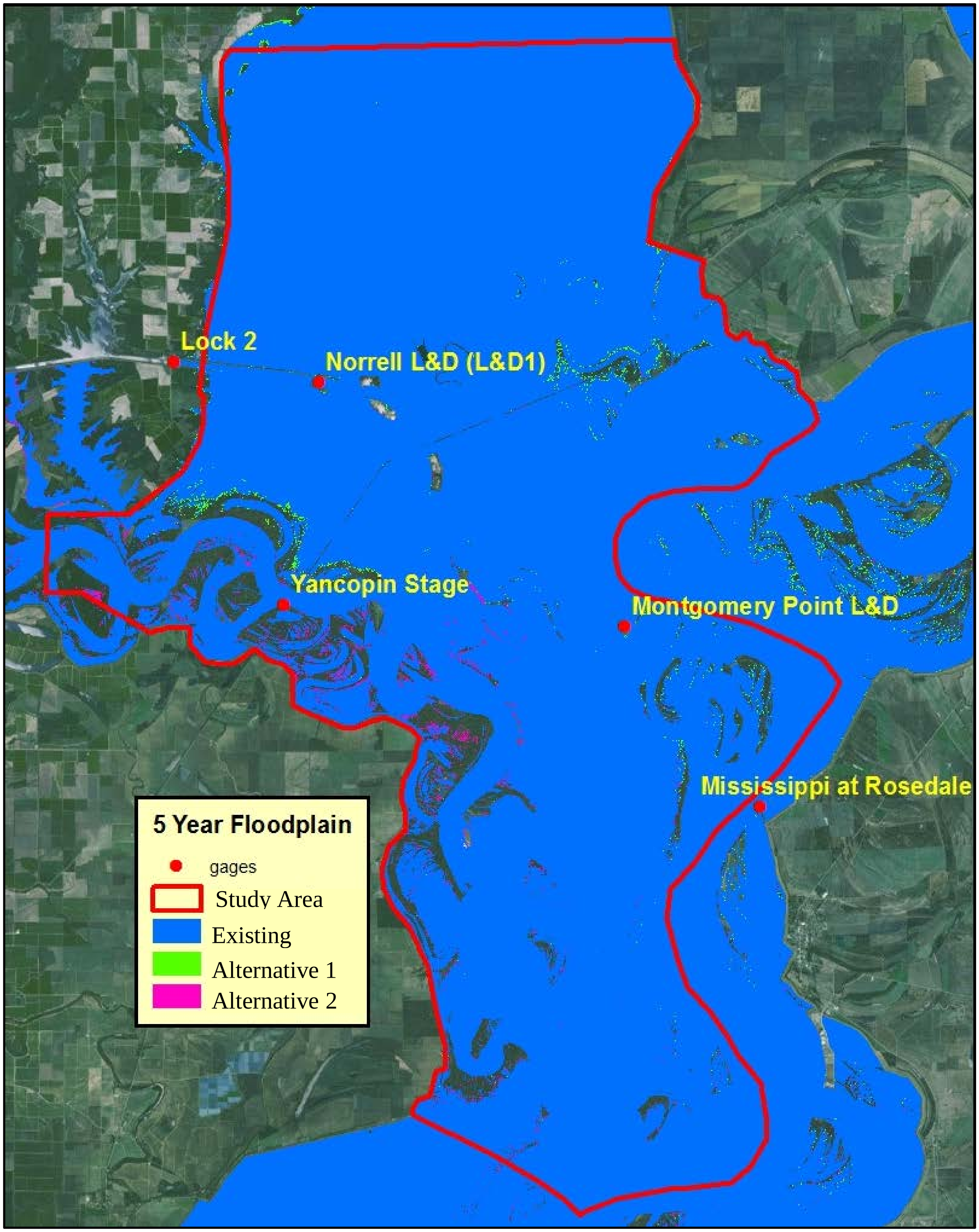


Figure 14: 5-year Floodplain Inundation under the Existing Condition and Alternatives 1 and 2.

Executive Order 11998

EO 11998 requires federal agencies to avoid, to the extent possible, the short- and long-term adverse impacts associated with occupancy and modification of floodplains. Federal agencies are to avoid direct and indirect support of floodplain development wherever there is a practicable alternative. In accomplishing this objective, "each agency shall provide leadership and shall take action to reduce the risk of flood loss, to minimize the impact of floods on human safety, health, and welfare, and to restore and preserve the natural and beneficial values served by floodplains in carrying out its responsibilities."

As stated earlier, implementing Alternative 1 or 2 would occur within the 100-year floodplain as mapped by FEMA. Currently, there is no development in the floodplain in or near the project area. Implementation of either alternative would not encourage development since the area is highly susceptible to continual flooding and is within the 2- and 5-year floodplain. The structures are not intended to reduce flooding throughout the area, just ensure that future cutoffs through the project area do not occur and that safe navigation can continue. The structures, however, would further reduce the natural floodplain interchange between the Arkansas and White rivers over the existing condition, which includes restricted floodplain interchange.

Alternative 1 would have less direct impacts (e.g. change in BOE) on floodplains than Alternative 2.

Biological Resources

Impacts to biological resources from construction related activities are expected to be very similar to those described in the FWOP condition. These impacts include: temporary decrease in aquatic habitat quality due to increased sedimentation; temporary to permanent habitat removal and/or fragmentation associated with the structures and access roads; habitat avoidance because of increased noise, dust generation, and vibrations; and mortality of slower moving species or species that are unable to leave the area. The level and duration of the impacts is dependent on the final design of each alternative, type of equipment used, duration of construction activities, and plans for restoration activities, if required. However, it is anticipated that once construction is complete, construction-impacts to aquatic species and terrestrial wildlife would cease and return to near baseline conditions.

As with any ground-disturbance activity, the probability of introducing, spreading, and/or establishing new populations of invasive, non-native species, particularly plant species, exists. Contractors would be required to clean all equipment prior to entering the construction area to avoid the spread of invasive into the project area.

<u>Aquatic Habitat</u>

Impacts described in the Future-Without Project Condition Water Resources section also apply to aquatic habitats in the project area. In addition, the following impacts have been identified.

Under Alternative 1 and 2, the Historic Cutoff would be opened providing a much wider flow path with less velocity than currently exists through the Melinda Corridor. This action allows waters from the Arkansas and White rivers to interchange at an elevation closer to historic conditions, providing a more frequent exchange of nutrients, as well as increased fish passage. Further, the opening will restore the function of Webfoot Lake by reducing or eliminating active erosion on the east side of the lake that is adversely affecting aquatic habitat.

Under both Alternatives, fish passage to Owens Lake from the Arkansas to the White rivers would be reduced from the existing condition due to the increased height of the structure through the Melinda Channel. Fish passage into Owens Lake from the White River would increase due to the opening through the existing Owens Structure under Alternative 1. Fish passage would not change under Alternative 2. There would be an increase in fish passage to and from both rivers through the Historic Cutoff with implementation of either alternative.

Terrestrial Habitat

HGM analysis of alternatives included direct impacts that involved the immediate loss of habitat from construction of project features. Indirect effects (i.e. altered hydrology) were not identified and therefore were not assessed. Although, there would be some minor change to flooding durations (<8 days total during the growing season), the changes would only occur a day or two added/reduced to/from the end of a flooding event. The HGM approach is not sensitive to these minor changes. Unlike in the Ark-White Cutoff Study, only one HGM wetland subclass, Riverine Backwater Flats, was identified in the study area. The Riverine Backwater subclass receives overbank flooding at flood return intervals of five years or less.

