Mississippi Valley Division,
Regional Planning and Environment Division South

Hatchie Loosahatchie Mississippi River Ecosystem Restoration Study

Appendix 1 – Management Measures

February 2023

CONTENTS

Section 1

INTRODUCTION

1.1 MEASURES BY COMPLEX

Measures were originally created for the Hatchie-Loosahatchie Mississippi River Ecosystem Restoration Study following the development of potential actions to solve problems while meeting the study objectives. The original array of measures consisted of 207 across the 11 complexes. These measures were informed by previous studies and existing data provided by the NFS and other subject matter experts. These measures were investigated to determine the applicable benefits for model input. The investigation process considered the natural history and any available research of the study area. Information gathered for each s is included by complex and measure name in the sections below.

Through the data collection and evaluation process, measures were combined and/or scaled if feasible. Measures were also screened if they were deemed infeasible or if could be completed through other projects. Other measures were screened after background, planning, and habitat benefits were compiled. Measures were also screened during various rounds of the cost effectiveness and incremental cost analysis (CE/ICA). Prior to the completion of CE/ICA, an array of 83 measures remained following scaling and/or screening. Screening iterations are denoted in the Table 1-1 below and referenced for each measure in the respective measure description tables. Following the measure descriptions is the resource significance table.

Table 1-1: CE/ICA Screening Criteria

Screening Iteration	Description
Pre CE/ICA	Screening occurred during measure development and prior to cost effectiveness and incremental cost analysis (CE/ICA)
CE/ICA Round 1	Screening occurred during the first round of CE/ICA due to performance related to efficiency
CE/ICA Round 2	Screening occurred during the second round of CE/ICA due to performance related to efficiency
Final Array	Screening occurred during the final array upon selection of the TSP

Section 2

Brandywine Complex

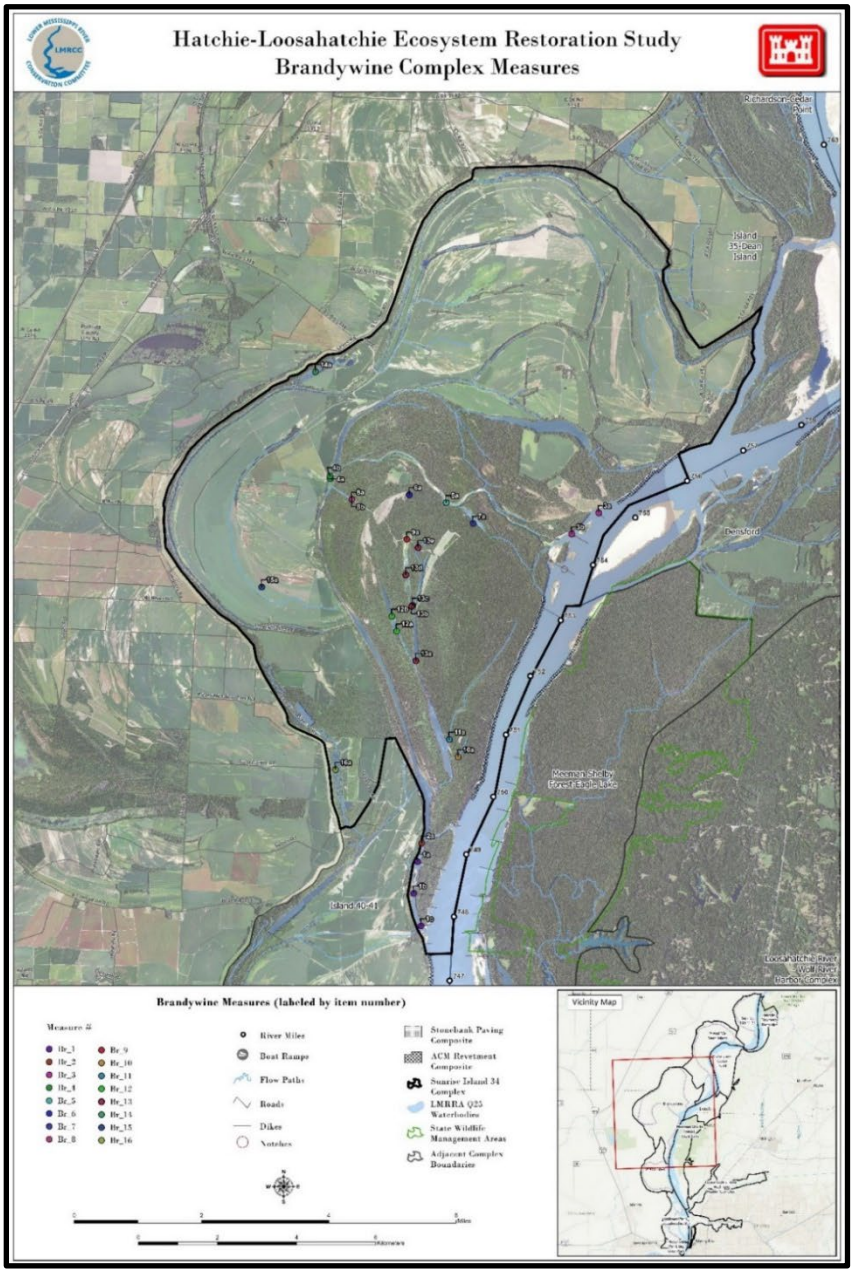


Figure 2-1 Brandywine Complex

2.1 BRANDYWINE (BR_1)

In 1953, a large unvegetated sandbar existed in the location of Poker Point (Guntren et al. 2016). After dike construction in 1959, the area just above Dike 3 at 748.0R had forested. Vegetation colonized the remainder of the current island area by 1988 (Guntren et al. 2016). The secondary channel now receives flow from Brandywine Chute and the main channel. Dike 1U is just upstream of the entrance to Poker Point secondary channel. This dike and Dike 1 (Br_1a) have naturally eroded notches while Dike 3 (Br_1c) was notched in 2015 to approximately +8 LWRP or 194.8 ft NGVD. Dike 2 (Br_1b) is a pile dike that has not been notched. The project team focused on the dikes within the channel because these dikes obstruct flow. The three dikes were categorized as items BR_1a, BR_01b, and BR_01c. Imagery suggests that the notch elevations in Dike 1 and Dike 2 are 192.1 ft and 191.9 ft (Oliver et al. 2016, Oliver unpublished). The river's elevation exceeded Dike 3 (highest obstruction) approximately 80.3% from 2010-2019. The project's river engineer felt that all three dikes could be lowered to a 0 ft. 2007 LWRP. There is sediment deposition especially below Dike 2. The PDT was uncertain if notching the dikes would produce sufficient velocity to remove this sediment. Sediment removal was included as an adaptive at year 5 after construction. If floods could scour the sediment, the team felt that there was good potential for a large flood to occur in 5 years. Alternatively, if sediment removal by scouring flows occurs incrementally during higher water events, this effect would be measurable after 5 years. BR_1 proposes to lower the existing notches in Poker Point.

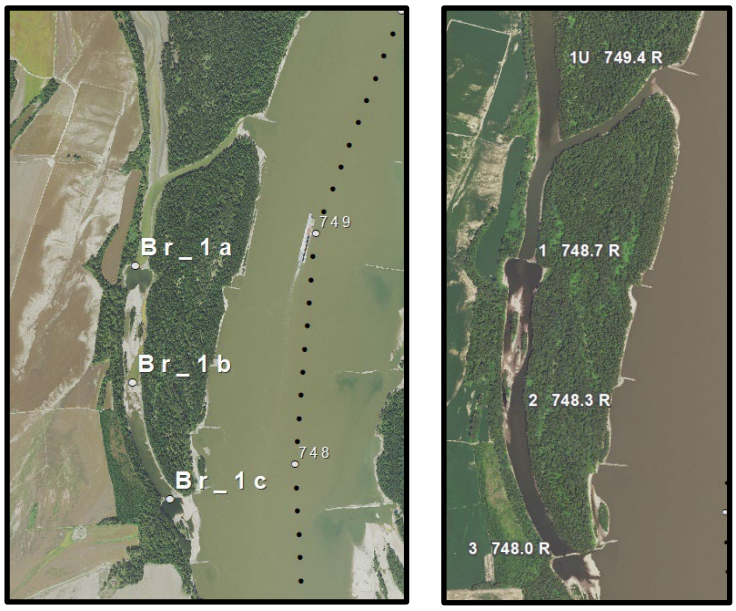


Figure 2-2. BR_1

Table 2-1: BR_1 Description

BR_1 Description of Features			
Measure Description	Dike Notching-Stone and Pile dikes		
Construction Activity	Dike Notching		
Model	Unidirectional		
Restoration Activity	Altering Connectivity		
Habitat	Secondary Channels (lotic aquatic)		
BR_1 Items			
Item	**Meets Objective**	**Notes**	**Screened**
BR_01a	2	Lower existing stone dike notch	No
BR_01b	2	Create notch in pile dike	No
BR_01c	2	Lower existing stone dike notch (at +8 LWRP TW 150' BW 50')	No
BR_1 Construction Assumptions			
BR_01a	Price based on most recent MATOC bid for notch, including contingency.		
BR_01b	Assumptions based off of a contractor's bid in MVS, including contingency since we are further downstream and varying channel conditions.		
BR_01c	Price based on most recent MATOC bid for notch, including contingency.		
BR_1 Real Estate Assumptions			
BR_01a	Assume work to be done in-channel below ordinary high watermark and/or incidental to construction costs contingencies.		
BR_01b			
BR_01c			
BR_1 OMRR&R Assumptions			
BR_01a	Stone Dike Notch O&M at year 30 estimated at 75% of construction cost.		
BR_01b	None		

BR_01c	Stone Dike Notch O&M at year 30 estimated at 75% of construction cost.
BR_1 Adaptive Management & Monitoring Assumptions	
BR_01a	Aquatic Bathymetric Survey - Rivers/Secondary Channels (A) at years 0,1,3,5,7,10 estimated at $450/mile; Fish & Invertebrate Surveys Monitoring - Bidirectional, Unidirectional, Isolation (A) at years 0, 3,5,7,10 estimated at $4167/event.
BR_01b	
BR_01c	

2.2 BRANDYWINE (BR_2)

Table 2-2: BR_2 Description

BR_2 Description of Features			
Measure Description	Woody Debris Traps		
Construction Activity	Woody Debris Traps		
Model	Wood Trap		
Restoration Activity	Aquatic Channel Enhancement		
Habitat	Secondary Channels (lotic aquatic)		
BR_2 Items			
Item-Feature	**Meets Objective**	**Notes**	**Screened**
BR_02a	2	Install woody debris traps to enhance invertebrate diversity in secondary channel.	No
BR_2 Construction Assumptions			
BR_02a	Costs estimated per ERDC and NFS based on Prairie Point assumed costs including contingency.		
BR_2 Real Estate Assumptions			
BR_02a	Assume work to be done in-channel below ordinary high watermark and/or incidental to construction costs contingencies.		

BR_2 OMRR&R Assumptions	
BR_02a	None
BR_2 OMRR&R Assumptions	
BR_02a	Aquatic Bathymetric Survey - Rivers/Secondary Channels (A) at years 0,1,3,5,7,10 estimated at $450/mile; Large Woody Debris Traps at years 1,3,5,7,10 estimated at $6000 per structure.

2.3 BRANDYWINE (BR_3)

BR_3 proposes to notch dikes to enhance flow around Corona Bar and into Brandywine Chute. The project team evaluated multiple options to enhance flow around Corona Bar and into Brandywine Chute. Item Br_3b was screened out prior to benefits evaluation because of navigation concerns. Item Br_3a was screened out during benefits evaluation because it did not measurably improve connectivity; its environmental benefits were difficult to predict; and it could be completed by other programs. The Corona Bar middle island between Dikes 1 and 2 vegetated between 1978 and 1988 after dike construction in 1970. The island developed from the sediments that deposited in the mouth of the historic bend which is now the present-day Brandywine Chute (Guntren et al. 2016). The upstream Dike 1U at 754.8R was constructed in 1995 and by 2007 the upper island between Dikes 1U and 1 was present and vegetated (Guntren et al. 2016). The upstream island can still be submerged during high water (NAIP 2012 – 2019) and as recent as 2020, flood waters submerged all but the tallest vegetation of all three islands.

The entrance to Brandywine Chute is narrow and nearly dry during low water (NAIP 2012, 2017). The secondary channel bed of Corona Bar's middle island has a large sediment deposit. There is an opportunity to direct more water into this area by increasing the depth and size of the notches in Dikes 1U (Br_3a) and 1 (Br_3b). This additional water could improve connectivity by increasing flows through Brandywine Chute and/or Corona Bar secondary channel and possibly scouring deposited sediment. There are navigation concerns in this area which were considered when finalizing this. The navigation channel flows along the Corona Bar dike tips and is confined by the sandbar on the opposite bank. There is a need to direct flow away from the dike tips for navigation safety.

Dike 1U was notched in 2015 with a planned top width of 100', bottom width of 50' and a 10ft depth. Dike 1 was re-notched to a planned top width of 160', bottom width of 50' and invert elevation of +0 ft LWRP (188.9 ft NAVD88). Imagery from 8October2021 at a water surface of 193.05 ft shows Dike 1U completely above water while Dike 1 notch is submerged (NAIP 2021). Imagery from 24August2017 at a water surface of 195.3 shows Dike 1U's notch submerged. This suggests that Dike 1U's notch is between 193.1 and 195.3; an elevation of 194 ft was used.

BR_3 proposes to widen the notch at Dike 1U. Because of navigation concerns, Dike 1 would remain unaltered. This could allow more flow into Corona Bar and Brandywine Chute while ensuring sufficient flows in the main channel for navigation. Flow exceeds the Dike 1U notch around 90% of days between 2010 and 2019. An elevation at or below 184.5 ft would be exceeded 100%.

Table 2-3: BR_3 Description

BR_3 Description of Features			
Measure Description	Dike Notching-Stone Dikes		
Construction Activity	Dike Notching		
Model	N/A		
Restoration Activity	Altering Connectivity		
Habitat	N/A		
BR_3 Items			
Item-Feature	**Meets Objective**	**Notes**	**Screened**
BR_03a	2	Increase notch top width from 100 ft to 150 ft (notch currently at 0 ft LWRP) in Dike 1U of Corona Bar. *Screening Criteria: Measure not affecting connectivity and seems better to accomplish through other programs.*	Yes – Pre CEICA
BR_03b	2	Deepen and widen existing notch (0 LWRP TW 160', BW 50') in Dike 1. Flow poor in 2012 image, dike renotched in 2015 by LMRCC. *Screening Criteria: Notch already at standard depth and dimensions.*	Yes – Pre CEICA
BR_3 Construction Assumptions			
BR_03a	Price based on most recent MATOC bid for notch, including contingency.		
BR_03b	None; notch determined to be at standard depth and dimensions.		
BR_3 Real Estate Assumptions			
BR_03a	Assume purchase of 150 aquatic acres of river channel for BR_03a.		

BR_03b	None; screened prior to real estate estimation.
BR_3 OMRR&R Assumptions	
BR_03a	Stone Dike Notch O&M at year 30 estimated at 75% of construction cost.
BR_03b	None; screened prior to OMRR&R estimation.
BR_3 Adaptive Management & Monitoring Assumptions	
BR_03a	Rivers/Secondary Channels (A) at years 0,1,3,5,7,10 estimated at $450/mile; Fish Surveys Monitoring - Velocity and Eddy at years 0, 3,5,7,10 estimated at $12000/event.
BR_03b	None; screened prior to Adaptive Management & Monitoring estimation.

2.4 BRANDYWINE (BR_4)

Brandywine Chute is a meander scarp that was forming in 1951. The main channel was abandoning historic Centennial Bend to cut across the point bar that became Brandywine Island (Simons et al. 1974). The historic Centennial Bend which was renamed Brandywine Chute is now 100 – 400 ft wide between its forested banks. In times of low water like October 2021, the aquatic area is less than 10 ft wide in places (NAIP 2021). The PDT felt that the bridge was acting as a grade control structure preventing channel bed elevation change in this degrading reach of the river (Biedenharn et al. 2017) and causing sediment deposition. For this measure, habitat benefits were generated for Br_4a. Item Br_4b is proposed to prevent impacts and maintain existing without project conditions. Project acreage is Brandywine Chute. Supplemental acreage included the adjacent main channel although all floodplain waterbodies which connect to Brandywine Chute would benefit.

This measure proposes to adjust the invert of the bridge (Br_4a) improving connectivity. The lower invert would also promote scouring flows and thus remove the unvegetated sediment throughout Brandywine further improving connectivity and channel longevity. Like Island 35 Chute, the invert of the Brandywine Chute bridge is unknown and was assumed to be the same as the nearby sediment deposit. The sediment deposit is dry/has very little water in the 8 October 2021 NAIP image and the corresponding water elevation is 192.5 ft. The invert of the bridge was assumed to be 192.5 ft which was exceeded 91.5% of the time from 2010 – 2019. An elevation of 184 ft would be exceeded 100% of the time.

With the lowering of the bridge invert, Brandywine's channel bed elevation will likely decrease (the channel will get deeper). McKenzie Chute is a large floodplain lake that connects to Brandywine. Water likely drains out of McKenzie Chute into Brandywine

during low water. If Brandywine's channel bed lowered, then the connection between Brandywine and McKenzie would also lower (maintaining connectivity). If Item Br_4a was constructed then at times of very low water, lake water levels would drop lower than current. There are tradeoffs between allowing naturally adjusting connectivity and the decrease in aquatic area that could occur during low water. For McKenzie Chute, the PDT felt that it was most important to maintain aquatic area by constructing a weir (Br_4b).

