Three Rivers Southeast Arkansas Study

Appendix N: Mitigation Plan and

Monitoring and Adaptive Management Plan

THREE RIVERS SOUTHEAST ARKANSAS

Introduction

The Three Rivers Southeast Arkansas Feasibility Study (Three Rivers Study) is being conducted by the U. S. Army Corps of Engineers (USACE) to recommend modifications to the McClellan-Kerr Arkansas River Navigation System (MKARNS) that would provide long-term sustainable navigation and promote the continued safe and reliable economic use of the MKARNS.

Study Authority

Section 216, 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.

Study Purpose

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

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

Non-Federal Sponsor

The Arkansas Waterways Commission is the non-federal sponsor for the Three Rivers Southeast Arkansas Study. An amended feasibility cost-sharing agreement was executed in June 2015.

Recommended Plan

The recommended plan consists of a newly constructed 2.5-mile long containment structure at an elevation of 157 feet above mean sea level (ft msl) that 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 head cut south of the existing Melinda Structure. From there, it would head northeast and connect to the existing Soil Cement Structure north of Jim Smith Lake. It continues to follow the existing Soil Cement Structure alignment terminating at the existing Historic Closure Structure. The recommended plan also includes a relief opening at the Historic Cutoff to an elevation 145 ft msl regardless of the width. In addition, the existing Melinda Structure would be demolished in place and the debris would be pushed into the deep scour hole at the top of the head cut. Finally, adding an opening in the existing Owens Lake Structure between Owens Lake and the White River would prevent water from backing up into Owens Lake, which would impact the bottomland hardwood forest. The opening would be designed to allow fish passage into Owens Lake.

INTRODUCTION

In accordance with the mitigation framework established by Section 906 of the Water Resources Development Act (WRDA) of 1986 (33 US 2283), as amended by Section 2036 of WRDA 2007 and Section 1040 of the Water Resources Reform and Development Act (WRRDA) of 2014, the Council on Environmental Quality's (CEQ) National Environmental Policy Act (NEPA) regulations (40 CFR Sections 1502.14(f), 1502.16(h), and 1508.20) and Section C-3 of Engineering Regulation (ER) 1105-2-100, the USACE has prepared this mitigation plan to ensure that project-caused adverse impacts to ecological resources are avoided or minimized to the extent practicable, and that remaining, unavoidable impacts are compensated to the extent justified.

Mitigation planning is an integral part of the overall planning process. In order to evaluate appropriate mitigation needs and options, the type, location, and level of potential adverse ecological impacts were identified and documented in the final Integrated Feasibility Report and Environmental Assessment (IFR/EA). Practicable avoidance and minimization measures were considered, followed by an assessment of potential compensatory mitigation measure and a rough order of magnitude cost for those measures. This process included close coordination with Federal and state resource agencies.

Minimization and Avoidance Measures

The first step in mitigation planning involves developing alternatives that avoid or minimize adverse environmental impacts. The initial array of alternatives was coordinated with resource agencies through a number of interagency meetings. Meetings focused on potential adverse impacts to high value fish and wildlife, further alteration of the hydrology, and adverse impacts to the Dale Bumpers White River National Wildlife Refuge (Refuge).

Several measures from the 2009 Ark-White Cutoff Study served as starting points in measure design, specifically the Ark-White alternative that involved raising and extending the existing containment structure. Although the 2009 measure would have met study objectives, the 12-mile long containment structure would have had significant negative consequences including:

- Undesirable hydrologic changes to the Refuge,
- Land use conversion,
- Loss of bottomland hardwood forests,
- Habitat fragmentation,
- Incompatibility with the Refuge mission; and,
- Reduction in visual aesthetics.

To avoid these potential impacts in the Three Rivers Study, the Project Delivery Team (PDT) analyzed different alignments for new containment structures that would achieve

study objectives and minimize detrimental impacts. After numerous iterations, team hydrologists, engineers, and biologists identified a 2.5-mile long alignment that incorporates natural high ground as much as possible. The new recommended alignment would permanently impact 25 acres of forested wetlands, which is significantly less than the 2009 alignment design that would have affected 96 to 104 acres of wetlands. The current recommended alignment would also rely on existing access roads and would prevent the need to construct temporary or permanent access roads. Using high ground would also decrease the visibility of the structure in relation to the natural landscape, which increases its compatibility with the Refuge mission.