Detailed information associated with the HGM wetland analysis can be found in Appendix J.

Under Alternative 1, Riverine Backwater would realize a total loss (all functions) of 16.5 FCUs and under Alternative 2 Riverine Backwater would realize a total loss of 0.0 FCUs (Table 17). Alternative 2 does not realize any impacts due to all construction activities occurring within already disturbed areas. These totals are useful for understanding the magnitude of change associated with the alternative, the standard recommendation is to mitigate for the most-impacted function, thereby assuring that all other functional losses have been over-compensated. Therefore, mitigation for the Riverine Backwater class for Alternative 1 would be based on a loss of 4 FCU for the "Detain Precipitation" function. Mitigation needs under either alternative would be further refined further during PED.

Table 17: Change in Functional Capacity Units for Riverine Backwater under Alternatives 1 and 2.

Alternative	Change in FCU						
	Detain Floodwater	Detain Precipitation	Cycle Nutrients	Export Organic Carbon	Maintain Plant Community	Provide Wildlife Habitat	Total (all functions)
1	-1.6	-4.0	-1.7	-1.7	-3.1	-4.40	-16.5
2	0	0	0	0	0	0	0

Threatened and Endangered Species Effects Determinations

A biological evaluation was prepared for this study, which included analysis of Alternative 1. The Biological Evaluation was transmitted to USFWS in March 8, 2017, and can be found in Appendix E. USFWS concurred with the following effects determinations in a letter dated March 17, 2017 (Appendix E). Although the Biological Evaluation did not specifically address Alternative 2, impacts would be very similar to those described herein. The following determinations for threatened or endangered species that may occur in the Three Rivers Study Area were made in the Biological Evaluation:

Pallid Sturgeon

Alternative 1 **may affect, but is not likely to adversely affect** the Pallid Sturgeon.

- Pallid sturgeon use of the lower Arkansas River is thought to be incidental by experts studying this species. The current theory is that this species moves in to the lower Arkansas during flood events on the Mississippi River to avoid high water flows.
- Temporary impacts would reduce the quality of potentially suitable habitat in the lower Arkansas River, however construction activities would likely occur during low water conditions when pallid sturgeon prefer the Mississippi River.
- Pallid sturgeon are not known to occur in the lower White River.

Fat Pocketbook Mussel

Alternative 1 **may affect, but is not likely to adversely affect** the Fat Pocketbook Pearly Mussel.

- There is no change in the frequency or duration of flooding, thus no impacts are anticipated.
- Construction related activities may increase sediment in the lower Arkansas River, however it will be of short duration and would likely occur during low-flow conditions.
- The presence of suitable habitat downstream of the project area on the lower White River is unlikely due to maintenance dredging for navigation.

Rabbitsfoot Mussel

Alternative 1 **may affect, but is not likely to adversely affect** the Rabbitsfoot Mussel.

- The closest known populations are near St. Charles, Arkansas, 47 river miles upstream of the project area.
- Dredging and incision on the lower White River has likely destroyed any suitable habitat that may have once been present.
- It is not known to occur in the lower Arkansas River. Past mussel surveys on the lower Arkansas River have failed to record any mussel species.
- The USFWS PAR states that this species is very unlikely to occur in areas potentially affected by the project alternatives being discussed, therefore no impacts to this species is anticipated.

Pink Mucket Pearly Mussel

Alternative 1 **may affect, but is not likely to adversely affect** the Pink Mucket Pearly Mussel.

- The majority of pink mucket pearly mussel populations occur in the Ouachita Mountain ecoregion of west Arkansas.
- The closest specimens documented in the White River are located 150 – 200+ miles upstream of the study area.
- Preferred habitat is medium to large rivers in gravel with sand substrate. Gravel substrate is uncommon in the project area.
- Dredging and incision on the lower White River has likely destroyed any suitable habitat that may have once been present.

- The Pink Mucket Pearly Mussel is not known to occur in Arkansas River. Past mussel surveys on the lower Arkansas River have failed to record any mussel species.
- The USFWS PAR states that this species is very unlikely to occur in areas potentially affected by the project alternatives being discussed, therefore no impacts to this species is anticipated.

Scaleshell Mussel

Alternative 1 **may affect, but is not likely to adversely affect** the Scaleshell Mussel.

- The closest documented occurrence of the Scaleshell Mussel in the White River is approximately 236 river miles above the Project Area.
- Harris and Christian (2009) indicate that the Scaleshell Mussel prefers small to medium sized rivers in Arkansas and is considered an Ozark Highlands species.
- Preferred habitat for the Scaleshell is stable riffles and runs with gravel or mud substrate and moderate current velocity. The lower White and Arkansas rivers lack riffle-run habitat, and gravel substrate.
- The Scaleshell Mussel is not known to occur in the Arkansas River. Mussel surveys on the lower Arkansas River have failed to record any mussel species.
- Dredging and incision on the lower White River has likely destroyed any suitable habitat that may have once been present.

Ivory-billed Woodpecker

Alternative 1 **may affect, but is not likely to adversely affect** the Ivory-billed Woodpecker.

- Surveys conducted throughout potential habitat in the Big Woods region failed to document any IBWO individuals.
- Construction actions will have no direct effect to the IBWO. Approximately 25 acres of bottomland hardwood forest will be lost due to construction of the containment structure, but several thousand acres of suitable habitat exists adjacent to this area.
- Indirect effects are possible during construction (habitat avoidance from noise and activity), however, they will be temporary and of short duration. The presence of several thousand acres of contiguous habitat in the Big Woods area provides ample room to escape disturbance.
- The USFWS PAR indicates the Service no longer recommends official pre-project surveys, however any observations of birds or potential signs of occupation (foraging signs or cavities) should be reported to the Service.

Interior Least Tern

Alternative 1 **may affect, but is not likely to adversely affect** the Interior Least Tern (ILT).

- ILTs are known to use sandbars near the project area for nesting. The closest known nest site is located on the Melinda Sandbar, located immediately across the lower Arkansas River from the Melinda Channel.
- Flood frequency and duration analysis data documents no direct impacts to ILT nests due to elevations of sandbars, versus elevation of water exchange from the proposed action.

- Construction related activities will result in a temporary increase in noise and human disturbance in the area, which could lead to habitat avoidance by the ILT. Ample habitat exists elsewhere on Arkansas and Mississippi rivers if disturbance is an issue.
- Construction will likely occur during low-flow conditions (summer/fall), when ILTs are in Central and South America and the Caribbean.

Piping Plover

Alternative 1 **may affect, but is not likely to adversely affect** the Piping Plover.

- While suitable stopover habitat is present, no birds have been documented in the Three Rivers Study Area.
- Flood frequency and duration analysis data documents no direct impacts to piping plover stopover habitat due to elevations of sandbars, versus elevation of water exchange from the proposed action.
- Construction related activities will result in a temporary increase in noise and human disturbance in the area, which could lead to habitat avoidance by piping plovers. However, ample habitat exists nearby on lower Arkansas and Mississippi rivers if disturbance is an issue.
- Plovers typically use stopover sites for only a few days, thus would be relocating regardless of any disturbance.