Even in the lowest water imagery (NAIP 2012, 2017, and 2021), there is a 20 – 30 ft channel connecting McKenzie Chute to Brandywine Chute. Therefore, the channel has a lower elevation bed than the bridge and sediment deposit. Connecting channels do not typically have steeply sloping banks. With a 30' wide channel and the deepest point at the channel's midpoint, a 3 ft deep channel would result in the 1:5 or 20% slope. Thus, the channel's invert may be around 189.5 ft. exceeded 95% of the time

BR_4 proposes to adjust the invert of the bridge (BR_04a) improving connectivity. The lower invert would also promote scouring flows and thus remove the unvegetated sediment throughout Brandywine further improving connectivity and channel longevity. This measure also proposes installation of a weir in McKenzie Chute to maintain connectivity.

Figure 2-3. BR_4

Table 2-4: BR_4 Description

BR_4 Description of Features

Measure Description	Meander Scarp Flow Restoration
Construction Activity	Bridge Replacement; Weir
Model	Unidirectional
Restoration Activity	Altering Connectivity
Habitat	Meander Scarp/tertiary channels (lotic aquatic)

BR_4 Items			
Item-Feature	**Meets Objective**	**Notes**	**Screened**
BR_04a	3	Lower bridge invert at the apex of Brandywine Chute to increase connectivity in meander scarp.	No
BR_04b	3	Install weir at the mouth of McKenzie Chute to prevent water levels from falling below existing lows (i.e., maintain this floodplain waterbody while restoring downstream meander scarp activities in Item BR_04a).	No

BR_4 Construction Assumptions	
BR_04a	Bridge Replacement cost based off of AR DOT bridge replacement assuming competitive bid contract, including contingency, same costs as Island 35 Bridge replacement.
BR_04b	R200 rock weir, 10ft crown, 1:1.5 side slopes, 80ft long.
BR_4 Real Estate Assumptions	
BR_04a	Assume purchase of 5 aquatic acres of woodlands for construction activities.
BR_04b	
BR_4 OMRR&R Assumptions	
BR_04a	None
BR_04b	Control structure O&M at year 30 estimated at 50% of construction cost.
BR_4 Adaptive Management & Monitoring Assumptions	
BR_04a	Aquatic Bathymetric Survey - Rivers/Secondary Channels (A) at years 0,1,3,5,7,10 estimated at $450/mile; Fish & Invertebrate Surveys Monitoring - Bidirectional, Unidirectional, Isolation (A) at years 0, 3,5,7,10 estimated at $4167/event.
BR_04b	

2.5 BRANDYWINE (BR_5)

BR_5a proposes to construct innovative bank protection or river training structures to enhance aquatic diversity while reducing bank erosion and sedimentation. The erosion may be contributing to the sediment deposit downstream in Brandywine Chute. During low water, this sediment can act as a dam preventing flow through the chute. Land managers have noted erosion along the island bank about 2 miles into Brandywine Chute. This erosion reduces the acreage of the large contiguous tract of valuable oak dominated bottomland hardwood forest growing on the island's highest ground by an estimated 0.04 acres per year (G. Earth 1997, 2021). Without the project, an additional 2 acres could erode over the project life. The erosion may also be contributing to the sediment deposit downstream in Brandywine Chute.

Because this measure reduces sedimentation that could impact the chute's flow, the aquatic project acreage includes Brandywine Chute. This effect on connectivity is less certain because the bank protection is a localized measure, therefore there is no supplementary acreage.

Figure 2-4. BR_5

Table 2-5: BR_5 Description

BR_5 Description of Features			
Measure Description	Hardpoint Bank Protection		
Construction Activity	Riprap Bank Protection		
Model	Eddy		
Restoration Activity	Aquatic Channel Enhancement		
Habitat	BLH (floodplain)		
BR_5 Items			
Item-Feature	**Meets Objective**	**Notes**	**Screened**
BR_05a	1 and 2	Install hardpoints to enhance aquatic diversity while reducing sedimentation and bank erosion within Brandywine Chute; qualitative benefits help to preserve the scarce oak dominated high ridge bankline (important for neotropical migrants such as Swansons Warblers).	No
BR_5 Construction Assumptions			
BR_05a	Riprap (river placement) 2,200 LF, 50ft strip, 2ft thick, R200. 2 acres of clearing for haul road.		
BR_5 Real Estate Assumptions			
BR_05a	Assume work to be done in-channel below ordinary highwater and/or incidental to construction cost contingencies.		
BR_5 OMRR&R Assumptions			
BR_05a	Riprap/river placement O&M at years 15, 30, 45 estimated at 25% of construction cost.		
BR_5 Adaptive Management & Monitoring Assumptions			
BR_05a	Aquatic Bathymetric Survey - Rivers/Secondary Channels (A) at years 0,1,3,5,7,10 estimated at $450/mile; Fish Surveys Monitoring - Velocity and Eddy at years 0, 3,5,7,10 estimated at $12000/event.		

2.6 BRANDYWINE (BR_6)

Brandywine Island was formed by the cutoff of a large point bar. The island's high elevation soils (yellow – brown) that form the natural levee and ridges are 1-25% hydric and sand to fine sandy loam (NWI, SSURGO). The lower elevation areas are all hydric and predominantly clay with some silty clay in the lowest areas (NWI, SSURGO). The highest ground supports a high-quality oak dominated bottomland hardwood forest. Within this forest, other more common floodplain forest species (cottonwood, sweetgum, willow, sycamore) compete with the hardwood trees. The dense forest canopy and competition also reduces and, in some cases eliminates, hardwood seedling growth. This measure proposes to girdle common floodplain forest trees and monitor seedling development to determine if planting additional oak species is needed (adaptive management). Elevations above 234.6 ft (71.5m) are unique to the area around Br_6a. A contour at this elevation was created, generalized and non-forest area removed to determine the tree girdling/benefit area (white outline on imagery). This measure would directly benefit the tree girdling area and provide supplemental benefits to the contiguous forest and beyond.

BR_6 proposes to girdle common floodplain forest trees and monitor seedling development to determine if planting additional oak species is needed (adaptive management). With this forest, other more common floodplain forest species (cottonwood, sweetgum, willow, sycamore) compete with the hardwood trees. The dense forest canopy and competition also reduces and, in some cases eliminates, hardwood seedling growth.

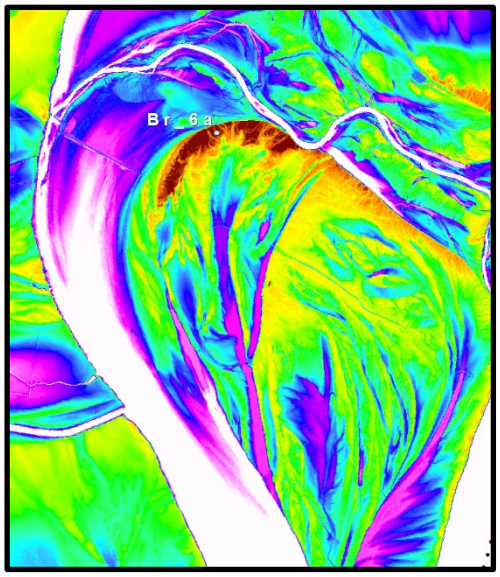


Figure 2-5. BR_6

Table 2-6: BR_6 Description

BR_6 Description of Features			
Measure Description	Forest Stand Improvement-BLH		
Construction Activity	Floodplain Vegetative		
Model	HGM		
Restoration Activity	Enhance and Restore Natural Vegetation		
Habitat	BLH (floodplain)		
BR_6 Items			
Item-Feature	**Meets Objective**	**Notes**	**Screened**
BR_06a	1	Create canopy gaps (tree girdling) and promote oak regeneration on Brandywine Island with additional oak planting. Enhance high ridge and scarce oak dominated habitat for neotropical migrants such as Swansons Warblers.	No

BR_6 Construction Assumptions	
BR_06a	HGM costs provided by ERDC.
BR_6 Real Estate Assumptions	
BR_06a	Assume purchase of 78 floodplain acres of woodlands.
BR_6 OMRR&R Assumptions	
BR_06a	None
BR_6 Adaptive Management & Monitoring Assumptions	
BR_06a	HGM AMM costs provided by ERDC.

2.7 BRANDYWINE (BR_7)

The lower elevation natural levee to the southeast of Br_6, contains some oak interspersed with abundant sweetgum. With additional light, the sandy 1-25% hydric soil above elevations of 227.5 ft (inundated < 14 days in 2017) may be suitable for river cane. This measure proposes to girdle sweetgum trees to promote rare river cane breaks and oak regeneration at and above elevations of 227.5ft (69.34m). The USGS 2014 elevation data were used to create a contour at this elevation and then a generalized outline created (white line in imagery) to determine the acreage. Seedling and root sprout development would be monitored to determine if additional treatment is needed (adaptive management). This measure would directly benefit the tree girdling area and provide supplemental benefits to the contiguous forest and beyond.

BR_7 proposes to girdle sweetgum trees to promote rare river cane breaks and oak regeneration. This forest area contains some oak interspersed with abundant sweetgum. Sweetgum is a common floodplain tree that can dominate forests with suitable soils. The trees produce abundant seeds and new trees can also develop from the roots of a parent tree (root sprouts) (Briscoe 1973). The dense forest canopy and competition reduces oak seedling growth and shades out river cane.

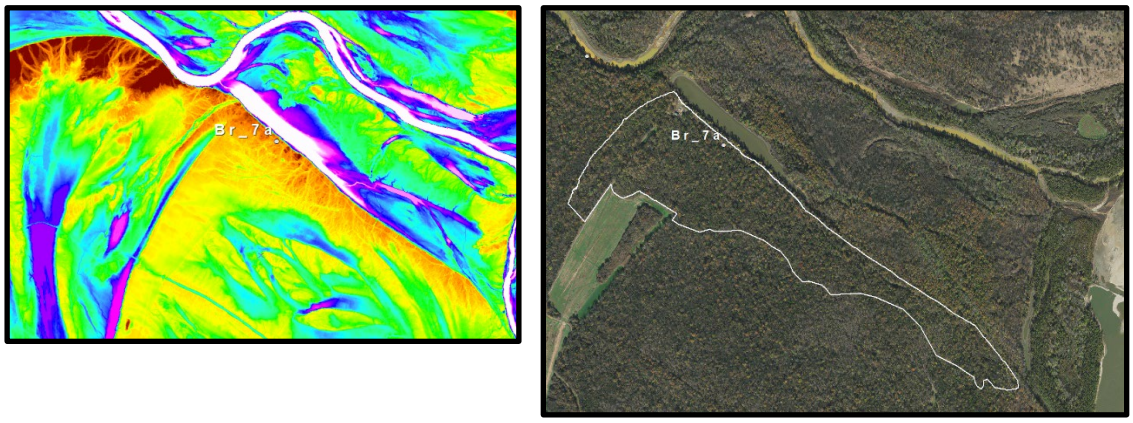


Figure 2-6. BR_7

Table 2-7: BR_7 Description

BR_7 Description of Features	
Measure Description	Forest Stand Improvement-BLH

Construction Activity	Floodplain Vegetative
Model	HGM
Restoration Activity	Enhance and Restore Natural Vegetation
Habitat	BLH (floodplain)

BR_7 Items			
Item-Feature	**Meets Objective**	**Notes**	**Screened**
BR_07a	1	Create canopy gaps (tree girdling) to promote river cane and some oak species on Brandywine Island for neotropical migrants such as Swansons Warblers. Adaptive management for control of sweet gum through herbicide or prescribed fire.	No

BR_7 Construction Assumptions	
BR_07a	HGM Costs provided by ERDC.
BR_7 Real Estate Assumptions	
BR_07a	Assume purchase of 196 floodplain acres of woodlands.

BR_7 OMRR&R Assumptions	
BR_07a	None
BR_7 Adaptive Management & Monitoring Assumptions	
BR_07a	HGM AMM costs provided by ERDC.

2.8 BRANDYWINE (BR_8)

The main road that provides access to the island's interior and infrastructure runs perpendicular to the historic old channels that flow across the island. The old channel bed is approximately 213.2 ft upstream and 211.3 ft downstream of the road. The road bed ranges from 218.3 – 220.8 ft. The three 48" culverts that allow water to pass under the road are undersized and perched. The project team assumed their elevation was around 214.5 ft. The elevated road and undersized culverts pond water and increase sediment deposition upstream. This promotes water and disturbance tolerance, conditions favored by non-native invasive and common species. The project team considered replacing the

existing set of three 48” culverts with box culverts (Br_8b) or an approximately 330’ low water crossing (Br_8a). The low water crossing was eliminated from further consideration because it would make the privately owned island inaccessible during times of high water. Box culverts with an invert around 213 ft. would facilitate water and sediment movement across the floodplain. This would allow less water tolerant species to thrive in the sandy 1-25% hydric soil promoting rare forest species. The project acreage was any ground upstream of the culverts with an elevation at or below the current road low elevation of 218.3 ft. The larger box culverts with lower invert will increase the rate that this land dries out and prevent water from ponding on land below the current culvert invert of 214.5 ft.

BR_8 proposes to replace three undersized and perched culverts with box culverts which would facilitate water and sediment movement across the floodplain to prevent water from ponding on land below the current culverts.

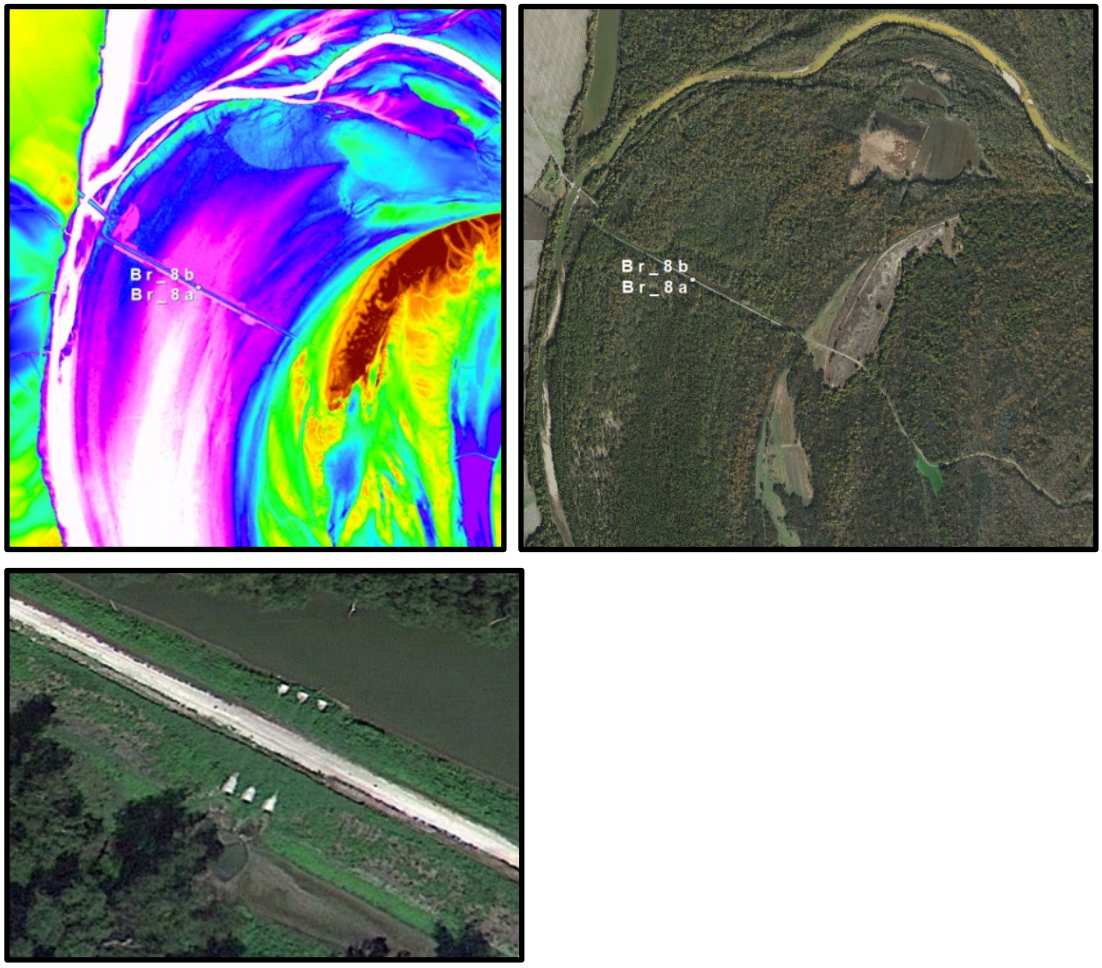


Figure 2-7. BR_8

Table 2-8: BR_8 Description

BR_8 Description of Features	
Measure Description	Forest Stand Improvement - BLH
Construction Activity	Floodplain Vegetative; Culverts
Model	HGM
Restoration Activity	Enhance and Restore Natural Vegetation

Habitat		BLH (floodplain)	
BR_8 Items			
Item-Feature	**Meets Objective**	**Notes**	**Screened**
BR_08a	1	Replace three 48in culverts with 330ft low water crossing to reduce ponding in upstream forest to promote mast producing trees and neotropical migrants. *Screening Criteria: Bridge/culvert under road connects parts of slough.*	Yes – Pre CEICA
BR_08b	1	Replace three 48in culverts with a 6x3 box culvert to facilitate debris passage to reduce ponding in upstream forest; includes additional plantings to promote mast producing trees and neotropical migrants (41 acres planting ~ 20% of total benefit acreage).	No
BR_8 Construction Assumptions			
BR_08a		None; bridge/culvert under road connects parts of slough.	
BR_08b		Replace three 48in culverts with box culvert(s) or structure(s) facilitate debris passage to reduce ponding in upstream forest to promote mast producing trees and neotropical migrants. Install a 6x3 concrete box culvert, place aggregate road surface. HGM costs provided by ERDC.	
BR_8 Real Estate Assumptions			
BR_08a		None; screened prior to real estate estimation.	
BR_08b		Assume purchase of 207 floodplain acres of woodlands.	
BR_8 OMRR&R Assumptions			
BR_08a		None; screened prior to OMRR&R estimation.	
BR_08b		Box culvert blockage removal O&M at years 10, 20, 30, 40 estimated at $3000 per structure.	
BR_8 Adaptive Management & Monitoring Assumptions			
BR_08a		None; screened prior to AMM estimation.	
BR_08b		HGM AMM costs provided by ERDC.	