This new alignment by itself significantly reduces hydrologic changes (i.e., increases or decreases in depth and duration of flooding in bottomland hardwoods) as compared to other alternatives, but not to acceptable levels. This alignment would also induce incising along White River shorelines. To mitigate these impacts, the design includes a relief opening in the Historic Cutoff Structure. Lowering the elevation of this structure would eliminate the incising and some of the erosion that would likely occur in the Future without Project (FWOP) condition, including erosion on the Refuge. As an ancillary benefit, hydrology in Webb Foot Lake would return to more historic conditions, allowing the oxbow to fully function and avoid future loss of functionality due to erosion and sedimentation.

Adding the relief opening further would eliminate all direct and indirect hydrologic changes on the Refuge; however, there was one location in Owens Lake, outside the Refuge, that still experienced increases in depth and duration of flooding. Hydrologists found that this area captured water and had no way to drain, and therefore proposed adding an opening in the existing Owens Lake structure. After the design included the opening, model runs showed no direct, and minimal indirect changes in hydrology with implementation of the recommended plan, when compared to existing conditions.

Modeling also showed that leaving the Melinda Structure in place would create excess turbulence on the toe of the new structure, which would in turn reduce structural resiliency. To avoid this, USACE would demolish the Melinda Structure and place demolition debris into the large scour hole at the top of the headcut. Removing the Melinda Structure also provides ancillary benefits by connecting the two oxbow halves of Owens Lake that would restore functionality of the oxbow.

Although the new containment structure would impede fish passage between the Arkansas and White rivers during high flows, opening the Historic Cutoff Structure would reintroduce fish passage between the two rivers in a manner similar to historic conditions, and thus resolve the concern. Opening the Owens Lake Structure and removing the Melinda Structure would also reintroduce fish passage in Owens Lake that has been cutoff since construction of the two containment structures. These proposed actions are a net benefit to fish and other aquatic species.

Short-term temporary impacts associated with plan construction would occur on approximately 25 acres. Impacts would be minimized by implementing best management practices (BMPs) and restoring disturbed sites not needed for project operations such as staging areas, the construction footprint, and disposal sites. USACE would allow these 25 acres to revert to preconstruction conditions, resulting in no net loss of bottomland hardwoods or wetlands.

Mitigation Needs

After all possible minimization and avoidance measures were incorporated into the recommended plan, adverse permanent impacts to 25 acres (10 hectares (ha)) of bottomland hardwoods would be unavoidable as a result of converting bottomland hardwoods to impervious surface along the structure's alignment.

Model Selection

To determine the amount of mitigation compensation required to ensure no net wetland loss, the PDT utilized the Hydrogeomorphic Approach to Assessing Wetland Functions in Forested Wetlands in the Delta Region of Arkansas, Lower Mississippi River Alluvial Valley (HGM) to evaluate present wetland functions in the project area, and those functions that would be lost as a result of construction. This HGM model was certified for regional use on November 22, 2011.

It is assumed that impacts to wetland functions assessed using HGM, while not specific to any particular wildlife species, represents a measure of ecosystem health and value to wetland dependent wildlife.

The HGM approach first groups wetlands into regional subclasses based on functional similarities in 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 inserted into a simple logic model that describes the level to which each function is being performed by a 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 (in hectares) to calculate the amount of Functional Capacity Units (FCU) for each assessed function. FCUs can then be used to compare wetlands in the same regional subclass.

The HGM analysis of the recommended plan was limited to direct impacts that consist of habitat loss due to construction. Indirect effects (altered hydrology) were minimal (and possibly the result of "noise" from using 10 meter DEM elevations in the modeling), therefore were not assessed.

To establish the baseline wetland condition, a team of USACE, Arkansas Game and Fish Commission (AGFC), and U.S. Fish and Wildlife Service (FWS) biologists collected

data on eleven plots evenly distributed along the proposed containment structure alignment. All data was electronically entered on Arkansas Delta HGM Field Data Sheets for calculation. As previously mentioned, the calculator generated Pre-Project FCIs for the six functions associated with Riverine Backwater wetlands (Table N-1).

To determine Post-Project FCIs, the team used HGM sites 1-4 for comparison. These four sites are located on the existing containment structure, thus should be a representation of what the Post-Project habitat condition will be for the new containment structure. For this analysis, the team selected the lowest value for each variable from the four forms. This was done to estimate a "worst-case" future condition for mitigation purposes. The Post-Project FCIs are presented in Table N-1.