Rufa Red Knot

Alternative 1 **may affect, but is not likely to adversely affect** the Rufa Red Knot.

- Rufa Red Knots are considered an uncommon species in Arkansas, as they primarily use coastal areas during migration and wintering.
- While suitable stopover habitat is present, no birds have been documented in the Three Rivers Study Area.
- Flood frequency and duration analysis data presented in Section 5 documents no direct impacts to rufa red knot stopover habitat due to elevations of sandbars, versus elevation of water exchange from the proposed action.
- Construction related activities will result in a temporary increase in noise and human disturbance in the area, which could lead to habitat avoidance by rufa red knots. However, ample habitat exists nearby on lower Arkansas and Mississippi rivers if disturbance is an issue.
- Rufa red knots typically use stopover sites for only a few days, thus would be relocating regardless of any disturbance.

Fish and Wildlife Management Areas

Implementation of either alternative would require construction on the Dale Bumper National Wildlife Refuge. While a compatibility determination has not yet been done, Alternative 1 could potentially be found more compatible than Alternative 2. It would not substantially change the hydrology of the Refuge or surrounding properties. This is important because studies have not been carried out to determine whether changes in hydrology would be a benefit or detriment to Refuge habitats. With lack of such a study, the best option is not to institute additional changes. This alternative accomplishes that goal, maintains connectivity between the White and Arkansas rivers via the Historic Cutoff, and has minimal direct impacts on the Refuge (0.63 miles of containment structure/less than 10 acres).

Cultural Resources

The Area of Potential Effect (APE) for this study is the horizontal and vertical footprint for all actions involved with Alternative 1. The proposed actions do not overlap any of the previously identified archaeological sites, and the previously identified archaeological sites are outside the horizontal footprint for all identified actions. Construction of the containment structure alignment would have the potential to affect prehistoric cultural resources since portions of the alignment are in undisturbed areas or on high ground. Creating a relief channel through the historic cutoff containment structure would have a moderate potential to bury or uncover archaeological sites due to changes in water movement. Due to noted historic activity along the waterways and inland through the study area there is potential for encountering historic archaeological sites. None of the proposed actions will affect the existing channel and therefore no impacts to submerged cultural resources are expected.

Based on the current information for the proposed actions associated with Alternative 1, there is a potential to affect historic properties. These affects consist of direct impacts from earth moving, excavation activities, borrow locations, utilizing access road/routes, staging areas, and other associated actions that will have to be evaluated to determine if there is the potential for undiscovered cultural resources at each location. The USACE recommends cultural resources investigations to identify and evaluate any historic properties within the APE of Alternative 2. USACE will execute a Programmatic Agreement with the Arkansas SHPO, Advisory Council on Historic Preservation (ACHP), and the appropriate federal recognized Indian Tribes to ensure compliance with Section 106 prior to construction.

Recreation and Aesthetics

Recreation and aesthetic impacts would be very similar to the FWOP condition in that during construction there would be a temporary reduction in recreational opportunities in the immediate vicinity of the construction footprint. Alternative 1 and 2 would have a longer single duration of the temporary loss of recreation opportunities compared to the FWOP; however, both alternatives would have only have one duration of construction rather than up to four separate periods of construction as is the case with the FWOP.

Under Alternative 1, fewer temporary access roads would be required to construct the containment structure resulting in a smaller short-term visual disturbance on the landscape. However, the structure would be significantly longer than any of the FWOP structures resulting in a greater permanent visual disturbance on the landscape. The proposed structure, as designed, is tallest east of the Melinda headcut at 12 feet, but for the most part, the structure is only seven feet taller than the existing structure and the adjacent road surface, while areas near the Jim Smith Lake natural berm (south of the proposed alignment) would be lower than the natural berm. Visual disturbance is anticipated to be limited to those who travel on the adjacent road or by watercraft on the White or Arkansas rivers. The height of the structure is low enough that the surrounding BLH forest masks the structure from areas further away.

Under Alternative 2, five structures would be constructed all within the Owens Lake/Melinda Structure channel. Despite having an additional structure to construct, there would be fewer miles of temporary access road construction. Because the structures are all in proximity to each other, the majority of the access roads could be utilized to construct the next structure, unlike in the FWOP where each structure would require its own set of temporary roads. Visibility of the structures would be similar to the FWOP condition.

Adverse impacts to recreation and aesthetics are anticipated from implementation of Alternative 1 or 2. Under both alternatives, recreation impacts would be temporary, short in duration, and extremely localized. Temporary aesthetic impacts from construction of access roads and presence of construction equipment are anticipated; permanent impacts are anticipated from the presence of the new structures although the level of impact is expected to be localized to the immediate vicinity of the structure locations. These visual disturbances are considered adverse but do not rise to the level of significant.

Transportation

Implementation of either Alternative would cause a temporary closure of roads in the project area. The affected roads are not main highways or arterial streets that are regularly used by the public and are predominately used by recreationists or individuals accessing hunting lands or timber management stands. Temporary closures would not limit access to public or private lands because lands can be accessed by alternate routes. Therefore, implementation of either alternative is not anticipated to cause any undue hardship among motorists.

Both alternatives have been preliminarily designed in such a way as to not induce dangerous cross currents on the MKARNS which would create unsafe navigation. After further refining during PED, additional analysis would be completed to ensure that dangerous cross currents are not introduced.

Socioeconomics and Environmental justice

Socioeconomic impacts would be very similar to the FWOP conditions in that during construction there would be temporary increases in employment in the construction sector and increased revenue in the local economy. Alternative 1 and 2 would have a longer single duration of temporary increases compared to the FWOP; however, both alternatives would have only have one duration of construction rather than up to four separate periods of construction as is the case with the FWOP.

Impacts to Environmental Justice populations and children would be identical to the FWOP.

Hazardous, Toxic, and Radioactive Wastes (HTRW)

HTRW would not be impacted by any of the proposed alternatives. Construction activities related to each alternative would require monitoring to prevent the spill and escape of fuels, oils, or other machinery related substances. All appropriate federal, state, and local laws, regulations, and permits would be utilized to ensure that no hazardous or toxic wastes are introduced into the environment.

Summary of Impacts and Mitigation

Alternative 1 would result in the total loss of 16.5 FCUs of Riverine Backwater, whereas Alternative 2 results in no loss of Riverine Backwater habitat because all long-term disturbances would occur within already disturbed areas. The standard recommendation is to mitigate for the most-impacted function, thereby assuring that all other functional losses have been over-compensated.

Compensatory mitigation for impacts of each project alternative was determined by applying the HGM approach to calculate functional gains based on trajectories published in the Delta HGM Guidebook (Klimas et al. 2004). The HGM approach calculated the number of FCUs needed to compensate wetland impacts then converted it to acres by analyzing the change in wetland functionality for a "typical" acre of restored wetland under a variety of different scenarios for the Riverine Backwater subclass. Initial calculations indicate the direct impacts associated with Alternative 1 would result in the loss of 4.0 FCUs for the "Detain Precipitation" function (the most-impacted function). For Alternative 1, 4.0 FCUs would require restoration of approximately 10 acres of farmed wetland.