2.9 BRANDYWINE (BR_9)

As the main access road continues east from Br_8 into the island interior, it cuts across additional historic channel paths. At the location of Br_9a, imagery suggests three approximately 2ft diameter culverts have been installed (G. Earth 2021, 2015). The road bed in this area ranges from 219.1 to 221.5 ft. Site managers indicate that the culverts are undersized and water ponds on the north (upstream) side of the road. This is supported by multiple years of imagery showing water on both sides of the road (NAIP 2016, 17,19, & 21: G. Earth 2013, 2015, and 2021) and a 1ft higher water surface elevation upstream of the road than downstream in the elevation data (USGS 2014). The project team saw an opportunity to improve water movement and fish passage and reduce operations and maintenance by replacing the existing culverts with box culvert(s) at a lower invert. Since the area was flooded when the elevation data were acquired, the culvert and historic channel elevations are unknown. The slope of the shore and the length of flooded area can sometimes be used to estimate depth. This assumes that the submerged channel bed has a slope similar to the adjacent bare ground slope and for this location, the deepest point of the channel is against the road. Using this method, the calculated channel bed was 214.6 ft (65.4m). Since the water surface was a foot different, we assumed the downstream channel bed was 213.6 ft. The project acreage was any ground upstream of the culverts with an elevation at or below the current road low elevation of 219.1 ft. The supplemental acreage was the adjacent forest.

BR_9 proposes to replace existing culverts with box culvert(s) at a lower invert. Site managers indicate that the culverts are undersized and water ponds on the north (upstream) side of the road. A box culvert(s) will improve water movement and fish passage and reduce operations and maintenance of replacing culverts.

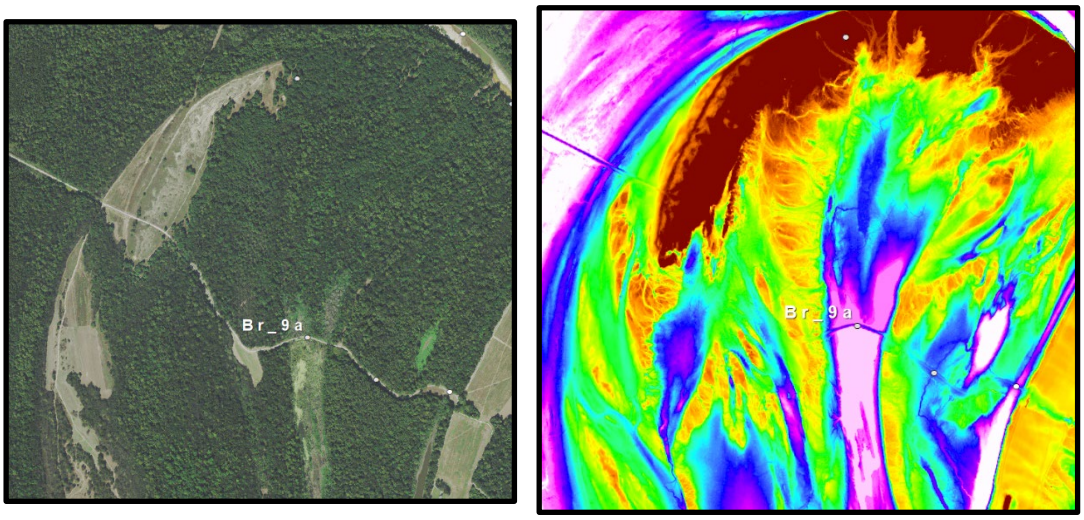


Figure 2-8. BR_9

Table 2-9: BR_9 Description

BR_9 Description of Features			
Measure Description	Forest Stand Improvement - BLH		
Construction Activity	Floodplain Vegetative; Culverts		
Model	HGM		
Restoration Activity	Enhance and Restore Natural Vegetation		
Habitat	BLH (floodplain)		
BR_9 Items			
Item-Feature	**Meets Objective**	**Notes**	**Screened**
BR_09a	1	Replace three culverts with structure(s) that maintain road elevation while reducing ponding in upstream forest to promote mast producing trees and neotropical migrants (includes 15 acres planting).	Yes – CEICA Round 1

		Screening criteria: first iteration of CEICA showed poor performance.	
BR_9 Construction Assumptions			
BR_09a	Install 6x3 concrete box culverts, place aggregate road surface; HGM costs provided by ERDC.		
BR_9 Real Estate Assumptions			
BR_09a	Assume purchase of 15 floodplain acres of woodlands.		
BR_9 OMRR&R Assumptions			
BR_09a	Box culvert blockage removal O&M at years 10, 20, 30, 40 estimated at $3000 per structure.		
BR_9 Adaptive Management & Monitoring Assumptions			
BR_09a	HGM AMM costs provided by ERDC.		

2.10 BRANDYWINE (BR_10)

Many of the old channels that cross Brandywine Island have obstructions that block their flow before they connect to the southern leg of Brandywine Chute. There is a two-track road that crosses the flow path of a historic slough near the southeast corner of Brandywine Island. This road appears to have an undersized and perched culvert which reduces connectivity and creates adverse hydraulic conditions. This measure proposes to replace this culvert with a fish friendly structure with a lower invert. The acreage for this measure is the upstream slough.

BR_10 proposes to replace a culvert with a fish friendly structure at a lower invert. The existing culvert appears to be undersized and perched which reduces connectivity and creates adverse hydraulic conditions.

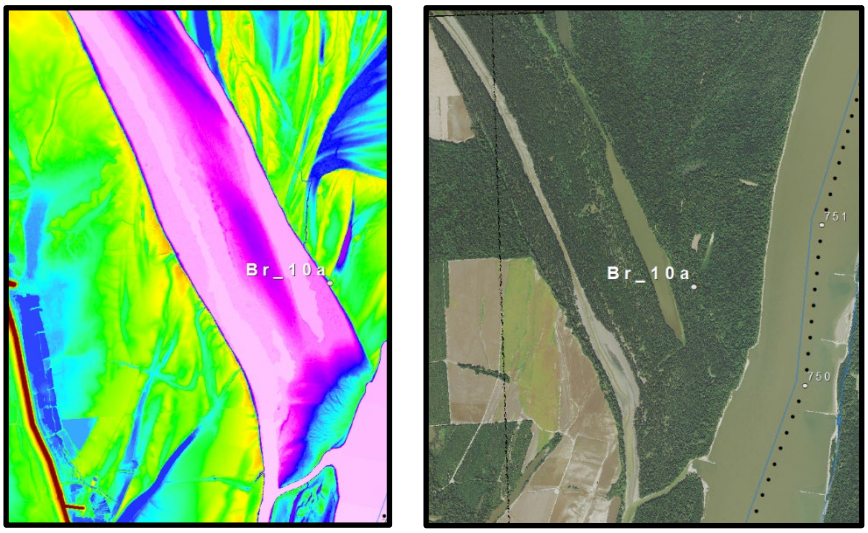


Figure 2-9. BR_10

Table 2-10: BR_10 Description

BR_10 Description of Features			
Measure Description	Flow Restoration to Backwater Slough		
Construction Activity	Culverts; Riprap Bank Protection		
Model	Bidirectional		
Restoration Activity	Altering Connectivity		
Habitat	Slough (lentic aquatic)		
BR_10 Items			
Item-Feature	**Meets Objective**	**Notes**	**Screened**
BR_10a	3	Install control structure (culvert) to increase connectivity to a slough in the southeast corner of Brandywine Island.	Yes – CEICA Round 1

		Screening Criteria: First iteration of CEICA showed poor performance.	
BR_10 Construction Assumptions			
BR_10a	36in CMP 125 linear ft. R200 riprap inlet and outlet protection (73.5 tons).		
BR_10 Real Estate Assumptions			
BR_10a	Assume purchase of 2 aquatic acres of woodlands.		
BR_10 OMRR&R Assumptions			
BR_10a	Culvert O&M at year 30 estimated at 100% of construction cost; riprap O&M at years 15, 30, 45 estimated at 50% of initial construction cost		
BR_10 Adaptive Management & Monitoring Assumptions			
BR_10a	Aquatic Lidar Surveys (ROV)- Small Channels (A) at years 0,7 estimated at $2400/event; Fish & Invertebrate Surveys Monitoring - Bidirectional, Unidirectional, Isolation (A) at years 0, 3,5,7,10 estimated at $4167/event.		

2.11 BRANDYWINE (BR_11)

Just above and on the other side of a natural levee from Br_10, a 5’ diameter steel pipe with an invert around 211 ft. connects to and drains Brandywine Island’s southeastern hydric clay soil interior. During low level floods, water backs up through this pipe inundating the interior forest. This inundation promotes the growth of water tolerant species. If the pipe and its manmade channel were not present, river water would have to reach 220.6 ft before flowing into Brandywine Island’s southeastern interior. There is an opportunity to install a downstream flap gate on this pipe which would allow interior water to drain out but prevent water from backing up through the pipe. This would reduce the frequency of interior flooding promoting less common species with lower inundation tolerance. In 2017, the river exceeded 211 ft. approximately 88 days and 220.6 ft. around 24 days. The acreage for this measure is the interior land < 220.6 ft and supplementary acreage is any forest adjacent to this low-lying forest.

BR_11 proposes to install a downstream flap gate on culvert pipe to allow interior water to drain out but prevent water from backing up through the pipe.

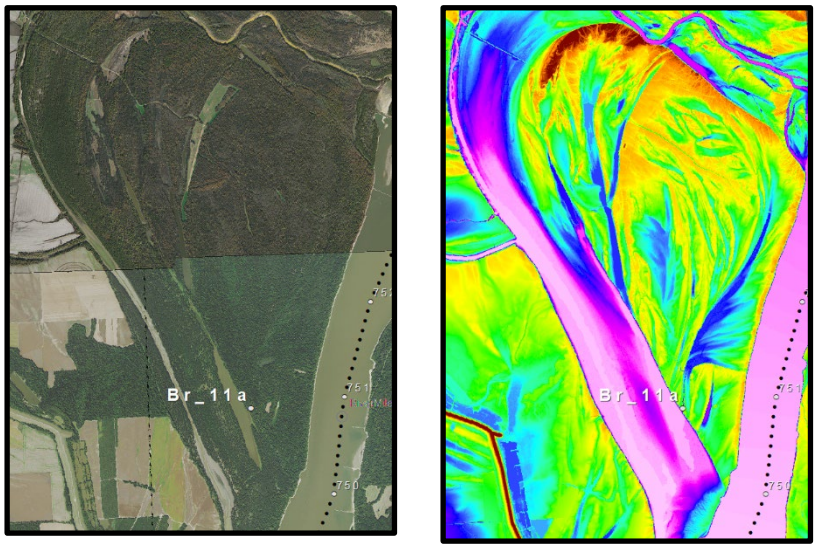


Figure 2-10. BR_11

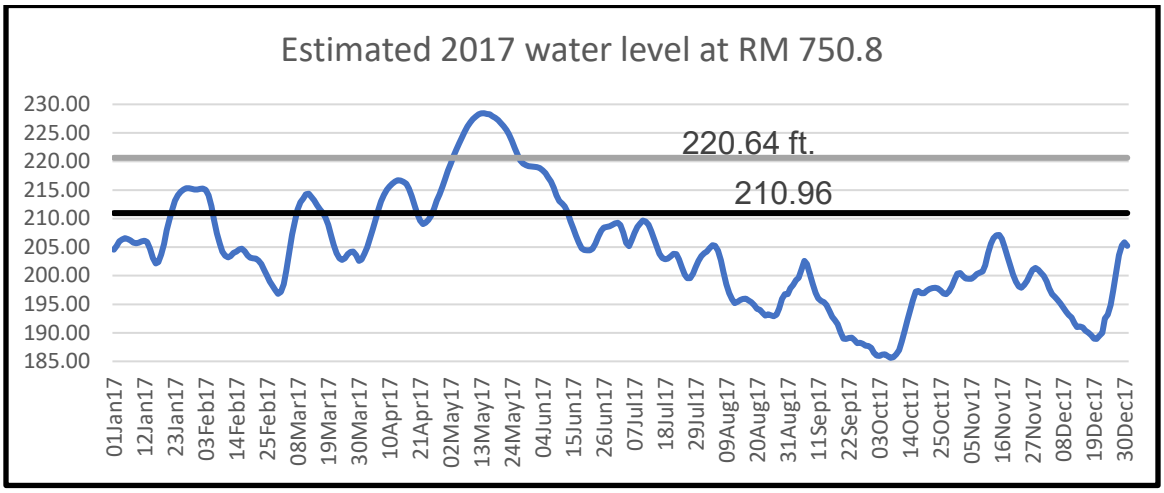


Figure 2-11. BR_11 Water Level

Table 2-11: BR_11 Description

BR_11 Description of Features			
Measure Description	Forest Stand Improvement-BLH		
Construction Activity	Floodplain Vegetative; Culverts		
Model	HGM		
Restoration Activity	Enhance and Restore Natural Vegetation		
Habitat	BLH (floodplain)		
BR_11 Items			
Item-Feature	**Meets Objective**	**Notes**	**Screened**
BR_11a	1	Install flap gate on existing thick steel culvert (5ft diameter) which drains the southeastern 1/3 of Brandywine Island to reduce forest inundation frequency and promote mast producing trees; includes additional plantings to promote mast producing trees and neotropical migrants (120 acres planting ~ 20% of total benefit acreage).	No
BR_11 Construction Assumptions			
BR_11a	Install 60in (assumed culvert diameter) aluminum flap gate. HGM costs provided by ERDC.		
BR_11 Real Estate Assumptions			
BR_11a	Assume purchase of 600 floodplain acres of woodlands.		
BR_11 OMRR&R Assumptions			
BR_11a	Aluminum flap gate O&M at year 30 estimated at 100% of initial construction cost.		
BR_11 Adaptive Management & Monitoring Assumptions			
BR_11a	HGM AMM costs provided by ERDC.		

2.12 BRANDYWINE (BR_12)

A series of floodplain lakes connect to Brandywine Chute along the southwestern edge of the island. One set of lakes parallels the chute path (Br_12) while a second set branches off into the island's interior (Br_13). There are berms, possibly with water control structures or culverts, around the lower end of the lakes within this measure. This measure proposes to alter the structures or berms to improve connectivity and fish passage. These lakes currently connect about 35% of days from 2010 - 2019. The acreage for this measure is the sloughs whose connectivity would be enhanced supplemented by Brandywine Chute and the main channel.

BR_12 proposes to alter the structures or berms around the lower end of the floodplain lakes along the southwestern edge of the Brandywine Island. This would improve connectivity and fish passage between the floodplain lakes and Brandywine Chute.