For the recommended plan, the Riverine Backwater wetlands along the new containment alignment would realize a total loss (all functions) of 16.5 FCUs (Table N-1). 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 (Habitat for Fish and Wildlife; loss of 0.44 FCIs), thereby assuring that all other functional losses are over-compensated. Therefore, mitigation for the recommended plan is based on a loss of 4.4 FCUs (0.44 FCI X 10 ha impact site) for the "Habitat for Fish and Wildlife" function.

Table N-1: Change in Functional Capacity Index (FCI) and Units (FCUs) for Riverine Backwater

Function	Pre-Project			Post-Project			Net Change		
	FCI	**Adj. FCIs**	**Adj. FCUs**	**FCI**	**Adj. FCIs**	**Adj. FCUs**	**FCI**	**Adj. FCIs**	**Adj. FCUs**
Detain Floodwater	0.89	0.00	0.00	0.73	0.00	0.00	(0.16)	(0.16)	(1.60)
Detain Precipitation	0.73	0.73	7.30	0.33	0.33	3.33	(0.40)	(0.40)	(4.00)
Cycle Nutrients	0.86	0.86	8.60	0.69	0.69	6.90	(0.17)	(0.17)	(1.70)
Export Organic Carbon	0.86	0.86	8.60	0.69	0.69	6.90	(0.17)	(0.17)	(1.70)
Maintain Plant Communities	0.79	0.79	7.90	0.48	0.48	4.80	(0.31)	(0.31)	(3.10)
Habitat for Fish and Wildlife	0.89	0.89	8.90	0.45	0.45	4.50	(0.44)	(0.44)	(4.40)
Totals	5.02	5.02	50.20	3.37	3.37	33.70	(1.65)	(1.65)	(16.50)

MITIGATION PLANNING

ER 1105-2-100 and the Clean Water Act specify requirements for mitigation planning for bottomland hardwoods and wetlands.

- **Bottomland hardwoods**: "Mitigation plans shall ensure that adverse impacts to BLHs are mitigated in-kind, to the extent practicable. The intent is that the BLH as an ecological system be mitigated rather than mitigating for faunal species in an upland hardwood forest habitat type. In this instance "to the extent possible" shall take into consideration the availability of manageable units of existing or

restorable BLH and the practicability and feasibility of implementing management measures to accomplish in-kind mitigation. In-kind does not necessarily mean acre-for-acre, but may be restoration or the increased management of BLH to compensate for the loss of biological productivity (habitat quality)."

- **Wetlands**: "District commanders shall ensure that adverse impacts to wetland resources are fully mitigated. Mitigation shall be accomplished through appropriate actions taken to avoid, minimize, and compensate for unavoidable losses as required to clearly demonstrate efforts made to meet the administration's goal of no net loss of wetlands."

Mitigation Objective

The Three Rivers Environmental Team made up of biologists, hydrologists, botanists, and other specialists from the USACE, FWS (Ecological Services Office and Refuge), and AGFC met several times on-site and via webinars to develop a mitigation objective:

> *"Mitigation should maintain and improve the quality of floodplain resources within the watershed through the strategic selection of compensatory mitigation sites*."

The team developed this broad objective to provide multiple opportunities beyond traditional in-kind mitigation of purchasing and restoring land.

Mitigation Measures Considered

With the mitigation objective in mind, the team proposed an initial array of mitigation measures and determined whether a measure should carry forward for further consideration (Table N-2).

Table N-2: Initial Array of Mitigation Measures

Mitigation Measure	Description	Screened or Carried Forward
In-Kind		
Mitigation Banking	Purchase credits from a mitigation bank	Carried forward as stand-alone alternative.
Restoration of Agricultural and Fallow Lands	Purchase and restore fallow field to bottomland hardwoods (BLHs). Replant BLH vegetation in the degraded historic wetland areas and restore hydrologic connectivity.	Carried forward as stand-alone alternative.