The environmental team proposed several potential mitigation measures, such as restoring wetlands along the existing containment structure, restoring an agricultural or fallow field to wetlands, increasing and/or decreasing drainage in a few identified areas, and "out-of-kind" measures. Mitigation banking was considered; however, the nearest mitigation bank does not cover the project area and is therefore not eligible for use.

The consensus of the environmental team was that impacts to wetlands would best be compensated by restoring agricultural lands in the project area to forested wetlands with the understanding that lands acquired for mitigation would likely include a combination of cleared agricultural and forest land. Restoration along the existing containment structure and drainage measures each had a substantial cost increase over restoring agricultural lands and were therefore not considered further.

As per ER 1105-2-100, an incremental cost analysis would be performed for all recommended mitigation plans to identify and describe the least cost plan. Typically, this analysis is completed using Cost Effective Incremental Cost Analysis. The team opted to not employ the use of Cost Effective Incremental Cost Analysis for this project due to the substantial cost differences among the various mitigation options. Purchasing and restoring agricultural lands yields that greatest output for the least cost. Other plans required more than double the cost to achieve the same output, therefor further analysis was unwarranted.

Cumulative Impact Analysis

This section presents the cumulative impacts of Alternative 1 and 2. NEPA regulations require that cumulative impacts of a proposed action be assessed and disclosed in an EIS. The Council on Environmental Quality (CEQ) regulations define a cumulative impact as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time." (40 CFR 1508.7)

USACE used NEPA guidance to identify resource topics that would be considered in the cumulative impact analysis (40 CFR 1508.25). From a review of the likely environmental impacts analyzed in Chapter 2 Affected Environment and Future Without Project Condition and this chapter (Future With-Project Condition), the USACE determined that the analysis of cumulative impacts would be limited to the following resource topics: land use, air quality, geology and soils, water resources, biological resources, recreation and aesthetics, and socioeconomics.

With respect to the remaining topics (e.g. climate, environmental justice, and HTRW) the future with-project condition shows that either alternative would either not result in any direct or indirect impacts and therefore would not contribute to a cumulative impact (i.e. there would be no impact related to environmental justice); or that the nature of the resource is such that impacts do not have the potential to cumulate (i.e. impacts related to geology are site specific and do not cumulate), or that the future with- or future-without project condition analysis is in essence a cumulative analysis and no further evaluation is required. For example, because climate change is global in nature, the future without-project condition and future with-project condition analysis is inherently a cumulative impact assessment.

For each resource topic that was carried forward for cumulative impact analysis, the timeframe for cumulative analysis is approximately 60 years in the past (1955) and 50 years in the future (2075). This timeframe accounts for the period of time when the MKARNS became operational and significant modifications on the White River were completed. This period of time also captures the period of time when a significant number of environmental laws were enacted in which resource protection became a priority. The future timeframe is in align with the economic period of analysis.

- Past, present, and reasonably foreseeable future actions are diverse and too numerous to list each individual activity but can be categorized by the following types of activities: Reservoir and hydropower operations by the USACE, Southwest Power Administration, and public utilities
- USACE operation and maintenance (OMRR&R) activities such as dredging, flood control structure (e.g. levees)
- USACE Regulatory (i.e. Section 404 permitting)
- Fish and Wildlife management activities conducted by USFWS, AGFC, non-government entities, and private landowners
- Land use on federal and private lands
- Source point and non-point source pollutant activities by the public and industrial sectors.

Irreversible and Irretrievable Commitment of Resources

The alternatives evaluated involve the use of both natural and socioeconomic (industrial) resources. Irreversible and irretrievable general industrial resource commitments that would be associated with the implementation of either alternative include: capital resources, labor resources, fuels, and other construction-related materials. The use of such resources would not adversely impact the availability of such resources for other projects both now and in the future.

Natural resources utilized or changed under any of the action alternatives would include biotic resources, water resources, existing land uses and visual resources. In general terms, the use and/or associated changes of natural and industrial resources would be considered irretrievable under any of the alternatives. Most of the adverse impacts associated with each alternative can be mitigated.

Resource Area	Alternative 1 or 2	Past Actions	Present Actions	Reasonably Foreseeable Future Actions	Cumulative Impacts
Land Use	• Relatively minor change in land use consisting of shift from BLH/wetlands and previously disturbed areas to structural features of the alternatives. • Reduction in erosion and headcutting.	• MKARNS construction and related projects has changed the land use of hundreds of acres from BLH/wetlands to construction footprints of projects; • Previous BLH/wetlands have been converted to agricultural fields; • Timber stands have been harvested for industry use and converted to a monoculture of even-aged forest • Reduction in land due to conversion to open water and/or dry streambed.	• Land use is normally constant consisting of state and federal wildlife management areas, private hunting clubs, timber production stand maintenance, and MKARNS operation and maintenance (O&M) activities. • Protection of the contiguous BLH in the MAV as a unique and valuable resource. • Continual erosion and headcutting.	• Continuation of present actions. Additional timber harvesting resulting in a conversion of hardwood stand to open grass areas which will begin a successional progression towards a mature hardwood stand. • MKARNS deepening may require additional dredge disposal sites that will convert existing land use to a disposal pile. • Area is not anticipated to be developed in the future.	• The conversion of BLH/wetlands and previously disturbed areas to impervious surface would be less than that converted under the past actions and would not cumulatively impact any future land use changes. Mitigation would offset any impacts. • Beneficial cumulative impact by reducing ongoing erosion and headcutting, significantly reducing the risk of a breach.
Air Quality	Minor construction related air emissions in the form of fugitive dust and vehicle emissions during construction only.				Cumulatively the impacts from either Alternative wouldn't cause the area exceed NAAQS. No cumulative impacts anticipated.

Resource Area	Alternative 1 or 2	Past Actions	Present Actions	Reasonably Foreseeable Future Actions	Cumulative Impacts
Geology and Soils	• No geology impacts. • Minor alternation in soils as a result of construction of alternatives. Impact limited to footprint of each alternative. • Reduction in erosion from existing headcutting. • Loss of approximately 15 acres of prime farmland. • Changes in topography.	• No geology impacts. • Soil modifications in construction areas due to compaction and borrow material placement; • Continual loss and replacement of soils in the area due to flooding. • Erosion from headcutting. • Loss of prime farmlands from construction of structures; Gain of prime farmlands from construction of flood control structures and dewatering activities • Changes in topography from construction of structures;	• No geology impacts. • O&M activities of existing structures can result in minor soil modification from compaction and borrow material placement. Dredging activities results in the removal of sediment from the system. • Continual loss and replacement of soils in the area due to flooding. • Erosion from headcutting. • Loss of prime farmland if O&M activities require construction of access roads or widening of structures.	• MKARNS will be deepened to 12 feet removing additional sediment from the system and adding additional sediment to the existing and/or new placement areas. • Soil loss and replacement from future flooding events.	• No cumulative impacts to geology. • Cumulatively impacts are expected to be minor. Alternative 1 would result in a further reduction in potential sediment moving between the Arkansas and White rivers, but is likely to be offset by opening the historic cutoff. • Beneficial cumulative impact by reducing ongoing erosion and headcutting, significantly reducing the risk of a breach.