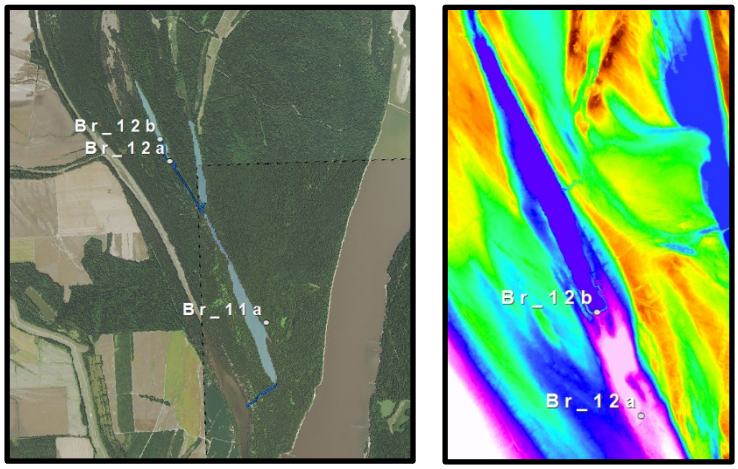


Figure 2-12. BR_12

Table 2-12: BR_12 Description

BR_12 Description of Features	
Measure Description	Flow Restoration to Backwater Slough
Construction Activity	Earthwork; Culverts; Riprap Bank Protection
Model	Bidirectional

Restoration Activity		Altering Connectivity	
Habitat		Slough (lentic aquatic)	
BR_12 Items			
Item-Feature	**Meets Objective**	**Notes**	**Screened**
BR_12a	3	Cleanout channel to improve connectivity to sloughs adjacent and parallel to the downstream leg of Brandywine Chute.	No
BR_12b	3	Improve connectivity to sloughs adjacent and parallel to the downstream leg of Brandywine Chute by replacing and lowering invert of culvert to increase connectivity.	No
BR_12 Construction Assumptions			
BR_12a		Assumed excavation of 5ft depth for 3 acres and 3 acres of clearing.	
BR_12b		Culvert replacement. Two-36in CMP 150 ft long, 174-ton R200 riprap for inlet and outlet protection.	
BR_12 Real Estate Assumptions			
BR_12a		Assume purchase of 25 aquatic acres of woodlands and 6 floodplain acres of woodlands.	
BR_12b			
BR_12 OMRR&R Assumptions			
BR_12a		Channel cleanout O&M at years 15, 30, 45 estimated at 25% of initial construction cost.	
BR_12b		Culvert O&M at year 30 estimated at 100% of construction cost; riprap O&M at years 15, 30, 45 estimated at 50% of initial construction cost.	
BR_12 Adaptive Management & Monitoring Assumptions			
BR_12a		Aquatic Lidar Surveys (ROV)- Small Channels (A) at years 0,7 estimated at $2400/event; Fish & Invertebrate Surveys Monitoring - Bidirectional, Unidirectional, Isolation (A) at years 0, 3,5,7,10 estimated at $4167/event.	
BR_12b			

2.13 BRANDYWINE (BR_13)

The sloughs included in Measure Br_13 branch off the flow path that connects to Br_12. These lakes lie in the old channel paths that flow across Brandywine Island. This includes modifying or removing five obstructions to improve connectivity to these interior sloughs.

With the current obstructions and culverts, these sloughs connect from 11 – 33% of the time.

BR_13 proposes to modify or remove five obstructions to improve connectivity to interior Brandywine Island sloughs.

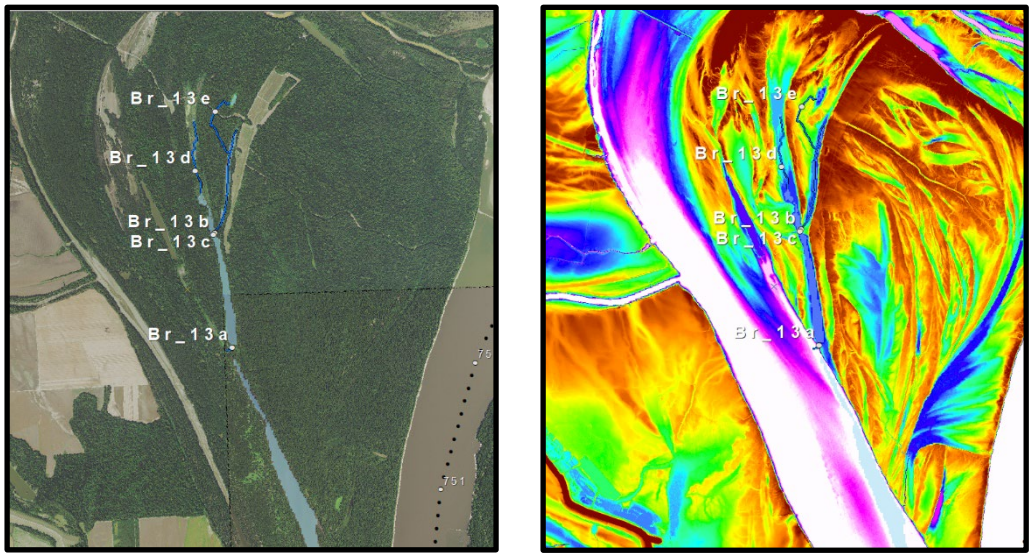


Figure 2-13. BR_13

Table 2-13: BR_13 Description

BR_13 Description of Features			
Measure Description	Flow Restoration to Backwater Slough		
Construction Activity	Culverts; Riprap Bank Protection; Earthwork		
Model	Bidirectional		
Restoration Activity	Altering Connectivity		
Habitat	Slough (lentic aquatic)		
BR_13 Items			
Item-Feature	**Meets Objective**	**Notes**	**Screened**

BR_13a	3	Install culvert to improve connectivity to sloughs which branch off toward the island interior from those in measure Br_12. *Screening Criteria: screened in final array of alternatives.*	Yes – Final Array
BR_13b	3	Install culvert to improve connectivity to sloughs which branch off toward the island interior from those in measure Br_12. *Screening Criteria: screened in final array of alternatives.*	
BR_13c	3	Channel cleanout to improve connectivity to sloughs which branch off toward the island interior from those in measure Br_12. *Screening Criteria: screened in final array of alternatives.*	
BR_13d	3	Channel cleanout to improve connectivity to sloughs which branch off toward the island interior from those in measure Br_12. *Screening Criteria: screened in final array of alternatives.*	
BR_13e	3	Install culvert to improve connectivity to sloughs which branch off toward the island interior from those in measure Br_12. *Screening Criteria: screened in final array of alternatives.*	

BR_13 Construction Assumptions	
BR_13a	Assumed three 36in CMP 250 ft long and 109-ton R200 inlet and outlet protection.
BR_13b	Three 36in CMP 40 ft long and 109 tons of R200.
BR_13c	Assumed excavation of 200 CY and 1 acre of clearing.
BR_13d	Channel cleanout. 862,406 sq ft, assume 2ft depth based on profile - 63,882 CY; 19.8 acres clearing, including mobilization/demobilization.

BR_13e	100 LF 60in Culvert; assume 8ft channel bottom for 400 LF and 6ft depth (1,780 CY). 100 TN of inlet/outlet protection and road resurfacing for R-125.
BR_13 Real Estate Assumptions	
BR_13a	Assume purchase of 80 aquatic acres of woodlands and 20.8 floodplain acres of woodlands.
BR_13b	
BR_13c	
BR_13d	
BR_13e	
BR_13 OMRR&R Assumptions	
BR_13a	Culvert O&M at year 30 estimated at 100% of construction cost; riprap O&M at years 15, 30, 45 estimated at 50% of initial construction cost.
BR_13b	Culvert O&M at year 30 estimated at 100% of construction cost; riprap O&M at years 15, 30, 45 estimated at 50% of initial construction cost.
BR_13c	Excavation O&M at years 15, 30, 45 estimated at 25% of initial construction cost.
BR_13d	Channel cleanout O&M at years 15, 30, 45 estimated at 25% of initial construction cost.
BR_13e	Culvert O&M at year 30 estimated at 100% of construction cost; riprap O&M at years 15, 30, 45 estimated at 50% of initial construction cost.
BR_13 Adaptive Management & Monitoring Assumptions	
BR_13a	Aquatic Lidar Surveys (ROV)- Small Channels (A) at years 0,7 estimated at $2400/event; Fish & Invertebrate Surveys Monitoring - Bidirectional, Unidirectional, Isolation (A) at years 0, 3,5,7,10 estimated at $4167/event.
BR_13b	
BR_13c	
BR_13d	
BR_13e	

2.14 BRANDYWINE (BR_14)

These borrow areas have been present since at least 1985 (G. Earth) and are likely very shallow.

BR_14 proposes to enhance the aquatic area of borrow pits by increasing depth following environmental design of borrow area recommendations. Levee borrow areas are typically constructed with a flat bottom and gently sloping sides. Overtime, sediment accumulates and the borrow areas become shallower. This would increase habitat complexity to the borrow areas.

Figure 2-14. BR_14

Table 2-14: BR_14 Description

BR_14 Description of Features			
Measure Description	Restoring Habitat Complexity in Borrow Area		
Construction Activity	Earthwork		
Model	Borrow Floodplain		
Restoration Activity	Waterbody Enhancement		
Habitat	Borrow Areas (lentic aquatic)		
BR_14 Items			
Item-Feature	**Meets Objective**	**Notes**	**Screened**

BR_14a	3	Deepen and create habitat complexity in series of borrow pits (47 acres of permanent waterbodies mapped from Q25 waterbodies v7). *Screening Criteria: First iteration of CEICA showed poor performance. Geotech indicated sandy soils and potential seepage concerns.*	Yes – CEICA Round 1

BR_14 Construction Assumptions	
BR_14a	Estimate is based on excavating with no haul. Assumed depth of excavation 5ft. Survey is required to determine current borrow pit depth. Full borrow pit analysis will be required to verify the allowable excavation depth based on seepage conditions at each borrow pit. This could lead to the borrow pits not being able to be excavated at all or being able to be excavated more than 5ft. 232,320 CY (75% of the borrow area.)
BR_14 Real Estate Assumptions	
BR_14a	Assume purchase of 47 aquatic acres of woodlands.
BR_14 OMRR&R Assumptions	
BR_14a	Borrow excavation and unwatering O&M at year 30 estimated at 12.5% of initial construction cost.
BR_14 Adaptive Management & Monitoring Assumptions	
BR_14a	Fish Surveys - Borrow Areas at years 0,3,5,7,10 estimated at $5455/event.

2.15 BRANDYWINE (BR_15)

Willow Lake's historic lakebed is currently farmed. A channel has been dug down the middle of the lakebed to speed drainage. The agricultural drainage channel flows through a structure under a road and into Brandywine Chute with an invert around 204.7 ft. This invert elevation provides good connectivity for spring spawning and rearing of fishes if it is ungated. The drainage channel has no forested buffer and likely moves considerable sediment and nutrients. There is sediment deposition in Brandywine Chute from the point where the Willow Lake drainage enters to the downstream mouth, approximately 20,000 ft. Google Earth imagery shows that the Willow Lake area was farmed in 1985 while a 1962 topographic map illustrates the lake.

There is an opportunity to restore the historic lake area which would reduce sediment and nutrient influx into Brandywine Chute (a rare Meander Scarp), restore seasonally flooded herbaceous habitat in an area identified as high quality for Alligator Gar spawning, and improve fish passage in Brandywine Chute. The project team proposes to restore the more frequently flooded area adjacent to the drainage channel to herbaceous wetland. As the elevation increases, the planting would transition to natural succession of buttonbush and bottomland forest. The boundary for restoration was developed from the satellite imagery inundated area when the river is at or below a 50% discharge. This area was modified to include the upstream channel that brings water into Willow Lake and the downstream channel that connects to Brandywine Chute to enable better control of sediment and chemical inputs and water input/output. The east and west edges were also smoothed and modified to follow existing roads. This modified boundary represents the benefits acreage.

BR_15 proposes to restore the more frequently flooded area adjacent to the drainage channel to herbaceous wetland. This would reduce sediment and nutrient influx into Brandywine Chute (a rare meander scarp), restore seasonally flooded herbaceous habitat in an area identified as high quality for Alligator Gar spawning, and improve fish passage in Brandywine Chute.

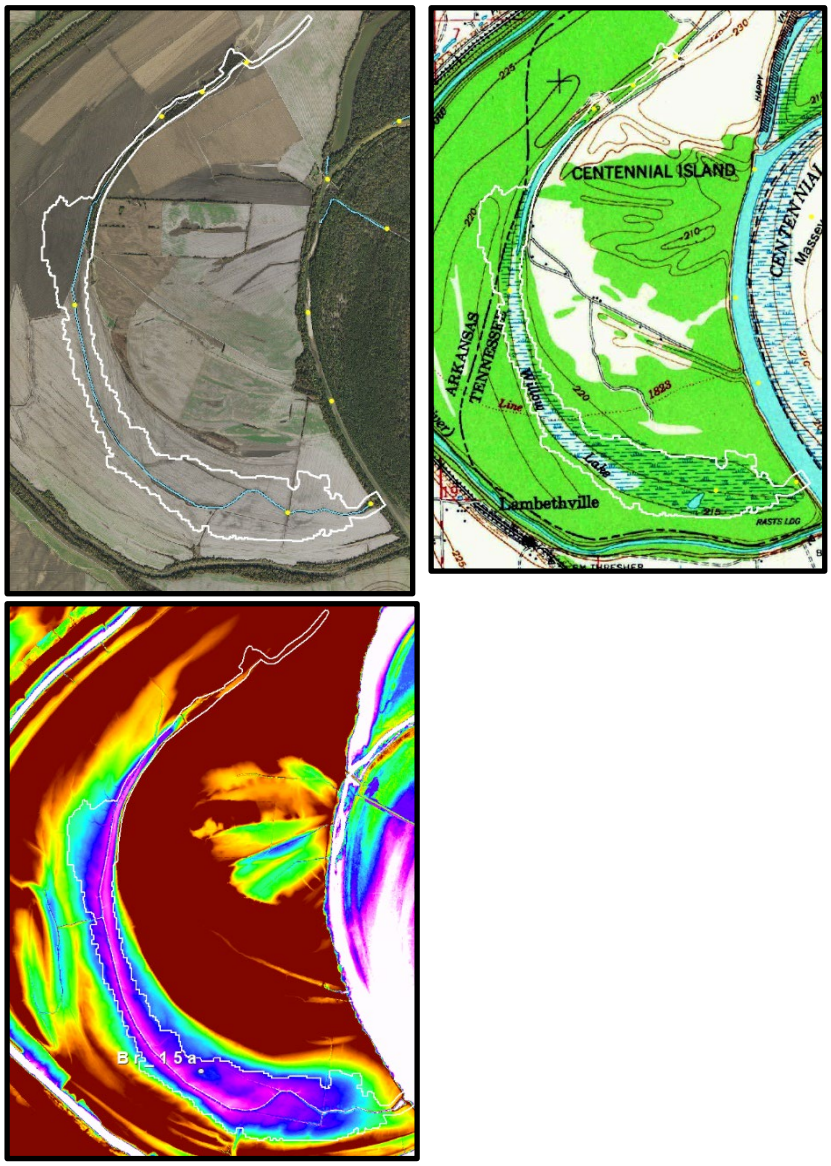


Figure 2-15. BR_15

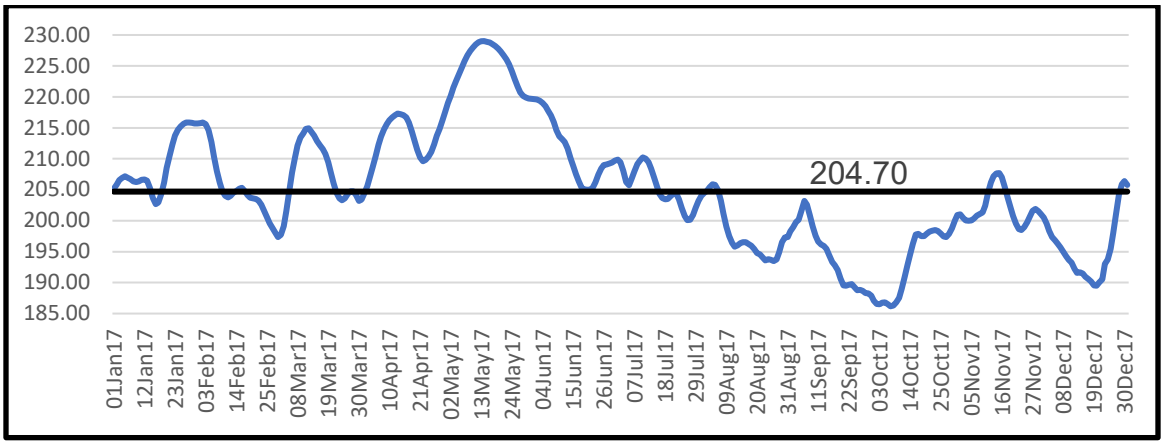


Figure 2-15. BR_15 Water Level

Table 2-15: BR_15 Description

BR_15 Description of Features			
Measure Description	Wetland Complex Restoration		
Construction Activity	Floodplain Vegetative		
Model	HGM		
Restoration Activity	Enhance and Restore Natural Vegetation		
Habitat	Seasonally herbaceous wetland (aquatic & floodplain)		
BR_15 Items			
Item-Feature	**Meets Objective**	**Notes**	**Screened**
BR_15a	1 and 3	Convert low elevation frequently flooded agriculture field (583 acres) which was historically the bed of Willow Lake to seasonally herbaceous wetland (rare habitat type), Alligator Gar spawning habitat (per USFWS HSI) and to reduce sediment and nutrient influx into Brandywine Chute; includes transitioning from 60% seasonally herbaceous wetland plantings to 10% scrub/shrub through natural succession to 30% BLH plantings. *Screening Criteria – Second iteration of CEICA showed poor performance. Much of this measure is on existing NRCS*	Yes – CEICA Round 2

		easements and likely could be better accomplished through other programs. Measure is located on Tennessee lands on the opposite bank of the River and is difficult to access for Tennessee sportsman. Future potential opportunities since NRCS easement.	
BR_15 Construction Assumptions			
BR_15a	HGM costs provided by ERDC.		
BR_15 Real Estate Assumptions			
BR_15a	Assume purchase of 583 floodplain acres of agricultural land.		
BR_15 OMRR&R Assumptions			
BR_15a	None		

BR_15 Adaptive Management & Monitoring Assumptions	
BR_15a	HGM AMM costs provided by ERDC.

2.16 BRANDYWINE (BR_16)

BR_16 proposes to enhance the aquatic area by increasing depth following environmental design of borrow area recommendations (ERDC 2021). Like measure Br_14, these borrow areas have been present since at least 1985 (G. Earth) and are likely very shallow.