Mitigation Measure	Description	Screened or Carried Forward
Restoration of BLHs along the Existing Containment Structure	Remove the portion of the existing containment structure west of LaGrues Lake that would no longer be needed. Removal would restore historic hydrology in the area. Natural regeneration would convert the site back to BLHs.	Screened**:** This measure was screened for several reasons: 1) the estimated cost of removing the material exceeded $1.5M; 2) an HGM assessment of restoring the site would not fulfill all of the mitigation needs; 3) AGFC and FWS biologists felt this should be removed as part of the project, and not mitigation.
Hydrologic Restoration	Restoration of degraded wetlands near the project site by lowering or removing levees, canal berms, or roads; filling or blocking small channels; ditch clean out; or construction of new drainage canals which would facilitate draining or ponding of wetlands to increase wetland function.	Screened**:** Three specific locations were identified that BLH could benefit from hydrologic restoration, however, the identified locations are all on USFWS property. Several real estate issues arise with completing mitigation on USFWS land including an inability to obtain a compatibility statement for work to be completed and inability to obtain the land in fee through purchase or condemnation (33 USC SS 2283(b))".
Preservation of Land	Purchase BLHs from a private landowner under a perpetual conservation easement, or permanent transfer to AGFC or USFWS for preservation in perpetuity.	**Screened:** Over 160,000 acres of BLH are currently under USFWS, USACE, or AGFC ownership and management in or adjacent to the study area. Private lands near the project site contain valuable BLH forests that are managed for the benefit of wildlife to produce economic income (e.g. hunting leases); therefore, these lands are not recommended for purchase as they would result in adverse economic impacts that would be unreasonable to mitigate.
Out-of-Kind Mitigation		

Mitigation Measure	Description	Screened or Carried Forward
Restore Fish Passage	Construct opening in various existing structures to increase fish passage into oxbow lakes.	**Screened:** Although lack of fish passage throughout the Three River study area was identified as most in need of restoration and would benefit the system the most, USACE policy requires in-kind mitigation if feasible. Feasible in-kind measures are available.

*BLH = Bottomland Hardwoods

Development of Mitigation Alternatives

Because the initial array consisted of only two measures, alternative selection was straight forward. Alternatives included are:

- Alternative 1: Mitigation Banking
- Alternative 2: Restoration of Agricultural or Fallow Fields

Both alternatives would restore land not currently functioning as bottomland hardwood ecosystems. Restoration, for purposes of this document, is defined as the return of an ecosystem to a close approximation of its condition prior to disturbance. This indicates that the restoration is intentional and emulates the structure, function, diversity, and dynamics of a previously existing natural ecosystem with the understanding that complete restoration to historic conditions may not be feasible due to much greater hydrologic change throughout the entire system from construction projects affecting thousands of square miles. Trying to restore to a previously existing natural ecosystem is less important than matching tree species with topographic, soil, and hydrologic conditions that exist on a site after a project is complete. Therefore, scientists must rely on best professional judgment and any available data to determine the composition and structure of restored forests based on expected long-term hydrologic conditions to develop site specific mitigation plans.

The following discusses the two alternatives carried forward for consideration. The PDT developed a conceptual design for feasibility level mitigation planning. Specific site design criteria would be part of PED. Bottomland hardwood forests are extremely variable and even a difference of a few inches of elevation can change the vegetative and hydrologic characteristics of an area; therefore, the level of detail here is broad in scope and leaves a lot of judgment in the hands of the PED team.

Alternative 1 – Mitigation Bank

The Three Rivers project area is in the Lower Arkansas watershed (HUC 08020401). The PDT used the USACE Regulatory In-lieu Fee and Bank Information Tracking

System (RIBITS) to identify potential mitigation banks. One bank, the Fourche Bayou Mitigation Bank, is situated the same HUC watershed and has a primary service area that encompasses the project site (Figure N-1). All wetland restoration activities, including subsequent management and monitoring will be the responsibility of the bank. Bottomland hardwood seedlings (bare-root) were planted by this mitigation bank on approximately 50 acres in 2016-17 to satisfy the restoration component. The Fourche Bayou Mitigation Bank currently has 70 wetland credits available and 210 additional credits scheduled for release over the next few years.

To determine the number of credits needed to fully mitigate the 4.4 FCU loss, the HGM model was used to calculate the FCIs/acre a BLH site would produce via the bare-root planting strategy used by the Fourche Bayou Mitigation Bank. Using performance standards established for this mitigation bank, and experience gained from restoring and monitoring thousands of acres of BLH forests in the Mississippi Alluvial Valley (MAV), a desired future condition was determined for the mitigation site (50 years post restoration). FCIs were then calculated for six growth periods: Year 0, 1, 5, 10, 25, and 50 to determine an average FCI gain.

The Fourche Bayou MB site is a mixture of BLH Flats, Riverine Backwater, and Unconnected Alluvial Depressions. For comparison purposes, the Low-Gradient Riverine Backwater FCI/FCU calculator was used to determine mitigation needs.