Resource Area	Alternative 1 or 2	Past Actions	Present Actions	Reasonably Foreseeable Future Actions	Cumulative Impacts
Water Resources	• No change in hydrology (Alt 1) or minimal change in hydrology (Alt 2) • Reduction in WOTUS, specifically wetlands. Mitigation required. • Minimal change in floodplains • Beneficial change in lake connectivity at Owens Lake. • Temporary decrease in water quality associated with construction activities.	• Corps Construction activities (MKARNS dredging, Ark-White Cutoff, Montgomery Point Lock & Dam., etc.) resulted in modification of frequency and duration of flooding from the Arkansas and White rivers within the study area. Significant impacts were mitigated primarily through reforestation activities. • Significant reduction in floodplain function, including lake connectivity, due to river training and flood control actions. • Significant reduction in BLH/wetlands because of conversion to agriculture fields and timber harvest stands. • Increase in surface water due to erosion and headcutting.	• MKARNS dredging and O&M on existing Corps projects in the area continue to have mainly temporary impacts to water resources in the study area. • Increase in surface water due to erosion and headcutting. • Decreased water quality due to barge traffic on the MKARNS and temporary decrease in water quality during O&M activities.	• Continued O&M on Corps projects would have temporary impacts on water resources in the study area. • No major flood control projects or river training actions are projected, except for deepening of the MKARNS, which would increase the surface water depth. • Continued decreased water quality due to barge traffic on the MKARNS.	Corps activities have permanently modified the water resources in the study area. Impacts from the alternatives are insubstantial compared to the changes experienced in the past. Cumulatively the alternatives are anticipated to result in less than significant impacts to water resources due to no/insignificant change in hydrology, floodplains, and water quality; reconnection of Owens Lake; and mitigation of BLH/wetlands loss.

Resource Area	Alternative 1 or 2	Past Actions	Present Actions	Reasonably Foreseeable Future Actions	Cumulative Impacts
Biological Resources	• Impacts from conversion of BLH/wetlands would occur, but would be appropriately mitigated. • Temporary impacts from increased noise, vibration, and dust would occur during construction.	Significant impacts to fish and wildlife resources have occurred due to the construction of past Corps projects in the area and conversion of habitats. USACE and USFWS projects have been mitigated, but state and private land impacts have not.	O&M activities, depending upon the scale, of existing projects would likely impact biological resources (wetlands, aquatic species, etc.) and would require mitigation.	Future O&M or construction of additional structures if needed would more than likely impact wetland resources and would require full mitigation.	Cumulatively, less than significant adverse impacts are anticipated, but would be appropriately mitigated to offset the habitat loss. Other impacts are temporary in nature and cumulatively should not have any impact of biological resources.
Threatened & Endangered Species	T&E may be affected by the alternatives, but are not likely to be adversely affected.	Previous river training, dredging, conversion of BLH/wetlands to agricultural lands, clearcutting of timber stands, and other past activities have reduced the available habitat for T&E species, particularly species that prefer slow and shallow rivers with cobble beds.	Impacts from current O&M activities (i.e. dredging activities, USFWS and AGFC management activities, private land timber maintenance) have had section 7 or section 10 consultation completed.	Any future activities will require full compliance and coordination with the USFWS and state agencies to ensure the protection of any T&E species in the area.	No significant cumulative impacts are anticipated. See Appendix E for a more detailed analysis.
Cultural Resources	No cultural resources are expected to be impacted from any of the alternatives analyzed. Monitoring during construction would be conducted and if any cultural resources are discovered work would cease until investigation can be performed.	Previous Archeological surveys have found minimal cultural resources in the area. Past projects have had no impact on any known cultural resources.	Current O&M activities are monitored for cultural resources. If found, proper investigation are conducted.	Any future new projects or O&M activities of existing structures would be monitored for the presence of cultural resources. Proper investigations would be conducted if significant resources are uncovered.	No significant cumulative impacts are anticipated.

Resource Area	Alternative 1 or 2	Past Actions	Present Actions	Reasonably Foreseeable Future Actions	Cumulative Impacts
Recreational and Aesthetic Resources	• Temporary reduction in recreational use of the immediate project area; however, in the future, flooding would not occur as frequently increasing the availability of recreation activities. • Aesthetically, the area would be impacted by the construction of any of the alternatives to varying degrees.	• Minor impacts to recreation due to minor losses in fish and wildlife habitat. • Beneficial impacts in the form of improved access. • Flood control structures and river training activities have modified the natural setting of the area.	• Current projects such as O&M activities only temporary impacts to recreational activities. • O&M activities should only have temporary adverse effects to aesthetic values due to presence of construction equipment and personnel and restoration of disturbed areas following construction.	Future actions are expected to be similar to the present action.	• No cumulative impacts to recreation are anticipated. • Aesthetic values of the area would have less than significant cumulative impacts to the natural setting of the area.
Transportation	• Alternatives would result in the construction of temporary haul roads that would not be maintained. Navigation would be protected due to alternatives constructed. • Reliable navigation is anticipated.	• Haul roads were constructed to aid in the construction of past structures in the area, access timber harvest stands, and for recreational purposes. • Navigation has been protected due to past Corps projects, but periodically is shut down due to unsafe conditions.	• Roads in the study area are currently maintained by USACE, USFWS, AGFC and private landowners but are frequently closed due to flooding. • Navigation is maintained by USACE, but remains at risk due to potential breach of the existing containment structure.	• No additional modification or additions to existing roads are anticipated. • The protection of Navigation interests are a major concern and future projects, if required, would be constructed to protect these national interests.	• Beneficial cumulative impacts associated with implementation of either alternative are anticipated since the existing access roads would not flood as frequently and proposed access roads would be temporary. • Beneficial cumulative impacts are anticipated due to increased safe and reliable navigation with implementation of either alternative.

Resource Area	Alternative 1 or 2	Past Actions	Present Actions	Reasonably Foreseeable Future Actions	Cumulative Impacts
Socioeconomics	Minor beneficial impacts were/would be realized due to temporary increase in employment and local revenue during construction.		Current projects such as the Montgomery Point lock and dam provide only a minor input into the local economy. Timber production provides employment opportunities and minor economic benefits to the local economy. Recreation provides local revenue, particularly during hunting season.	Minor beneficial impacts would be realized due to temporary increase in employment and local revenue during construction.	Temporary beneficial cumulative impacts are anticipated.

CHAPTER 5: RECOMMENDED PLAN

Alternative 1, the Containment Structure at elevation 157 with an opening at the Historic Cutoff is the recommended plan. This is also the NED plan.

Description of the Recommended Plan

Alternative 1 consists of a newly constructed containment structure at an elevation of 157 feet msl. This structure would be approximately 2.5 miles long (Figure 15). The new structure would begin on natural high ground just south and west of the existing Melinda Structure located on the south side of Owens Lake. It would continue east and cross the Melinda Headcut south of the existing Melinda Structure. From there, it would head northeast and connect to the existing containment structure north of Jim Smith Lake. It would continue to follow the existing containment alignment terminating at the existing Historic Cutoff Containment Structure.

This alternative would have an opening at the Historic Cutoff. The optimal width of the opening would be determined during design, but would be at elevation 145 ft msl regardless of the width. The new opening reduces, or at least does not increase, the maximum head differential across the isthmus allowing USACE to control the location of future overtopping events and decreases the duration of the head differential and velocities of the flow between the rivers, which provides for safe navigation. Further, the opening would restore the function of Webfoot Lake and reduce erosion on the east side of the lake, which has existing nick points that may lead to future head cutting.