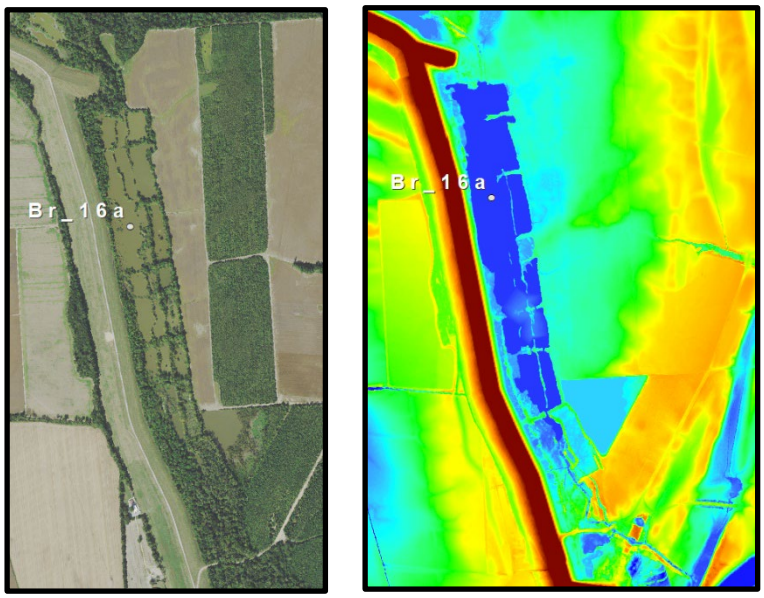


Figure 2-16. BR_16

Table 2-16: BR_16 Description

BR_16 Description of Features			
Measure Description	Restoring Habitat Complexity in Borrow Area		
Construction Activity	Earthwork		
Model	Borrow		
Restoration Activity	Waterbody Enhancement		
Habitat	Borrow Areas (lentic aquatic)		
BR_16 Items			
Item-Feature	**Meets Objective**	**Notes**	**Screened**
BR_16a	3	Deepen and create habitat complexity in borrow pits (mapped as 54 acres of permanent waterbodies from Q25 waterbodies v7).	Yes – CEICA Round 1

		Screening Criteria: First iteration of CEICA showed poor performance. Geotech indicated sandy soils and potential seepage concerns.	
BR_16 Construction Assumptions			
BR_16a	Estimate is based on excavating with no haul. Assumed depth of excavation 5ft. Survey is required to determine current borrow pit depth. Full borrow pit analysis will be required to verify the allowable excavation depth based on seepage conditions at each borrow pit. This could lead to the borrow pits not being able to be excavated at all or being able to be excavated more than 5ft. 260,755 CY (75% of the borrow area.)		
BR_16 Real Estate Assumptions			
BR_16a	Assume purchase of 54 aquatic acres of woodlands		
BR_16 OMRR&R Assumptions			
BR_16a	Channel cleanout O&M at years 15, 30, 45 estimated at 25% of initial construction cost and unwatering O&M at year 30 estimated at 12.5% of initial construction cost.		
BR_16 Adaptive Management & Monitoring Assumptions			
BR_16a	Fish Surveys - Borrow Areas at years 0,3,5,7,10 estimated at $5455/event.		

Section 3

Densford Complex

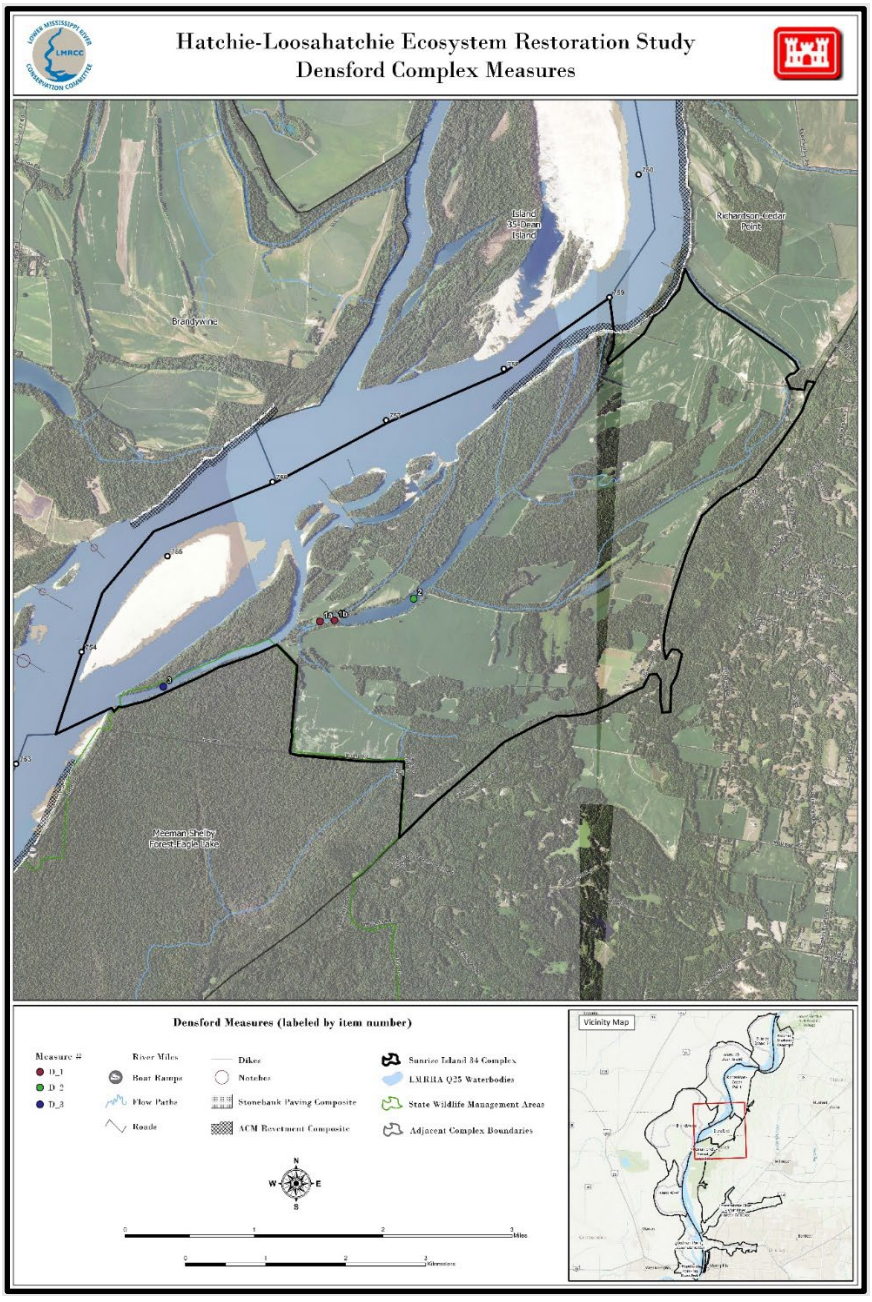


Figure 3-1 Densford Complex

3.1 DENSFORD (D_1)

Thweatt Chute has been isolated at its upper end possibly for over a century (USGS 1931, Guntren et al. 2016). The channel at the lower end of the chute passes over two field roads (low water crossings) and connects to Densford secondary channel. Imagery suggests that culverts were replaced with low water crossings after the 2011 flood (G. Earth).

D_1 proposes to degrade the remnant crossing at D_1a which appears to be no longer in use (NAIP 2021) and lower the crossing at D_1b.

Figure 3-2. D-1

Table 3-1: D_1 Description

D_1 Description of Features	
Measure Description	Flow Restoration and Habitat Complexity to Backwater Slough
Construction Activity	Grade Control Structures; Earthwork; Riprap Bank Protection
Model	Bidirectional
Restoration Activity	Altering Connectivity

Habitat	Slough (lentic aquatic)

D_1 Items			
Item-Feature	**Meets Objective**	**Notes**	**Screened**
D_1a	3	Cleanout channel to increase connectivity by 2ft depth to Thweatt Chute. *Screening Criteria: screened in final array of alternatives.*	Yes – Final Array
D_1b	3	Modify obstruction by installation of low water crossing to increase connectivity by 4ft depth to Thweatt Chute. *Screening Criteria: screened in final array of alternatives.*	
D_1 Construction Assumptions			
D_1a	2ft deep, 3,600 sq ft area, 270 CY excavation, 1 acre clearing and grubbing. No hauling, including mobilization/demobilization.		
D_1b	Road crossing (assume low water crossing, not culvert). 4ft degrade (include 2ft thick R200 riprap), 3,000 sq ft, 450 CY excavation, 350 TN riprap, including mobilization/demobilization.		
D_1 Real Estate Assumptions			
D_1a D_1b	Assume purchase of 84 aquatic acres of woodlands and 1 terrestrial acre of woodlands totaling 85 acres for D_1a and 1b.		
D_1 OMRR&R Assumptions			
D_1a	Channel cleanout O&M at years 15, 30, 45 estimated at 25% of initial construction cost.		
D_1b	Channel cleanout O&M at years 15, 30, 45 estimated at 25% of initial construction cost and low water crossing O&M at year 30 estimated at 50% of initial construction cost.		
D_1 Adaptive Management & Monitoring Assumptions			

D_1a	Aquatic Lidar Surveys (ROV)- Small Channels (A) at years 0,7 estimated at $2400/event; Fish & Invertebrate Surveys Monitoring - Bidirectional, Unidirectional, Isolation (A) at years 0, 3,5,7,10 estimated at $4167/event.
D_1b	

3.2 DENSFORD (D_2)

Thweatt Chute has undoubtably accumulated sediment over its more than 100-year life span. As sediment accumulates, the lake bottom becomes gently sloping with relatively homogeneous flocculent substrate. Although scouring flows during large floods may remove sediment and create lakebed diversity, there is an opportunity to aide this process and enhance Thweatt Chute. This measure proposes to excavate sediment creating diversity in depth and substrate increasing the chute's longevity. Deepening Thweatt Chute is very similar to deepening a borrow area, and thus the borrow area model was used to calculate benefits. Borrow areas in the study and throughout the LMR are much smaller. Because of its size, the PDT felt that deepening 50% of the Thweatt Chute would provide a good balance of shallow water habitat for aquatic plants, fish spawning and macroinvertebrates and a sufficiently large deep area for shelter and overwinter habitat.

D_2 proposes to excavate sediment creating diversity in depth and substrate increasing Thweatt Chute's longevity. This measure will restore depth and habitat complexity to Thweatt Chute.

Table 3-2: D_2 Description

D_2 Description of Features			
Measure Description		Flow Restoration and Habitat Complexity to Backwater Slough	
Construction Activity		Earthwork	
Model		Borrow	
Restoration Activity		Waterbody Enhancement	
Habitat		Borrow Areas (lentic aquatic)	
D_2 Items			
Item-Feature	**Meets Objective**	**Notes**	**Screened**

D_2	3	Restore depth (5ft depth) and habitat complexity of Thweatt Chute. Landowners likely interested in deepening, but not reforesting adjacent field. *Screening criteria: screened in final array of alternatives.*	Yes – Final Array

D_2 Construction Assumptions	
D_2	Deepen 86 acres. 50% (42 acres) at 5ft depth. 340,000 CY. No hauling, including mobilization/demobilization.
D_2 Real Estate Assumptions	
D_2	Assume purchase of 84 aquatic acres of woodlands.
D_2 OMRR&R Assumptions	
D_2	Borrow excavation and unwatering O&M at year 30 estimated at 12.5% of initial construction cost
D_2 Adaptive Management & Monitoring Assumptions	
D_2	Fish Surveys - Borrow Areas at years 0,3,5,7,10 estimated at $5455/event.

3.3 DENSFORD (D_3)

D_3 proposes to add wood to the lower end of Densford secondary channel where the channel maintains a year-round connection to the main channel. The benefits evaluation acreage for this measure is the Densford secondary channel.

Figure 3-3. D-3

Table 3-3: D_3 Description

D_3 Description of Features			
Measure Description	Woody Debris Traps		
Construction Activity	Woody Debris Trap		
Model	Wood Trap		
Restoration Activity	Aquatic Channel Enhancement		
Habitat	Secondary Channels (lotic aquatic)		
D_3 Items			
Item-Feature	**Meets Objective**	**Notes**	**Screened**
D_3	2	Install wood traps to enhance aquatic invertebrate diversity.	No
D_3 Construction Assumptions			
D_3	Per ERDC and NFS. Signage incidental to construction. Mobilization/demobilization, materials and installation included.		
D_3 Real Estate Assumptions			

D_3	Assume work to be done in-channel below ordinary highwater and/or incidental to construction costs contingencies.
D_3 OMRR&R Assumptions	
D_3	None
D_3 Adaptive Management & Monitoring Assumptions	
D_3	Large Woody Debris Traps at years 1,3,5,7,10 estimated at $6000 per structure.

Section 4

Hatchie Towhead Randolph Complex

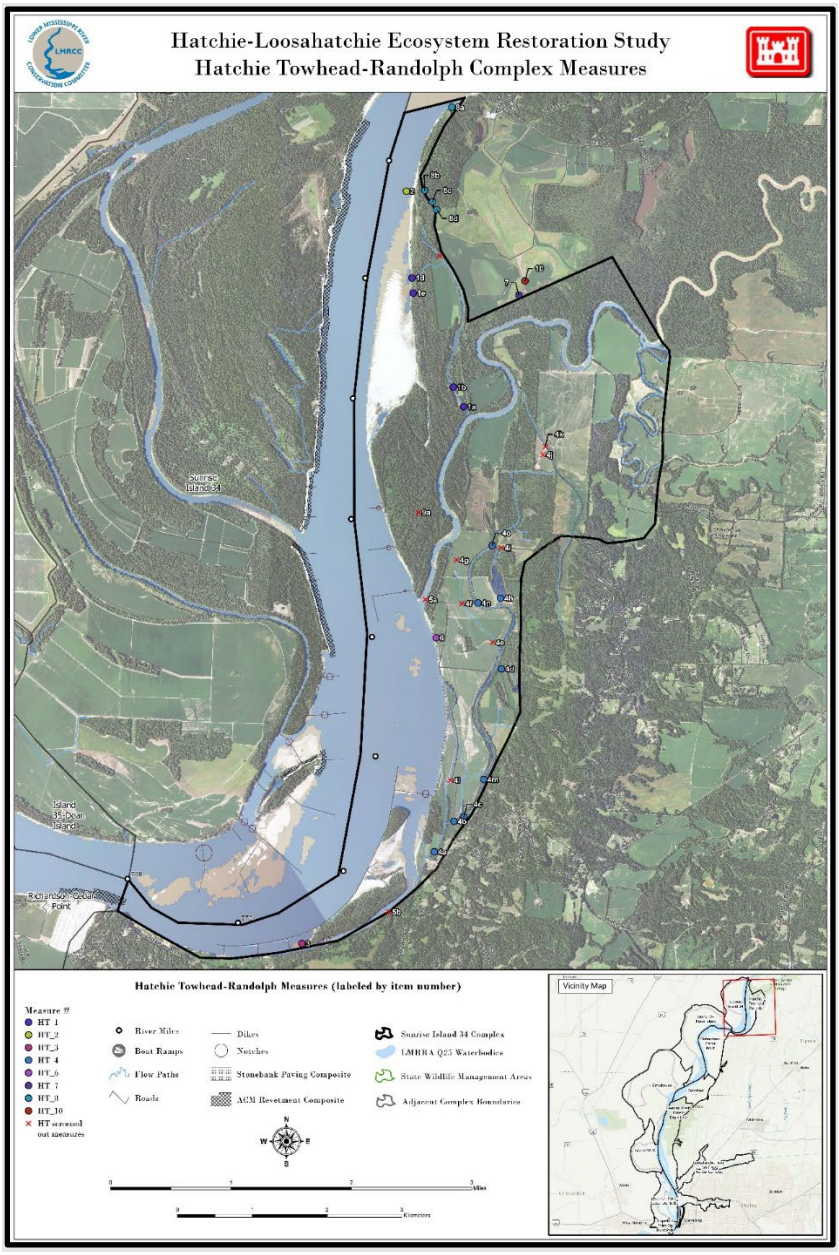


Figure 4-1 Hatchie Towhead Randolph Complex

4.1 HATCHIE TOWHEAD RANDOLPH (HT_1)

The slough in this measure is a historic Mississippi River secondary channel that now connects to the Hatchie River at its lower end and the Mississippi main channel at its upper end. The upper end connects to the LMR through low spots in the natural levee. The lowest is at 235.9 ft which is exceeded 8.8% of days between 1Jan10 to 31Dec19. The lower end connects to the Hatchie River. The lower channel appears to have two manmade obstructions which are higher than the channel bed, appear as berms in the elevation data, and may be field access roads. The ag field adjacent to the slough's west bank, floods as water levels rise in the slough until river water exceeds the natural levee and flows in from the upstream channel. The field has some partially hydric areas with silty clay, silty clay loam and silt loam soils (NWIS SSURGO). The ag field's boundary was digitized (NAIP 2018) and minimum (221.5 ft), average (229.7 ft, 16.9%), and maximum (236.2 ft) elevation calculated using zonal statistics.