Google Earth was used to determine values for HGM Tract Data, including:

- Forest tract size (ha);
- Percent of wetland tract with minimum 100-m buffer from surrounding land uses;
- Percent of tract perimeter within 0.5 km of suitable habitats;
- Percent of the site capable of ponding water.

For plot-specific information by year, values for the following elements were estimated based on PDT staff experience with the planting and monitoring of over 200,000 acres of BLH restoration throughout the Lower Mississippi Alluvial Valley.

- Basal area;
- Tree density (dbh >10 cm);
- Snag density (standing dead trees at least 1.4 meters tall and dbh >10 cm);
- Soil (O and A Horizon thickness)
- Composition of tallest woody vegetation stratum;
- Shrub/Sapling density (# stems at least 1.4m tall, < 10 cm dbh)
- Ground cover vegetation (% cover all herbaceous plants and woody plants <1.4m tall, and
- Woody debris biomass (3 size ranges);

The HGM model uses this data to calculate FCIs for the six wetland functions associated with Low Gradient Riverine Backwater wetlands, then factors the number of site hectares to calculate the FCU.

For years 0, 1, and 5, the model produced FCIs for four wetland functions (detain precipitation, cycle nutrients, and exporting organic carbon). Because of the lack of larger vegetation on the restoration site in early years, no FCI was produced for "fish and wildlife habitat". Beginning with year 10, woody vegetation on the site would reach a size that would result in a FCI for "fish and wildlife habitat". For year 50, data collected from the project site (pre-project) was used, as this area is mature BLH forest. Specifically, data from plot #8 of the baseline HGM analysis was used to populate most of the site-specific values needed. This site was selected because it represents the best forest condition of all eleven sites sampled, and based on experience, is achievable for the mitigation site. We then annualized these results via IWR software to determine the number of hectares required to meet the FCU need. The results indicate that 7.8 ha (19.38 acres) would be needed to satisfy the FCU deficit.

Since mitigation banks sell credits, and not restored acres, it is necessary to convert the needed acres to mitigation credits. The Fourche Bayou MB wetland restoration site is approximately 20 ha (50 acres). An Interagency Technical Team (ITR), made up of resource agency professionals, approved 280 mitigation credits for the site.

Hectare - Credit Conversion*

~50 acres (mitigation site) = ~20 hectares

- 280 credits/20 hectares = 14 credits/hectare

Conversion: 14 credits/hectare X 7.8 hectares = 109 mitigation credits.

(*SWL Regulatory personnel concur with this conversion method).

The cost of mitigation credits vary widely. Banks near large metropolitan areas often charge more per credit due to demand. The Fourche Bayou Mitigation Bank is a new bank located near Little Rock, Arkansas. As of 2017, no credits have been purchased, thus a per-credit value has not been established. For planning purposes, the PDT determined a range of $4,600 - $4,700/wetland credit was reasonable. The total estimated cost for 109 wetland mitigation credits is $507,000.

Potential Risks: Two possible risks have been identified by the PDT at this time regarding selection of Alternative 1 as the preferred plan.

1) The Fourche Bayou Mitigation Bank is a new, relatively small bank located near Little Rock, Arkansas. As of 2017, no credits have been sold. Depending on when the Three Rivers Feasibility Study is approved and funds appropriated for construction, there is potential that the bank would no longer have sufficient credits to purchase.

2) As discussed elsewhere in this plan, the two alternatives are separated by only $45,000. The actual cost of mitigation credits could exceed the estimate, thereby making Alternative 2 (purchaser and restore) the least cost alternative.

In the event that cost or availability of mitigation credits necessitate switching to Alternative 2, a detailed planting and monitoring plan would be developed. An Adaptive Management Plan and modification to the Real Estate Plan would also be developed to accompany the revised Mitigation Plan.

Personnel Requirements: Wetland development, operations, and monitoring is the responsibility of the mitigation bank.

Timing of Operations: Wetland restoration was completed in 2016-17 (bottomland hardwood reforestation via bare-root planting).

Determination of Success: Mitigation banking instruments establish criteria for success and would be followed. The mitigation bank owner(s) is responsible for annual monitoring and reporting. USACE Regulatory personnel review annual reports and make annual inspections to ensure adherence to restoration and monitoring protocol outlined in the instrument.