In addition to the containment structure, the existing Melinda Structure would be demolished in place (the debris would be pushed into the deep scour hole south of the structure) as part of Alternative 1. This reduces the turbulence of the water against the toe of the new containment structure thereby increasing its resiliency. Removal of the structure would also allow Owens Lake to reconnect to its former southern limb, returning open water function to the oxbow element of the flooded bottomland hardwood ecosystem that has been altered by the construction, operation and maintenance of the MKARNS. The structure at the north end of Owens lake would need to be lowered, or otherwise altered slightly to ensure water does not back up into Owens lake and damage the surrounding BLH.

Alternative 1 minimized environmental impacts over the No Action or other analyzed alternatives. Approximately 25 acres of long-term impacts, which requires 4.0 Functional Capacity Units of mitigation, would be realized through implementation of the recommended plan. Only 0.63 miles of the proposed containment structure would be built on Refuge lands, thereby minimizing direct impacts to the Refuge over other alternatives. Overall, the current hydrology in the surrounding bottomland hardwood forest would experience little to no change as a result of implementation of this alternative. Navigation would continue with no change in the current operation of the MKARNS.

Figure 15: Tentatively Selected Plan (Alternative 1) features.

Table 18: Status of Environmental Compliance

Policies	Compliance of Plan
Public Laws	
Archeological and Historic Preservation Act, 1974, as amended	In Progress
Archeological Resources Protection Act, 1979, as amended	In Progress
Clean Air Act, 1977, as amended*	Compliant
Clean Water Act, 1972, as amended*	Compliant
Coastal Zone Management Act, 1972, as amended	Not Applicable
Endangered Species Act, 1973, as amended*	Compliant
Farmland Protection Policy Act	In Progress
Fish and Wildlife Coordination Act, 1958, as amended*	Compliant
Magnuson Fisheries Conservation and Management Act	Not Applicable
Migratory Bird Treaty Act, 1918, as amended	Compliant
National Environmental Policy Act, 1969, as amended	In Progress
National Historic Preservation Act, 1966, as amended	In Progress
Native American Graves Protection and Repatriation Act, 1990	Not Applicable
Rivers and Harbors Act, 1899	Compliant
Wild and Scenic Rivers Act, as amended	Compliant
Executive Orders	
Environmental Justice (E.O. 12898)*	Compliant
Flood Plain Management (E.O. 11988)	Compliant
Protection of Wetlands (E.O. 11990)	Compliant
Protection of Children from Environmental Health Risks (E.O. 13045)	Compliant
Invasive Species (E.O. 13112)*	Compliant
Migratory Birds (E.O. 13186)*	Compliant

Project Implementation

Pre-Construction Engineering and Design

The PED Phase is cost shared 75% Federal, 25% non-Federal for navigation projects. The non-Federal sponsor for the PED phase is the Arkansas Waterways Commission. Prior to initiating the PED phase, the design team must develop a Project Management Plan (PMP) which defines the scope, work breakdown structure, schedule, and budget to complete PED. Additional items in the PMP are related to value management and engineering, quality control, communication, change management, and acquisition strategy. The draft PMP must be developed, negotiated, and agreed upon by all parties of the PED phase prior to initiation of the PED phase.

A number of activities are expected to take place during PED. These include the completion of a Design Documentation Report (DDR), plans and specifications (P&S), execution of the Project Partnership Agreement (PPA), and contract award activities.

Value Engineering Study

As stated earlier, ER 11-1-321 provides for the execution of the Value Engineering (VE) elements within the Project Management Business Process of the USACE and that Value Management shall be done by implementing the Value Management Plan (REF8023G) from the USACE Business Process Manual. A Value Engineering Study will be conducted during the design and construction phase in accordance to ER 11-1-321.

Detailed Design Report

The development of the DDR includes completing the final design of project features. As part of the DDR, the team would complete any ground surveys, utility surveys, and drilling and testing for subsurface (geotechnical) conditions as necessary to complete the final design. The measure footprints would be further defined based on surveys. Design parameters for all project features would be defined for development of the plans and specifications. Continued coordination with SHPO would ensure requirements for archeological resource investigations and mitigation continue to be met.

Plans and Specifications

Plans and Specifications include the development of project construction drawings and specifications, estimation of final quantities, and completion of the government cost estimate. Drawings and specifications are made available to contractors interested in bidding on the construction of the proposed project. It is estimated that several sets of plans and specifications would be developed for the containment structure and the opening in the Historic Cutoff. Arrangements for any onsite archeological monitoring during construction, if determined necessary, would be finalized prior to the conclusion of P&S.

Real Estate Acquisition

Real estate activities would be coordinated through the Real Estate Office of the Little Rock District. Also, prior to any solicitation of construction contracts, the District Chief of Real Estate is required to certify in writing that sufficient real property interest is available to support construction of the contract.

Project Construction

After award of the construction contract, the Government would manage project construction. Up to five contracts may be awarded. Inherent with this contract, a warranty period for actual construction items and plantings would be specified. Construction of the containment structure and lowering of the portion of the Historic Cutoff is expected to take 2.5 years to complete.

<u>Contract Advertisement and Award</u>
Once the plans and specifications are completed, and the rights of entry available to the Little Rock District, a construction contract would be solicited and advertised. The contract would be awarded to the lowest responsive bidder and notice to proceed can be expected within 30-45 days from bid opening.

Monitoring and Adaptive Management
ER 1105-2-100 allows for project monitoring and adaptive management during and after construction. Adaptive management for complex, specifically authorized projects may be recommended, particularly those projects. When recommended, the cost of adaptive management is limited to three percent of the total project cost excluding monitoring costs. No project-specific ecological monitoring or adaptive management measures are included as part of the Proposed Action for the Three Rivers Southeast Arkansas Project. A monitoring and adaptive management plan will be developed for the mitigation.

Operation, Maintenance, Repair, Replacement, Rehabilitation (OMRR&R)
OMRR&R is a Federal responsibility and will be carried out by USACE. The estimated annual OMRR&R costs are $511,634.

Project Implementation Schedule
The daft project implementation schedule is under development and will be included in the final report. The final schedule would be coordinated and approved by the non-Federal sponsor and included in the PED Project Management Plan.

Total Project Cost
The total project cost for the Recommended Plan is $137,853,000. This includes the base cost of the Recommended Plan $94,278,000 and a contingency of $31,878,000. Plus $11,197,000 in interest during construction, estimated Mitigation costs of 200,000 and estimated real estate costs of 300,000.

Cost Sharing
Construction costs would be shared 50%-50% between U.S. Treasury funds and funds from the Inland Waterways Trust.

Financial Plan and Capability Assessment
The non-Federal sponsor, the Arkansas Waterways Commission, is to provide a statement that attests to their capability to meet their financial responsibilities related to this project as agreed and described in this report. This section will contain that information as soon as the Waterways Commission provides it to USACE.

Views of the Local Sponsor
The local sponsor, the Arkansas Waterways Commission, supports the Recommended Plan and intends to participate in its implementation. A Letter of Intent stating their support and their intention to participate in the project implementation will be included in the Final Report.