In an average water year, the river would back up the downstream channel on to the ag field on 30 Apr. 2017 and drain off around 6 Jun. 2017. This period of inundation is suitable for alligator gar and other spawning fish. During this period, the upstream natural levee is overtopped allowing water to flow across the ag field from 5 – 23 May 2017. This upstream flow may be problematic as it brings colder LMR water onto the ag field and could kill the temperature sensitive alligator gar eggs (Allen pers comm 9May22). Therefore, this measure proposes to improve downstream connectivity and reduce upstream connectivity to optimize conditions in the ag. field and slough for spawning fishes. This measure's project acreage is the slough that would benefit from improved connectivity. Supplemental acreage is the downstream river habitat within the project area. Unrealized benefits include the 64-acre ag field which would provide spawning habitat for alligator gar and other fishes.

Measure Item detailed descriptions:

- Item HT_1a – This berm in the downstream channel has a low area in the middle that suggests it has eroded or been degraded (NAIP 2016). This low area (222.7 ft, 33.5%) is still higher than the adjacent channel (220.8 ft, 38.9%).
- Item HT_1b - The downstream channel is deeper and wider upstream and downstream of this berm suggesting the obstruction is an undersized culvert or water control structure. Below the eroded area, the channel bed is around 221.8 ft (36.1%) suggesting the invert is or should be set to this elevation.
- Item HT_1d – Upstream flow begins when this low spot in the natural levee allows water to flow directly onto the proposed alligator gar spawning site. Water must reach 235.9 ft to flow across this area; the channel is lower adjacent to the LMR. Raising the elevation to 242 ft would prevent water from flowing in during a normal year (2017). The project proposes to do this with bank protection.

- Item HT 1e was combined in Item HT_1d as a second area of bank protection. It is a second low spot in the upstream natural levee that allows water to flow directly onto the proposed alligator gar • spawning site. Currently, water must reach 236.2 ft to flow across this area.

HT_1 proposes to improve downstream connectivity and reduce upstream connectivity to optimize conditions in the agriculture field and slough for spawning fishes.

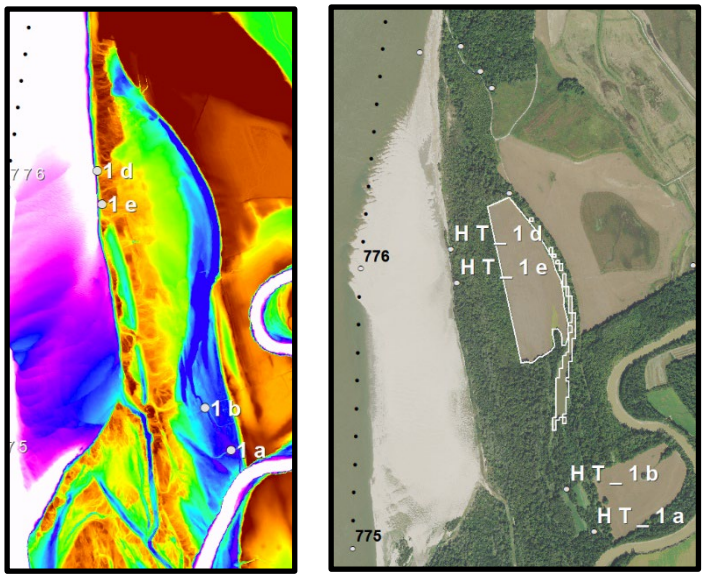


Figure 4_2. HT_1

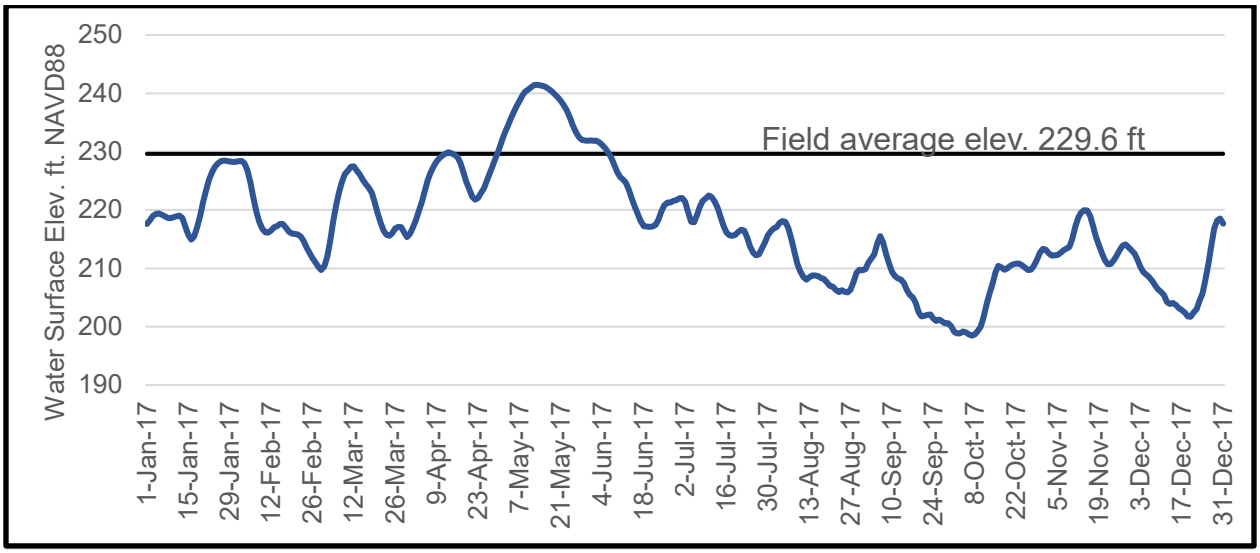


Figure. The river's 2017 (average water year) water surface elevation (WSE) compared to the ag field's average elevation. Hatchie river water would back up the downstream channel to inundate the ag field. WSE was determined at river mile 775.8. using the equation for slope, 8:00am daily gage readings at the Memphis and Osceola gages, and river miles.

Figure 4-3. HT_1 Water Level

Table 4-1: HT_1 Description

HT_1 Description of Features			
Measure Description	Flow restoration to backwater slough/ecologically sensitive area		
Construction Activity	Earthwork; Riprap Bank Protection		
Model	Bidirectional		
Restoration Activity	Altering Connectivity		
Habitat	Slough (lentic aquatic)		
HT_1 Items			
Item-Feature	**Meets Objective**	**Notes**	**Screened**
HT_1a	3	Improve downstream connectivity to provide high quality spawning in interior slough (and adjacent agricultural field) for Alligator Gar. Degrading low water crossing.	Yes – CEICA Round 2

		Screening criteria: second iteration of CEICA showed poor performance.	
HT_1b	3	Improve downstream connectivity to provide high quality spawning in interior slough (and adjacent agricultural field) for Alligator Gar. Degrading low water crossing. *Screening criteria: second iteration of CEICA showed poor performance.*	
HT_1d	3	Reduce flow across proposed Alligator Gar spawning site by construction of stone closure structure on bank. *Screening criteria: second iteration of CEICA showed poor performance.*	
HT_1e	3	Reduce flow across proposed Alligator Gar spawning site by filling channel or constructing bank protection *Screening criteria: item included with HT_1d.*	Yes – Pre CEICA
HT_1 Construction Assumptions			
HT_1a	30ftx20ftx2ft (45 CY) excavation and 0.5 acres of clearing, includes mobilization/demobilization.		
HT_1b	50ftx35ftx2ft (140 CY) excavation and 0.5 acres of clearing, includes mobilization/demobilization.		
HT_1d	Three R400 Closure structures (angle of repose, 1,600 LF, 6ft deep, 20ft crown) - 14,666, constructed from the river, includes mobilization/demobilization.		
HT_1e	Three low spots in top bank to all be included with 1d.		
HT_1 Real Estate Assumptions			
HT_1a	Assume purchase of 10 floodplain acres of woodlands.		
HT_1b			
HT_1d			
HT_1e	None; screened prior to real estate estimation.		

HT_1 OMRR&R Assumptions	
HT_1a	Channel cleanout O&M at years 15, 30, 45 estimated at 25% of construction cost.
HT_1b	
HT_1d	Riprap (river placement) O&M at years 15, 30 45 estimated at 25% of construction cost.
HT_1e	None; screened prior to OMRR&R estimation.
HT_1 Adaptive Management & Monitoring Assumptions	
HT_1a	Aquatic Lidar Surveys (ROV)- Small Channels (A) at years 0,7 estimated at $2400/event; Fish & Invertebrate Surveys Monitoring - Bidirectional, Unidirectional, Isolation (A) at years 0, 3,5,7,10 estimated at $4167/event.
HT_1b	
HT_1d	
HT_1e	None; screened prior to AMM estimation.

4.2 HATCHIE TOWHEAD RANDOLPH (HT_2)

The riverbend adjacent to Hatchie National Wildlife Refuge is eroding and fine sediment is depositing on the gravel bar downstream. Imagery shows that the bankline from river mile 776.7 to 777.0 has eroded by 0.13 acres per year between 1997 and 2019 (G. Earth). Without project, over 6.5 acres of riverfront forest and river cane could erode. This forest provides a corridor for species and protects interior areas of the refuge from scouring river flows. There is a relatively uncommon and unique group of species that utilize main channel gravel bars. The spaces between the gravel provide pockets of protected habitat. This measure proposes to install a chevron to maintain and expose gravel on the sandbar around river mile 776 and revetment to prevent the structure from causing shoreline erosion. To determine project acreage, a 2011 survey of the Loosahatchie Bar chevron was used. One-foot contours were created to determine the area scoured by the chevron. The highest elevation contour that outlined the scour area was used as the project acreage. There is no supplemental acreage for this measure.

HT_2 proposes to install a chevron to maintain and expose gravel on the sandbar around river mile 776 and revetment to prevent the structure from causing shoreline erosion.

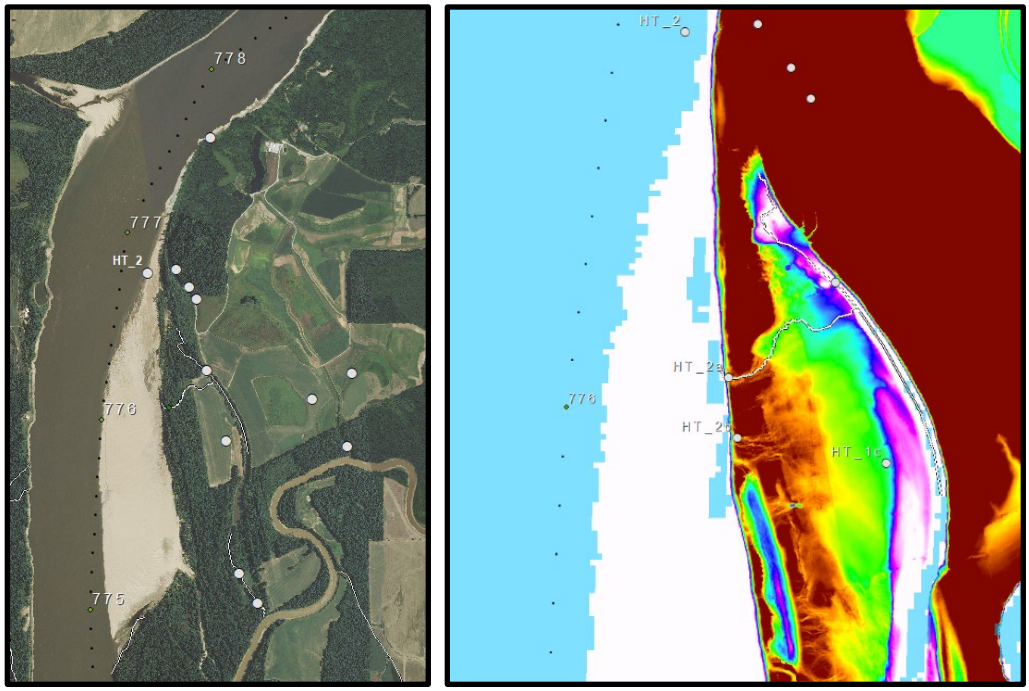


Figure 4-4. HT_2

Table 4-2: HT_2 Description

HT_2 Description of Features			
Measure Description	River Training Structure – Chevron		
Construction Activity	River Training Structure		
Model	Substrate		
Restoration Activity	Aquatic Channel Enhancement		
Habitat	MC/Main Channel Border (lotic aquatic)		
HT_2 Items			
Item-Feature	**Meets Objective**	**Notes**	**Screened**

HT_2 – Install River Training Structure	1 and 2	Install chevron (river training structure) and bank protection measures to maintain exposed gravel (qualitative-while also protecting existing river access, rivercane, and forest on Lower Hatchie NWR). *Screening criteria: second iteration of CEICA showed poor performance.*	Yes – CEICA Round 2
HT_2 Construction Assumptions			
HT_2	Assumed 24,800 tons of C-stone based off of Loosahatchie Bar chevron. 5,000 LF of bank paving, 2ft thick, 200ft wide (112,000 TN).		
HT_2 Real Estate Assumptions			
HT_2	Assume work to be done in-channel below ordinary highwater and/or incidental to construction costs contingencies.		
HT_2 OMRR&R Assumptions			
HT_2	Riprap (river placement) O&M at years 15, 30 45 estimated at 25% of construction cost; River Training Structure (Chevrons) O&M at years 15, 30 45 estimated at 25% of construction cost.		
HT_2 Adaptive Management & Monitoring Assumptions			
HT_2	Aquatic Bathymetric Survey - Rivers/Secondary Channels (A) at years 0,1,3,5,7,10 estimated at $450/mile; Fish Surveys Monitoring - Velocity and Eddy at years 0,3,5,7,10 estimated at $12000/event.		

4.3 HATCHIE TOWHEAD RANDOLPH (HT_3)

Despite numerous dike notches, Randolph secondary channel has considerable sediment. Imagery (NAIP 2012) indicates the sediment laden Hatchie River water is captured by the sand bars upstream of the vegetated island. Flows may be inadequate to flush the channel or sediment may be continually redeposited from the Hatchie River. Imagery from 2021 shows the channel along the vegetated island disconnected from the main channel at both ends. The water surface elevation for the 8 October 2021 image at the channel's location (RM770.8) is approximately 201.2 ft. which is assumed to be the sediment elevation. This elevation is exceeded 91.8% of days from 2010-2019. This sediment would need to be lowered to 193.2 to achieve 100% flow. Due to the continued influx of sediment from the Hatchie, upstream sediment removal may be short term unless Hatchie sediment loads are reduced or diverted (HT_5). Restoring upstream connectivity was screened out because tributary sediment control measures have been unsuccessful

in other LMR streams. The best option for Randolph secondary channel was to enhance downstream connectivity through the creation of a channel through the existing sediment plug. This was also screened out due to lack of success during a past attempt.

HT_3 proposes to improve connectivity to Randolph secondary channel by dredging the southern end.

Figure 4-5. HT_3

Table 4-3: HT_3 Description

HT_3 Description of Features	
Measure Description	Secondary Channel Low Flow Pilot Channel
Construction Activity	Earthwork
Model	N/A
Restoration Activity	Altering Connectivity
Habitat	N/A
HT_3 Items	

Item-Feature	Meets Objective	Notes	Screened
HT_3 – Channel Cleanout	2	Dredge downstream pilot channel to increase connectivity 500 ft x 160 ft wide to 193.2 ft depth. Enhances bidirectional flow. *Screening Criteria: This was attempted several years ago using a dustpan dredge, paid for by LMRCC. It was unsuccessful due to access and the re-sedimentation of material. Likely the same result will occur.*	Yes – Pre CEICA
HT_3 Construction Assumptions			
HT_3	Recommend deleting measure. This was attempted several years ago using a dustpan dredge, paid for by LMRCC. It was unsuccessful due to access and the re-sedimentation of material. Likely the same result will occur.		
HT_3 Real Estate Assumptions			
HT_3	None; screened prior to real estate estimation.		
HT_3 OMRR&R Assumptions			
HT_3	None; screened prior to OMRR&R estimation.		
HT_3 Adaptive Management & Monitoring Assumptions			
HT_3	None; screened prior to AMM estimation.		

4.4 HATCHIE TOWHEAD RANDOLPH (HT_4)

This involves the manmade drainages and historic channels that connect Ballard Slough and a series of floodplain waterbodies. At the upper (northern) end, a straight manmade channel connects to the Hatchie River. The channel's invert gets higher as it moves away from the Hatchie River suggesting flow is primarily from south to north. A straight manmade ditch branches off this channel and connects to a large depression. Ballard Slough forms at the southern end of this depression flowing south from this point. The team originally identified 14 obstructions in this area. Seven of these (items HT_4g, 4i, 4j, 4k, 4e, 4f, 4l) were screened out because they provided alternate routes to permanent waterbodies whose connectivity was being enhanced through the remaining items. The connectivity will be enhance by lowering the items detailed below. This will improve flow to the permanent waterbodies which represent this measures acreage.

Item HT_4a - Imagery shows this location as an ag field access road with a non-forested manmade ditch stretching ~660 ft upstream and downstream (NAIP 2021). In the elevation data, the item appears as an elevated berm with a higher invert (221.8 ft) channel upstream compared to 218.2 ft invert downstream.

Item HT_4b – Ballard Slough Rd crossing with lower elevation forested channel (15 – 20 ft wide) on either side. The upstream channel invert is approximately 227 ft while the downstream is 226.6 ft. The elevation data shows minimal scouring around the culvert suggesting it is correctly sized.