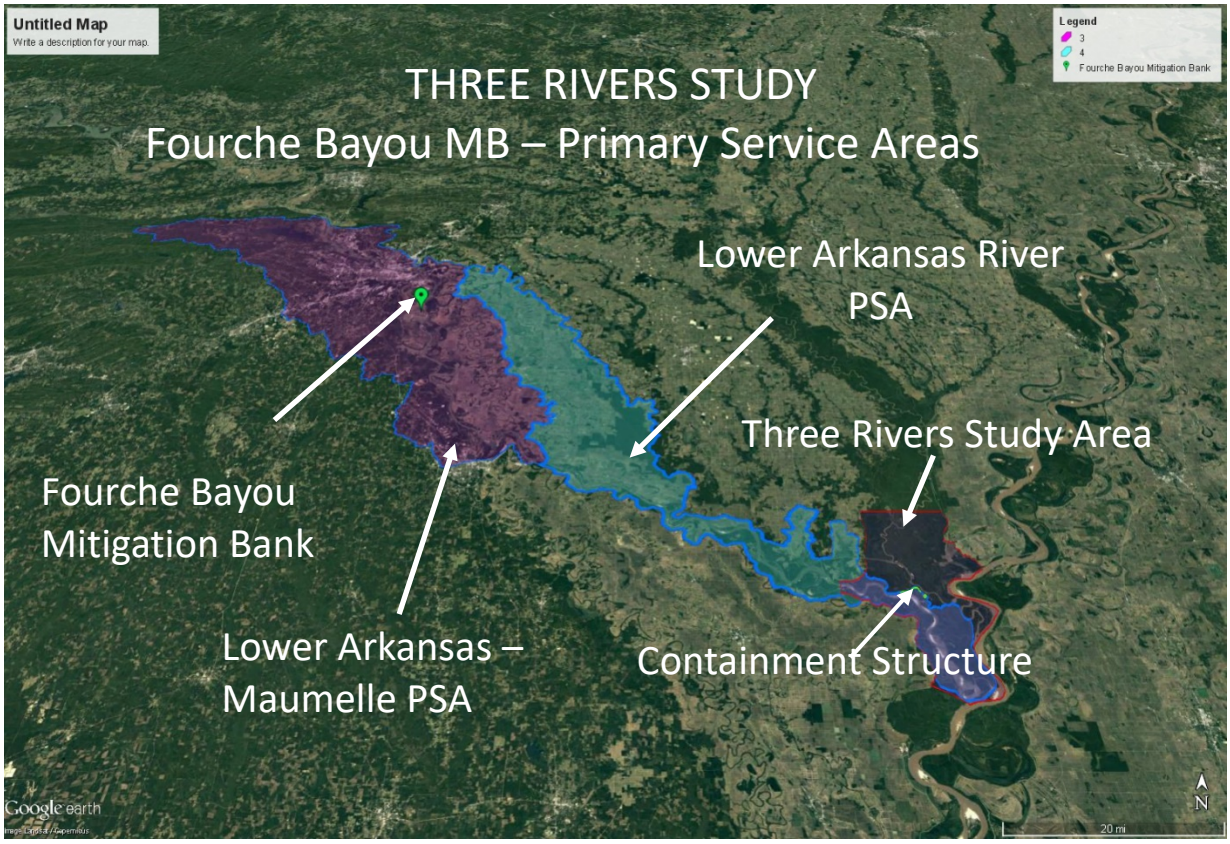

Figure N-1: Fourche Bayou Mitigation Bank - Primary Service Areas

Alternative 2 - Restoration of Agricultural/Fallow Lands

Bottomland hardwood forests consist of water tolerant trees and other plants that grow under moist soil conditions. Restoring the appropriate topography and hydrology to a fallow field would be critical to ensuring a successful restoration project. Hydrology is the most important factor affecting the distribution of tree species in their natural range. In areas where bottomland hardwoods are being restored. Matching site characteristics with tree species is critical. The natural hydrology of a site, soils, plant competition, domestic animals and wildlife such as beavers and insects, and disease can affect successful restoration. The length of time that a site holds water also affects survivability of tree species in this habitat, and relatively small changes in elevation can result in different tree communities inhabiting different locations vertically along streambanks.