Resource Agency Coordination

The PDT has worked closely with numerous state and federal resource agencies, including the USFWS, AGFC, ANHC, ANRC, and the NPS, throughout plan alternative development. Bi-weekly environmental team meetings were held to update the team on planning progress, model updates, and to ensure their concerns were addressed. Several meetings and site visits have been held with the resource agencies. Arkansas Game and Fish Commission and USFWS personnel assisted in site selection and data collection for the Hydrogeomorphic (HGM) analysis of project impacts in November 2016. Subsequent conversations and emails occurred in regard to the HGM results. Appendix C contains the official Planning Aid Letter from USFWS.

Correspondence by e-mail, webinars, and phone with the resource agencies has also occurred throughout study development. Ongoing coordination with USFWS is discussed in the subsection entitled “Fish and Wildlife Coordination Act.”

On 30 July 2015, study coordination was initiated with the Department of Arkansas Heritage’s (DAH) Historic Preservation Program (i.e., State Historic Preservation Officer – SHPO) and appropriate federally recognized tribes with responses being received from the Choctaw and Quapaw. On 5 Jan 2017, an additional conversation with DAH/SHPO archeologist confirmed the requirement for a cultural resources survey prior to construction. Coordination will continue through the study with the next step being the development of a Programmatic Agreement to affirm the completion of Section 106 requirements during the design phase and before construction begins.

Public Involvement

USACE held multiple public communication events with local citizens regarding the Ark-White Cutoff Study General Re-evaluation Report in 2005.

As part of the Ark-White Study a Notice of Intent (NOI) to prepare an EIS was published in the Federal Register on June 20, 2003. A workshop was held on June 26, 2003 in Pine Bluff, Arkansas to inform the public about the study and receive their comments and concerns. Over 270 people attended the workshop including: federal, state, and non-profit agency staff representing environmental, navigation, and high traffic interests; representatives from the energy, logging, shipping, and towing industries; landowners along the river; and private individuals with general interest in the study area. Fifteen comments were received during the 30-day public scoping period.

Prior to the Draft EIS for the Ark-White Cutoff Study being made available for public review, USACE withdrew its NOI to prepare an EIS, at which time the No Action alternative was selected and the study was terminated.

On September 14, 2015, a NOI was published in the Federal Register notifying the public of USACE intent to prepare an Integrated Feasibility Report and EIS for the Three Rivers Feasibility Study. USACE provided news releases to the local paper and was published on the Little Rock District website. A 30-day scoping period was provided for public comment acceptance, during which time no comments were received. No public scoping meetings or workshops were held for the Three Rivers Study prior to the draft Integrated Feasibility Report release. USACE will be publishing a withdrawal of the NOI prior to release of the draft Integrated Feasibility Report and EA. The NOI is no longer necessary due to downgrading the NEPA compliance document from an EIS to an EA.

Public review of the draft Integrated Feasibility Report and EA is scheduled to begin March 31, 2017 and run through April 30, 2017. A Public Meeting has been scheduled for April 17th from 4 to 7 pm at the Delta Rivers Nature Center in Pine Bluff, AR.

Environmental Operating Procedures

USACE's seven Environmental Operating Principles encourage Corps of Engineers employees to consider the environment in everything they do. They set the direction for USACE to achieve greater synergy between sustainability and execution of its projects and programs. Within the Civil Works planning arena, the Environmental Operating Principles guide the identification, evaluation, and selection of plan components to encourage implementation of productive and sustainable projects. The Recommended Plan for the Three Rivers Southeast Arkansas, study embodies this approach and philosophy. Each principle is discussed in more detail below.

- **Foster Sustainability as a way of life throughout the organization**

The Recommended plan would prevent future cutoffs from forming and reduce headcutting in multiple locations throughout the project area. If cutoffs form, infrastructure could be damage leading to negative impacts on navigation. If a cutoff forms and/or additional headcutting occurs, bottomland hardwoods and wetlands would be permanently converted to open water and/or dry channel beds leading to further ecosystem degradation. Sustainability principles will also be incorporated into the construction and demolition contracts of project features to minimize emissions, control runoff, and take advantage of recycling opportunities for construction debris.

- **Proactively consider environmental consequences of all Corps activities and act accordingly**

Plan formulation focused specifically on finding an environmentally sustainable alternative that would reduce the risk of breach in the project area while limiting potential impacts to the surrounding sensitive BLH ecosystem. The alignment of the containment structure for Alternative 1, the Recommended Plan, was designed to form with the existing topography rather than creating a "straight line" structure. By doing this, the length and overall footprint of the structure was reduced by over half from the structure that was designed in the Ark-White River Cutoff Study. As well, an opening at Owens Lake was incorporated into the proposed action to reduce ponding behind the proposed structure; thereby, reducing potential land cover changes and bottomland hardwood conversion to open water.

- **Create mutually supporting economic and environmentally sustainable solutions**

The alignment of the new containment structure deliberately takes advantage of natural high ground to minimize the footprint of the structure and reduce impacts to the environment. In addition, the removal of the Melinda Structure would create an open water habitat that has been lost in this portion of the system since the structure was constructed. Implementation of the proposed plan would reduce the risk of cutoffs forming which turn BLH forest to open water habitat.

- **Continue to meet our corporate responsibility and accountability under the law for activities undertaken by the Corps which may impact human and natural environments**

As discussed in Chapters Four and Five of this report, the Recommended Plan fully complies with legal and policy requirements to consider the impact of Corps of Engineers' projects on the human and natural environment.

- **Consider the environment in employing a risk management and systems approach throughout life cycles of projects and programs**

Uncertainty, and risk are discussed in detail in Section 3 of this report. The analysis concludes that, notwithstanding the predictive errors and uncertainty inherent in water resources planning, we can be confident that the Recommended Plan is economically justified and consistent with the Federal objective to contribute to national economic development consistent with protecting the Nation's environment. Very little, if any risks affecting the quality of the human environment would remain after project implementation.

- **Leverage scientific, economic, and social knowledge to understand the environmental context and effects of Corps actions in a collaborative manner**

Throughout the Three Rivers Southeast Arkansas Study, the PDT has consulted with resource agencies, and local governments in order to ensure that the best-available information was used in the planning process. Feedback received during the collaboration was utilized extensively in the screening process and in development of the project's mitigation features.

- **Employ an open, transparent process that respects the view of individuals and groups interested in Corps activities**

USACE coordinated with resource agencies on a bi-weekly basis throughout most of the study process. The concerns of all resource agencies were taken into consideration throughout the planning process and impacts to resources of concern were minimized to an acceptable level.

Conclusions

The Little Rock District recommends the approval and implementation of the NED plan as described in this document. This conclusion is based on the study findings in connection with the Feasibility Report and Integrated Environmental Assessment.

Recommendation

I recommend the structural features designed to promote sustainable navigation identified as the recommended plan in the Three Rivers Southeast Arkansas Feasibility Report and Integrated Environmental Assessment, proceed with implementation in accordance with the cost sharing provisions set forth in this report.

The recommended plan consists of a newly constructed 2.5 mile long containment structure at an elevation of 157 feet msl. The new structure would begin on natural high ground just south and west of the existing Melinda Structure located on the south side of Owens Lake. It would continue east and cross the Melinda Headcut south of the existing Melinda Structure. From there, it would head northeast and connect to the existing containment structure north of Jim Smith Lake. It would continue to follow the existing containment alignment terminating at the existing Historic Cutoff Containment Structure. In addition, the plan includes relief structure through the Historic Cutoff Containment Structure.