Item HT_4c – Elevation data and NAIP 2012, 13, 15, and 17 show water ponds upstream of this item suggesting there is no culvert in the berm. The channel invert downstream of the berm is 227.7 ft while the berm elevation is 229.8 ft. The berm could be degraded to the elevation of the channel invert downstream

HT_4m – There is a 900 ft. long area of 35 ft wide channel that is higher (232.5 ft) than the channel upstream and downstream. This higher area goes through what appears to be a stand of mature forest (NAIP 2021). The channel could be deepened to around 231 ft to match the elevation at the downstream end.

Item HT_4d – This item is a probable culvert on a ditch that branches off of Ballard Slough. The channel upstream and downstream of the culvert has three elevated areas that could be lowered to increase connectivity. These elevated areas appear different in the LiDAR data compared to other areas; they may be digital artifacts and thus not actually present. The channel invert upstream and downstream is approximately 232.8 ft.

Item HT_4h – There is a berm surrounding the lower end of the floodplain lake. HT_4h is placed where the berm crosses the outflow channel. Because of the berm and imagery showing water in the lake while areas outside of the berm are dry, it is likely that Item HT_4h represents a water control structure. Both the lake and outflow channel were inundated at the time of the elevation survey thus the channel bed elevation is not available. The water's surface was 231.8 ft and thus the channel bed is lower.

HT_4n – This item is a road crossing the main part of Ballard Slough. G. Earth imagery from 2020 clearly shows a culvert in the middle of the channel. In the elevation data the downstream channel is inundated but the upstream channel appears dry and has an invert of 232.6 ft. The ponded water, with a water surface of 231.8 ft, downstream suggests the invert may be too high and the invert should be adjusted to at least 231.3 ft.

HT_4o – Ballard Slough Rd. crosses the slough. There is a culvert in the middle of the channel and the upstream and downstream channel have an invert of 232.3 ft.

HT_4 proposes to improve aquatic connectivity of Ballard Slough channel by modifying obstructions along flow paths and along adjoining flow paths to adjacent floodplain

waterbodies. Fourteen obstructions were identified within the manmade drainages and historic channels that connect Ballard Slough and a series of floodplain waterbodies. Seven of the fourteen obstructions were screened out because they provided alternate routes to permanent waterbodies whose connectivity was being enhanced through the remaining items.

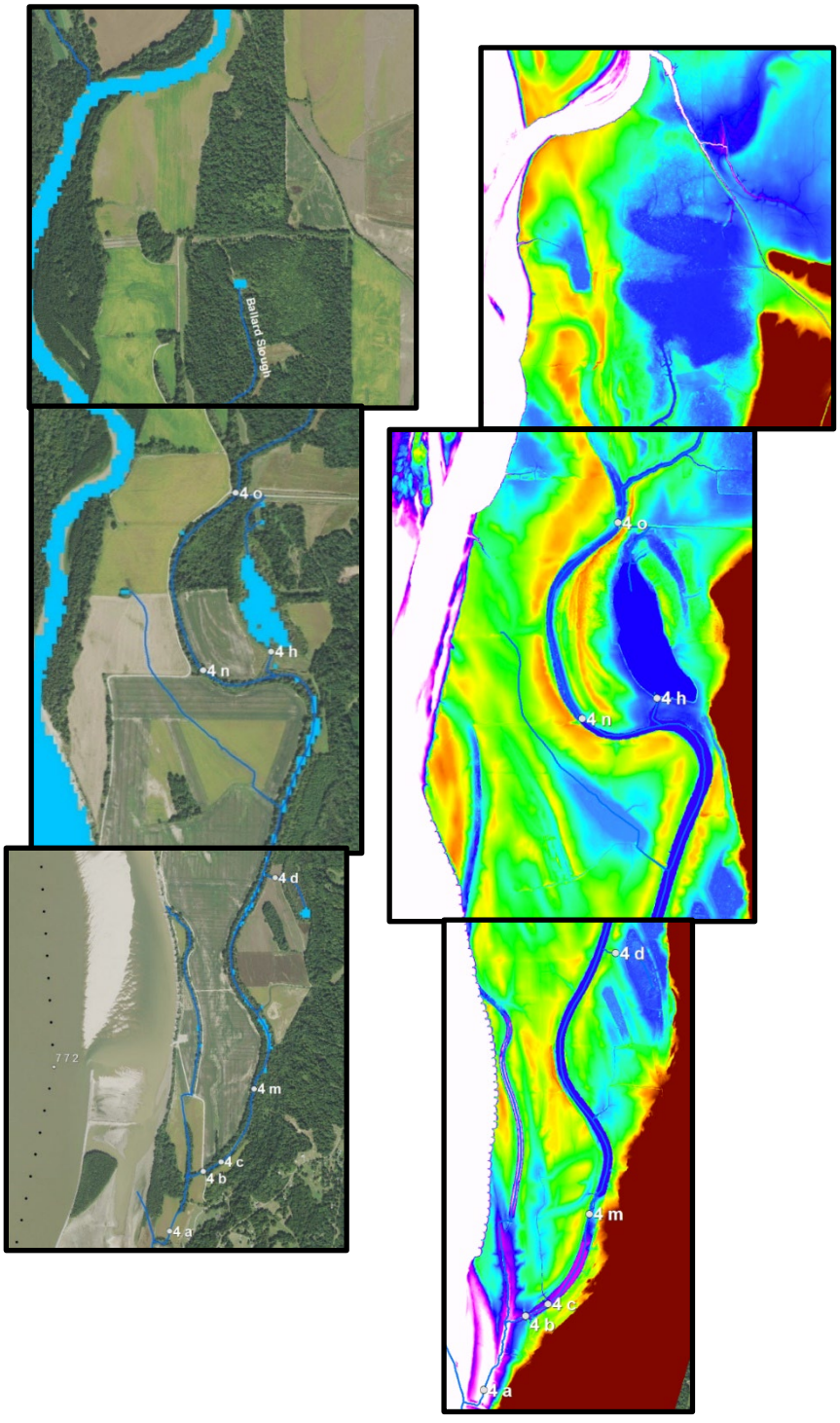


Figure 4-6. HT_4

Table 4-4: HT_4 Description

HT_4 Description of Features			
Measure Description	Flow Restoration to Backwater Slough		
Construction Activity	Culverts; Riprap Bank Protection		
Model	Bidirectional		
Restoration Activity	Altering Connectivity		
Habitat	Slough (lentic aquatic)		
HT_4 Items			
Item-Feature	**Meets Objective**	**Notes**	**Screened**
HT_4a	3	Modify obstruction/lower culvert invert to increase connectivity to Ballard Slough. *Screening criteria: screened in final array of alternatives.*	Yes – Final Array
HT_4b	3	Modify obstruction/lower culvert invert to increase connectivity to Ballard Slough. *Screening criteria: screened in final array of alternatives.*	
HT_4c	3	Modify obstruction/lower culvert invert to increase connectivity to Ballard Slough. *Screening criteria: screened in final array of alternatives.*	
HT_4d	3	Modify obstruction/lower culvert invert to increase connectivity to Ballard Slough. *Screening criteria: screened in final array of alternatives.*	
HT_4e	3	Modify obstruction/lower invert to increase connectivity.	

		Screening criteria: On a secondary flow path with a higher invert. Modification will not improve connection.	
HT_4f	3	Modify obstruction/lower invert to increase connectivity. *Screening criteria: On a secondary flow path with a higher invert. Modification will not improve connection.*	Yes – Pre CEICA
HT_4g	3	Modify obstruction/lower invert to increase connectivity. *Screening criteria: On a secondary flow path with a higher invert. Modification will not improve connection.*	
HT_4h	3	Modify obstruction/lower culvert invert to increase connectivity to Ballard Slough. *Screening criteria: screened in final array of alternatives.*	Yes – Final Array
HT_4i	3	Modify obstruction/lower invert to increase connectivity. *Screening criteria: Increased connectivity to this waterbody is better achieved through HT_4h.*	Yes – Pre CEICA
HT_4j	3	Modify obstruction/lower invert to increase connectivity. *Screening criteria: Berm appears in 2014 elevation data but google earth shows berm eroded in 2015 and then again without replacement in 2017.*	
HT_4k	3	Modify obstruction/lower invert to increase connectivity. *Screening criteria: Water in Ballard Slough drains flows from the south; this feature may drain adjacent agricultural lands and have little effect on Ballard Slough.*	

HT_4l	3	Modify obstruction/lower invert to increase connectivity. *Screening criteria: on a secondary flow path with a higher invert. Modification will not improve connection.*	
HT_4m	3	Cleanout sediment plug to increase connectivity to Ballard Slough. *Screening criteria: screened in final array of alternatives.*	Yes – Final Array
HT_4n	3	Modify obstruction/lower culvert invert to increase connectivity to Ballard Slough (culvert blown out in 2014). *Screening criteria: screened in final array of alternatives.*	
HT_4o	3	Modify obstruction/lower invert and enlarge culvert to increase connectivity to Ballard Slough. *Screening criteria: screened in final array of alternatives.*	

HT_4 Construction Assumptions	
HT_4a	Single 48in CMP 30 LF, 123 TN riprap inlet/outlet protection for R- 125, includes mobilization/demobilization.
HT_4b	Single 48in CMP 30 LF, 123 TN riprap inlet/outlet protection for R- 125, includes mobilization/demobilization.
HT_4c	40ftx10ftx2ft (34 CY) excavation and 0.5 acres of clearing, includes mobilization/demobilization.
HT_4d	Single 48in CMP 35 LF, 123 TN riprap inlet/outlet protection for R-125, includes
HT_4e	None; screened prior to construction estimation.
HT_4f	
HT_4g	

HT_4h	Two 48in CMPs 30 LF each, 246 TN riprap inlet/outlet protection for R-125, includes mobilization/demobilization.
HT_4i	None; screened prior to construction estimation.
HT_4j	
HT_4k	
HT_4l	
HT_4m	35' wide cleanout, 900' long, 2' deep (2733 CY), 1.5 acres of clearing, includes mobilization/demobilization.
HT_4n	Two 48" CMPs 35 LF each, 246 TN riprap inlet/outlet protection or R-125, includes mobilization/demobilization.
HT_4o	Two 48" CMPs 45 LF each, 246 TN riprap inlet/outlet protection for R-125, includes mobilization/demobilization.
HT_4 Real Estate Assumptions	
HT_4a	For HT_4, assume purchase 56 aquatic acres of woodlands.
HT_4b	
HT_4c	
HT_4d	
HT_4h	
HT_4m	
HT_4n	
HT_4o	
HT_4 OMRR&R Assumptions	
HT_4a	Riprap (river placement) O&M at years 15, 30, 45 estimated at 25% of construction cost.
HT_4b	
HT_4c	Channel cleanout O&M at years 15, 30, 45 estimated at 25% of construction cost.
HT_4d	Riprap (river placement) O&M at years 15, 30, 45 estimated at 25% of construction cost.
HT_4e	None; screened prior to construction estimation.

HT_4f	
HT_4g	
HT_4h	Riprap (river placement) O&M at years 15, 30, 45 estimated at 25% of construction cost.
HT_4i	None; screened prior to construction estimation.
HT_4j	
HT_4k	
HT_4l	
HT_4m	Riprap (river placement) O&M at years 15, 30, 45 estimated at 25% of construction cost.
HT_4n	
HT_4o	
HT_4 Adaptive Management & Monitoring Assumptions	
HT_4a	Rivers/Secondary Channels (A) at years 0,1,3,5,7,10 estimated at $450/mile; Fish Surveys Monitoring - Velocity and Eddy at years 0,3,5,7,10 estimated at $12000/event.
HT_4b	
HT_4c	
HT_4d	
HT_4h	
HT_4m	
HT_4n	
HT_4o	

4.5 HATCHIE TOWHEAD RANDOLPH (HT_5)

Riverine sediment control measures typically involve reducing in channel sediment mobilization or reducing tributary inputs. The tributaries and associated agriculture are outside the floodplain and thus outside the scope of this project. Grade control structures are used to reduce in channel sediment. These structures reduce channel slope and thus in channel sediment mobilization. A structure of this type could be constructed within the

project area. Controlling sedimentation from the Hatchie River would make reconnection of the upstream end of Randolph secondary channel sustainable.

Item HT_5a – This item was a grade control structure in the Hatchie River which would prevent further channel adjustment and channel sediment mobilization. This measure was removed from further consideration because tributary grade control structures have not been successful on other similar tributaries of the LMR.

Item HT_5b – The upper end of Randolph Secondary Channel receives sediment from the Hatchie River (see 1). There is currently a 2,100 ft long sediment plug at the upper end adjacent to a 160 ft wide remnant channel. This sediment plug could be removed to improve upstream connectivity and flow. However, this would allow Hatchie River flows to enter the secondary channel at times of low water. Low water periods are typically low velocity and thus high deposition. Therefore, there is a risk that the plug would quickly reform or alternatively the entire secondary channel could fill in. This measure was removed from further consideration.

Table 4-5: HT_5 Description

HT_5 Description of Features			
Measure Description	Flow Restoration to Backwater Slough		
Construction Activity	Culverts; Riprap Bank Protection		
Model	N/A		
Restoration Activity	Altering Connectivity		
Habitat	N/A		
HT_5 Items			
Item-Feature	**Meets Objective**	**Notes**	**Screened**
HT_5a	1 and 2	Grade control structure to reduce headcutting and sedimentation from Hatchie River (tributary). *Screening criteria: This measure was screened out because tributary grade control structures have not been successful on other similar tributaries of the LMR.*	Yes – Pre CEICA

HT_5b	2	Dredge upstream pilot channel to increase flow. Up 1,600 ft x 160 ft wide to 193.2 ft depth *Screening criteria: This measure was screened out because there is a risk that the plug would quickly reform or alternatively the entire secondary channel could fill in.*	
HT_5 Construction Assumptions			
HT_5a HT_5b	None; screened prior to construction estimation.		
HT_5 Real Estate Assumptions			
HT_5a HT_5b	None; screened prior to real estate estimation.		
HT_5 OMRR&R Assumptions			
HT_5a HT_5b	None; screened prior to OMRR&R estimation.		
HT_5 Adaptive Management & Monitoring Assumptions			
HT_5a HT_5b	None; screened prior to AMM estimation.		

4.6 HATCHIE TOWHEAD RANDOLPH (HT_6)

A large portion of the river's bankline in the Hatchie Towhead complex is farmed. Hardpoints have been placed along most of the bank to reduce erosion. A forest buffer would help prevent erosion and reduce scour from overtopping flood flows. This is especially important because the soils in this area are predominantly fine sandy loam (SSURGO). Erosion is more of an issue at this location because Randolph Secondary Channel is downstream. Eroded bankline likely deposits in the slower moving water of the secondary channel. Approximately 7,500 ft of the top left descending bank of the LMR from RM 771.8 – 773 has minimal forest. There are two lower elevation areas ~234-236 ft. where historic sloughs intersect the riverbank. The remaining higher bank area, shown as dark brown in the elevation image, is ~241-243 ft. The river would have overtopped the lower elevation areas from 5May2017 to 24May2017 with a 6 to 8.8% exceedance

from 2010-2019 while the higher elevations were not submerged in 2017 and have a 1 to 2% exceedance from 2010-2019. This measure's acreage was the 7,500 x 300 ft planting area and supplemental acreage was all adjacent forest.

HT_6 proposes to reforest the top bank of the Mississippi River.

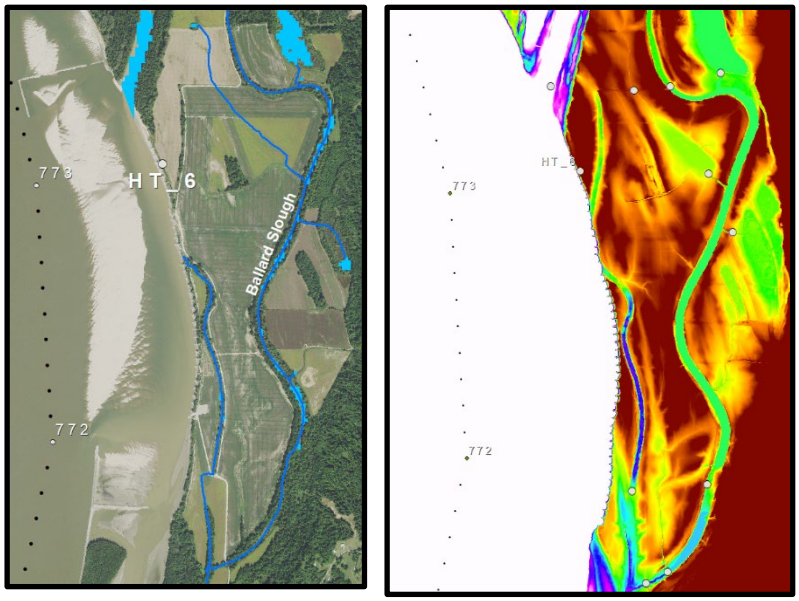


Figure 4-7. HT_6

Table 4-6: HT_6 Description

HT_6 Description of Features	
Measure Description	MS River Riparian Buffer
Construction Activity	Floodplain Vegetative
Model	HGM
Restoration Activity	Enhance and Restore Natural Vegetation
Habitat	Riverfront Forest - Riparian buffers (floodplain)
HT_6 Items	

Item-Feature	Meets Objective	Notes	Screened
HT_6	1	Install 300-ft wide X 7500-ft long (52 acres) forested riparian buffer adjacent to hardpoints and bank.	No
HT_6 Construction Assumptions			
HT_6		HGM costs provided by ERDC.	
HT_6 Real Estate Assumptions			
HT_6		Assume purchase of 52 floodplain acres of agricultural land.	
HT_6 OMRR&R Assumptions			
HT_6		None	
HT_6 Adaptive Management & Monitoring Assumptions			
HT_6		HGM AMM costs provided by ERDC.	