Alternative 2 would restore a fallow field to forested wetlands (bottomland hardwoods and associated wetlands). During the last few decades, conservation organizations and agencies have successfully reforested thousands of acres of agricultural land in the Lower Mississippi Alluvial Valley (MAV). This extensive amount of experience has allowed organizations to modify and refine planting techniques to achieve maximum success. USACE would be responsible for the purchase of mitigation property, initial restoration of the site, and subsequent monitoring of the site to ensure the mitigation is successful. Once restoration is fully successful, USACE would convey the property to the FWS for long-term management (contingent on FWS concurrence).

Based on the experiences of the organizations, the PDT developed three scales of sub-alternatives for analysis:

- 2a - Plant bare-root bottomland hardwood seedlings on 10 by 10 spacing (435 trees per acre);

- 2b - Plant spiral-wrapped bottomland hardwood trees (advanced seedlings) on 12 by 12 spacing (302 trees per acre); and,

- 2c - Plant 3-gallon potted trees on 12 by 12 spacing (302 trees per acre).

The same methodology used for the mitigation bank alternative was employed to determine hectares needed to satisfy the FCU deficit created by project impacts. For each sub-alternative, we calculated FCUs for six growth periods: Year 0, 1, 5, 10, 25, and 50 to determine an average FCU gain.

For consistency purposes, the Low-Gradient Riverine Backwater FCI/FCU calculator was used to determine mitigation needs. For the purchase and restore alternative, a few assumptions were necessary:

- Land selected for purchase would either be cleared or fallow;
- Property would be adjacent to the Refuge (within their acquisition boundary);
- Restoration would include BLH planting (bare-root seedlings), and minimal microtopography work, if needed;

Using experience gained from the restoration of thousands of acres of BLH forests in the Mississippi Alluvial Valley (MAV), a desired future condition was determined for the mitigation site (50 years post restoration).

Google Earth was used to determine values for HGM Tract Data, including:

- Forest tract size (ha);
- Percent of wetland tract with minimum 100-m buffer from surrounding land uses;
- Percent of tract perimeter within 0.5 km of suitable habitats;
- Percent of the site capable of ponding water.

Plot-specific information was established similar to the method used for Alternative 1.

Annualized results via IWR software was used to calculate the number of mitigation acres required by sub-alternative to meet the FCU need. The results are:

- Bare-root seedling: **7.8 ha** (19.38 acres – rounded to 20);
- Spiral-wrapped **7.8 ha** (19.38 acres – rounded to 20); (these are only slightly larger than bare-root, thus we estimated a similar growth rate).
- 3-gallon trees **6.5 ha** (16.36 acres – rounded to 17)

IWR-PLANNING SUITE APPLICATION

The Three Rivers Mitigation Plan was selected using the certified IWR Planning Suite software (version 2.0.9 RC). The IWR Planning Suite uses a cost effectiveness incremental cost analysis (CE/ICA) module to weigh the costs of plans against their nonmonetary outputs. Mitigation alternatives 1 and 2 were both advanced for final screening with the IWR Planning Suite. Costs were entered into the Annualizer program in the year they are projected to occur. Table 3 lists estimated total restoration expense for each alternative, and Table 4 summarizes average annual equivalent monetary costs and average costs per unit for each mitigation alternative. As shown, Alternative 1 is the most cost effective plan.

Table 3: Estimated Costs for Mitigation, Monitoring and Adaptive Management by Alternative

	Alternative 1 Mitigation Bank	Alternative 2a Bare Roots (20 acres)	Alternative 2b Spiral Wrap (20 acres)	Alternative 2c 3-Gallon Potted Trees (17 acres)
Mitigation Bank $4,600 - $4,700 per credit	$507,000	-	-	-
Mitigation (restoration plus real estate at $3,500 per acre)	-	$332,000	$672,000	$672,500
Monitoring and Adaptive Management	Costs included in fees to mitigation bank	$220,000	$220,000	$220,000
TOTAL	**$507,000**	**$552,000**	**$892,000**	**$892,500**

Table 4: Total and Average Cost per Alternative

Alternative	Output (AAHUs)	Total Average Annual Equivalent Cost ($1000)	Average Cost per Unit of Output
Mitigation Bank	11	$507	$46
Bare Root Planting (20 acres)	11	$552	$50
Spiral Wrap Planting (20 acres)	11	$892	$81
3-Gal. Potted Trees (17 acres)	11	$892	$81

MONITORING AND ADAPTIVE MANAGEMENT

Monitoring and adaptive management would be the responsibility of the mitigation bank, thus a Monitoring and Adaptive Management Plan is not included in this document.