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Robert G. Dixon
Colonel, U.S. Army
Commanding

Date ______________

The recommendations contained herein reflect the information available at this time, and current Department of the Army, and U.S. Army Corps of Engineers policies governing formulation of individual projects. The recommendations do not reflect the program and budget priorities inherent to the formulation of a national Civil Works construction program, nor the perspective of higher review levels within the Executive Branch of the U.S. Government. Consequently, the recommendations may be modified before they are transmitted to Congress as proposals for implementation funding. However, prior to transmittal to Congress, the sponsor, the State, interested Federal agencies, and other interested parties will be advised of any modifications, and be afforded the opportunity to comment further.

DRAFT FINDING OF NO SIGNIFICANT IMPACT

The Three Rivers Study Area is located in portions of Arkansas and Desha counties in southeast Arkansas, encompassing the confluence of the Arkansas and White rivers with the Mississippi River. At the request of the Arkansas Waterways Commission, and under authority of Section 216 of the Flood Control Act of 1970 (Public Law 91-611), the Little Rock District Corps of Engineers conducted a feasibility study to recommend solutions to problems impacting the long-term sustainable use of the McClellan-Kerr Arkansas River Navigation System (MKARNS).

There is a risk of breach of the existing containment structures near the entrance channel to the MKARNS on the White River. During high water events, water backing up the Mississippi can create significant head differentials between the Arkansas and the White rivers. The existing containment structures are subject to damaging overtopping, flanking, and seepage that could result in a catastrophic breach. The uninhibited development of a breach, or cutoff, has the potential to create various navigation hazards, increase the need for dredging, and adversely impact an estimated 200 acres of forested wetlands in the isthmus between the Arkansas and White rivers.

Structural and nonstructural alternatives were evaluated for consideration including restoring natural hydrologic connectivity between the Arkansas and White rivers, installing new and/or modifying existing structures in the isthmus, operational changes on existing dams on the Arkansas River, construction of setback levees, and channelization of the lower Arkansas River.

The recommended plan includes the construction of a new containment structure approximately 2.5 miles long at elevation 157 feet, beginning on natural high ground just south and west of the existing Melinda Weir located on the south side of Owens Lake. It would continue east and cross south of the existing Melinda Weir, then head northeast and connect to the existing soil cement containment structure north of Jim Smith Lake where it would follow the existing containment alignment and terminate at the Historic Cutoff Containment Structure (HCCS). A section of the HCCS ranging from 500 feet to 1,000 feet wide, would be lowered to elevation 145 feet to facilitate earlier water exchange during flooding to alleviate extreme head differentials between the two rivers. The Melinda Structure would be demolished to reduce turbulence on the toe of the new containment structure. This action would also reestablish the hydrologic connection of the two arms of Owens, increasing spawning and nursery habitat for native fish species. An opening would be constructed in the Owens Lake Weir to prevent changes in flood duration that could adversely impact forested wetlands (bottomland hardwood forest).

Impacts assessed for the recommended plan included, but were not limited to, those related to water, biological, cultural, and geologic resources, land use/recreation/transportation, socioeconomics, aesthetics, and hazardous and toxic substances. The recommended plan would not adversely affect any federally listed threatened and endangered species or critical habitat.

All practicable means to avoid or minimize environmental impacts due to construction of the recommended plan have been considered. The recommended plan has been designed with the smallest practicable footprint to meet the requirements of the proposed project.

The USACE recommends cultural resources investigations to identify and evaluate any historic properties within the APE of the recommended action. USACE will execute a Programmatic

Agreement with the Arkansas State Historic Preservation Office (SHPO), Advisory Council on Historic Preservation (ACHP), and the appropriate federal recognized Indian Tribes to ensure compliance with Section 106 prior to construction. In accordance with 36 CFR Part 800.6(b), should adverse impacts to any cultural or historic resources throughout the project corridor be unavoidable, an appropriate mitigation plan will be sought in consultation with the Arkansas SHPO and other interested parties and agencies, and fully implemented prior to project construction.

Based on a review of the information, it is determined that the implementation of the Recommended Action is not a major federal action which would significantly affect the quality of the human environment within the meaning of Section 102(2)(c) of the National Environmental Policy Act of 1969, as amended. Therefore, the preparation of an Environmental Impact Statement is not required.

______________________________	______________________________
Robert G. Dixon	Date

Colonel, US Army

Commanding

CHAPTER 6: LIST OF PREPARERS, ACRONYMS AND REFERENCES

The following USACE personnel made up the PDT:

Dana Coburn	Project Management
James Fisher	Office of Counsel
Melinda Fisher	Environmental Resources
Catherine Funkhouser	Hydrology and Hydraulics
Roderick Gaines	Civil Design
Norman Gartner	Civil Design
Craig Hilburn	Environmental Resources
Stuart Norvell	Economics
Nancy Parrish	Planning
Brian Raley	Real Estate
Martin Regner	Cost Engineering
Kelly Turner	Cost Engineering

LIST OF ACRONYMS

ADEQ	Arkansas Department of Environmental Quality
AGFC	Arkansas Game and Fish Commission
ANHC	Arkansas Natural Heritage Commission
ANRC	Arkansas Natural Resources Commission
BCC	Birds of Conservation Concern
BCR	Bird Conservation Region
BFE	Base Flood Elevation
BLH	Bottomland Hardwood
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CCS	Center for Climate Strategies
CWA	Clean Water Act
DDR	Design Documentation Report
EA	Environmental Assessment
EC	Engineer Circular
EO	Executive Order
EPA	Environmental Protection Agency
ESA	Endangered Species Act
FCU	Functional Capacity Unit
FEMA	Federal Emergency Management Agency
FONSI	Finding of No Significant Impact
ft msl	Feet Above Mean Sea Level
FWOP	Future Without Project
GCM	General Circulation Models
GHG	Greenhouse Gas
HEC-RAS	Hydrologic Engineering Center – River Analysis System
HGM	Hydrogeomorphic Approach
HTRW	Hazardous, Toxic, and Radioactive Wastes

IPaC	Information for Planning and Conservation
MKARNS	McClellan-Kerr Arkansas River Navigation System
MAV	Mississippi Alluvial Valley
NAAQS	National Ambient Air Quality Standards
NED	National Economic Development
NEPA	National Environmental Policy Act
NGVD	National Geodetic Vertical Datum
NWI	National Wetland Inventory
NPS	National Park Service
NRHP	National Register of Historic Places
OMRR&R	Operation, Maintenance, Repair, Replacement, and Rehabilitation
P&S	Plans and Specifications
PDT	Project Delivery Team
PED	Pre-Construction Engineering and Design
PMP	Project Management Plan
PL	Public Law
PNV	Potential Natural Vegetation
PPA	Project Partnership Agreement
SHPO	State Historic Preservation Office
TDML	Total Maximum Daily Loads
U.S.C.	United States Code
USFWS	U.S. Fish and Wildlife Service
USACE	U.S. Army Corps of Engineers
WOTUS	Waters of the U.S.
WMA	Wildlife Management Area

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