4.7 HATCHIE TOWHEAD RANDOLPH (HT_7)

This item would alter the western outflow from the manmade channel that moves water from the Hatchie River onto/off of food plots in the Hatchie NWR for Alligator Gar spawning. The field is composed of partially hydric silty clay loam and clay soils (NWIS, SSURGO). NWR managers indicate the fields start to flood at Osceola 25 ft stage. In 2017, the Osceola gage exceeded 25 ft from 1 May to 4 June. There are no obstructions within the channel and berms line either side. For the western plots, water flows out of the channel at the southern end of the berm and across 232.6 ft ground to begin inundating the lower elevation plots. This measure proposes to dig a channel through this ground, so that Hatchie River water will begin inundating the lowest elevations of the field as soon as the river water rises to that level. There is about 2 ft of difference between the lower elevation plot and water entry point. In 2017, water would flood the plots for 12 more days if the ground were lowered. This measure was evaluated using the bidirectional model. The acreage for this measure is the ground below 232.6 adjacent to the proposed channel times the percentage of time this ground is inundated in 2017. Supplemental acres are the downstream Hatchie River channel and main channel within the complex.

HT_7 proposes to dig a channel so the Hatchie River water will begin inundating the lowest elevations of the agriculture fields as soon as the river water rises to that level. Altering the western outflow from the manmade channel that moves water from the

Hatchie River onto/off of flood plots in the Hatchie NWR would improve habitat for Alligator Gar spawning.

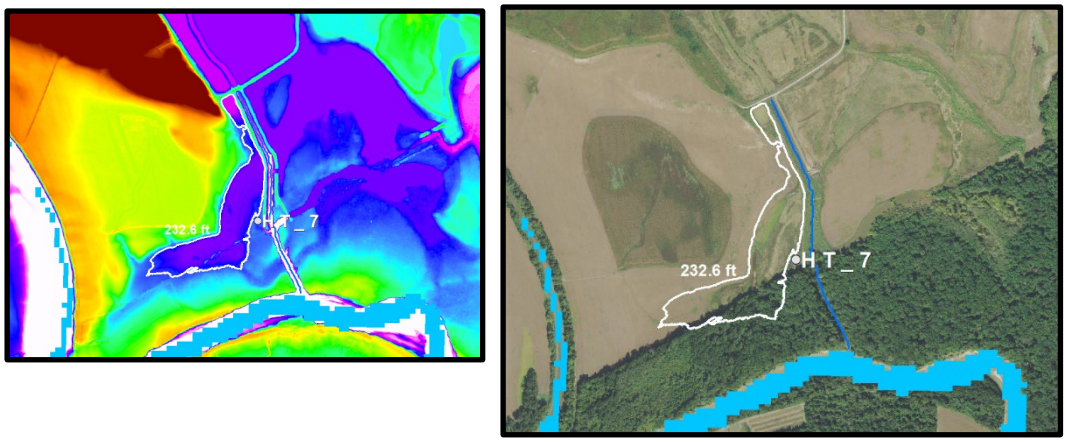


Figure 4-8. HT_7

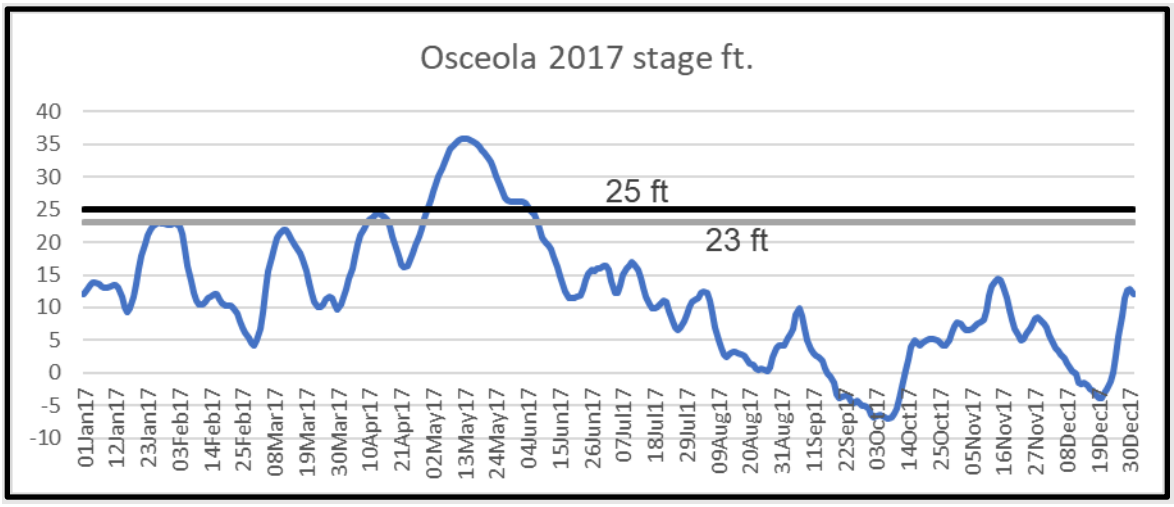


Figure. Osceola stage profile for 2017 with the food plot inundation elevation currently (black line) and with the project (grey line).

Figure 4-9. HT_7 Water Level

Table 4-7: HT_7 Description

HT_7 Description of Features	
Measure Description	Flow Restoration to Wetland
Construction Activity	Earthwork
Model	Bidirectional
Restoration Activity	Altering Connectivity
Habitat	Slough (lentic aquatic)

HT_7 Items			
Item-Feature	**Meets Objective**	**Notes**	**Screened**
HT_7	3	Alter flowpath by excavating channel on Lower Hatchie NWR to increase connectivity to Alligator Gar habitat on Lower Hatchie NWR. *Screening Criteria: First iteration of CEICA showed poor performance. Restoration likely to be better accomplished through other programs (e.g., USFWS fish passage program and/or funding).*	Yes – CEICA Round 1

HT_7 Construction Assumptions	
HT_7	Excavate trapezoidal channel to increase connectivity (4ft deep x 450ft long, 15ft BW - 600 CY), no clearing, includes mobilization/demobilization.

HT_7 Real Estate Assumptions	
HT_7	Assume purchase 21 floodplain acres of woodlands

HT_7 OMRR&R Assumptions	
HT_7	Channel cleanout O&M at years 15, 30, 45 estimated at 25% of construction cost.

HT_7 Adaptive Management & Monitoring Assumptions	
HT_7	Aquatic Lidar Surveys (ROV)- Small Channels (A) at years 0,7 estimated at $2400/event; Fish & Invertebrate Surveys Monitoring - Bidirectional, Unidirectional, Isolation (A) at years 0, 3,5,7,10 estimated at $4167/event.

4.8 HATCHIE TOWHEAD RANDOLPH (HT_8)

Three gullies have eroded into the natural bluff and are depositing sediment onto the floodplain to the south. The hillside's soils are Memphis silt loam (SSURGO). It is difficult to tell how the gullies formed. G. Earth imagery from 1997 suggests logging, agriculture, and possibly runoff from the reservoir to the north may have increased runoff into the bluff valleys forming the current gullies. Instream weirs or grade control structures (items HT_8b, 8c, and 8d) are proposed to reduce further erosion and deepening of the gullies. Because the cause of the gully formation was difficult to determine, the PDT proposed a river structure to reduce upstream overbank flooding (item HT_8a). Upon further investigation of the bluff elevation, this item was screened out as being unnecessary. The highest 1m contour denoting the top of the steeply sloped gully area was used to represent the project acreage. The adjacent forest was the supplemental acreage.

HT_8 proposes to install river training structures and grade control structures to reduce further erosion and deepening of gullies.

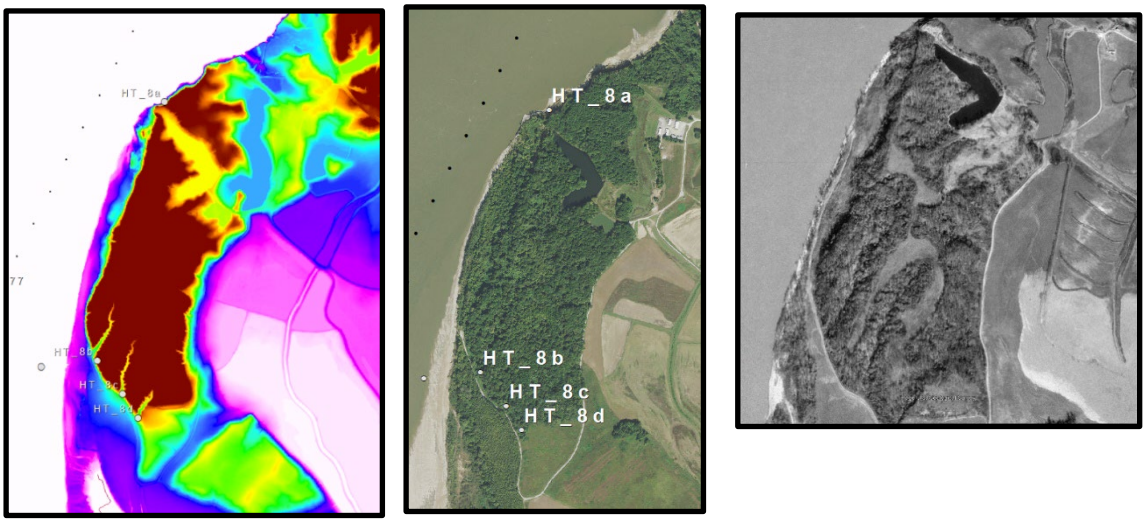


Figure 4-10. HT_8

Table 4-8: HT_8 Description

HT_8 Description of Features	
Measure Description	River Training Structure – Spur Dike
Construction Activity	River Training Structure

Model	HGM		
Restoration Activity	Aquatic Channel Enhancement – Spur Dike		
Habitat	Riverfront Forest - Riparian buffers (floodplain)		
HT_8 Items			
Item-Feature	**Meets Objective**	**Notes**	**Screened**
HT_8a	1	Spur dike or river training structure to divert water and reduce scour going into lake and also help reduce downstream scour coming off the bluff into 3 gullies. *Screening criteria: Trail dike will likely not improve upper bluff caving, see Randolph.*	Yes – Pre CEICA
HT_8b	1	Install four rock grade control structures to reduce gully erosion and downstream sedimentation. *Screening criteria: First iteration of CEICA showed poor performance.*	Yes – CEICA Round 1
HT_8c	1	Install three rock grade control structures to reduce gully erosion and downstream sedimentation. *Screening criteria: First iteration of CEICA showed poor performance.*	
HT_8d	1	Install one rock grade control structures to reduce gully erosion and downstream sedimentation. *Screening criteria: First iteration of CEICA showed poor performance.*	
HT_8 Construction Assumptions			
HT_8a	Assume 1,500 LF structure, +25 LWRP, 60ft depth, 14ft crown, $40/TN Trail dike will likely not improve upper bluff caving, see Randolph.		

HT_8b	Assume four rock grade control structures. Each grade control: R400, 85 ft long, 20 ft bottom width 3:1 side slopes. 2.5ft thickness with 0.5ft bedding stone. Assumed a 8:1 bed slope with a 15 ft apron inlet and 20 ft on the outlet. 1,100 TN, 680 CY excavation, Clearing 0.5 acres.
HT_8c	Assume 3 rock grade control structures. Each grade control: R400, 85 ft long, 20 ft bottom width 3:1 side slopes. 2.5' thickness with 0.5' bedding stone. Assumed a 8:1 bed slope with a 15 ft apron inlet and 20 ft on the outlet. 1100 TN, 680 CY excavation, Clearing 0.5 acres.
HT_8d	Assume 1 rock grade control structures. Each grade control: R400, 85 ft long, 20 ft bottom width 3:1 side slopes. 2.5' thickness with 0.5' bedding stone. Assumed a 8:1 bed slope with a 15 ft apron inlet and 20 ft on the outlet. 1100 TN, 680 CY excavation, Clearing 0.5 acres. Add rock protection for sediment basin dam, R400, 30ft tall 100 linear ft 3ft (500 TN).
HT_8 Real Estate Assumptions	
HT_8b	Assume purchase of 18 floodplain acres of woodlands; forest impact is already included in this acreage (HT_8b, 8c, 8d).
HT_8c	
HT_8d	

HT_8 OMRR&R Assumptions	
HT_8a	None; screened prior to OMRR&R estimation.
HT_8b	Channel cleanout O&M at years 15, 30, 45 estimated at 25% of initial construction cost; rip rap control structure O&M at year 30 estimated at 50% of construction cost.
HT_8c	
HT_8d	
HT_8 Adaptive Management & Monitoring Assumptions	
HT_8a	None; screened prior to AMM estimation.
HT_8b	Aquatic Lidar Surveys (ROV)- Small Channels (A) at years 0,7 estimated at $2400/event; Fish & Invertebrate Surveys Monitoring - Bidirectional, Unidirectional, Isolation (A) at years 0, 3,5,7,10 estimated at $4167/event.
HT_8c	
HT_8d	

4.9 HATCHIE TOWHEAD RANDOLPH (HT_9)

HT_9 proposes to create canopy gaps within the Lower Hatchie NWR forest to promote existing rivercane habitat. Rivercane has been reduced to fragmented populations due to anthropogenic development and closed canopy forests. Rivercane growth is enhanced with increased light levels therefore reduction of overstory canopy is a management tool for enhancing survival and growth of existing populations. This was screened out since it was determined that creating canopy gaps can be better accomplished by Lower Hatchie NWR staff.

Table 4-9: HT_9 Description

HT_9 Description of Features	
Measure Description	Forest Stand Improvement – Rivercane
Construction Activity	Floodplain Vegetative
Model	N/A
Restoration Activity	Altering Connectivity
Habitat	N/A

HT_9 Items			
Item-Feature	**Meets Objective**	**Notes**	**Screened**
HT_9a	1	Create Canopy Gaps in forest Lower Hatchie NWR to promote existing rivercane. Screening criteria: Better accomplished by Hatchie NWR staff.	Yes – Pre CEICA
HT_9 Construction Assumptions			
HT_9a	None; screened prior to construction estimation.		
HT_9 Real Estate Assumptions			

HT_9a	None; screened prior to real estate estimation.
HT_9 OMRR&R Assumptions	
HT_9a	None; screened prior to OMRR&R estimation.
HT_9 Adaptive Management & Monitoring Assumptions	
HT_9a	None; screened prior to AMM estimation.

4.10 HATCHIE TOWHEAD RANDOLPH (HT_10)

These food plots have clay hydric soils (SSURGO, NWIS). NWR managers indicate the fields start to flood at Osceola 25 ft stage. In 2017, the Osceola gage exceeded 25 ft from 1 May to 4 June. There are no obstructions within the channel and berms line either side. There is a notch in the berm (231.8 ft) that allows water onto the eastern plots. This area could be lowered to allow water to flow onto the lower elevation food plot. This would increase inundation by approximately 6 days in 2017. This measure was evaluated using the bidirectional model. The acreage for this measure is the ground adjacent to the channel with elevations at or below 231.8 times the percentage of time this ground is inundated in 2017. Supplemental acres are the downstream Hatchie River channel and main channel within the complex.

HT_10 proposes to alter the outflow from the manmade channel that moves water from the Hatchie River onto/off of eastern flood plots in the Hatchie NWR to improve Alligator Gar spawning habitat.

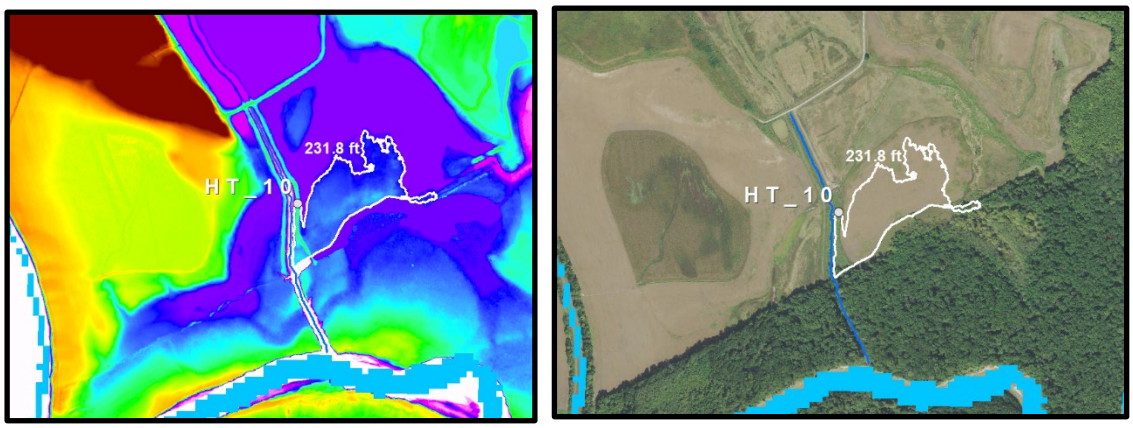
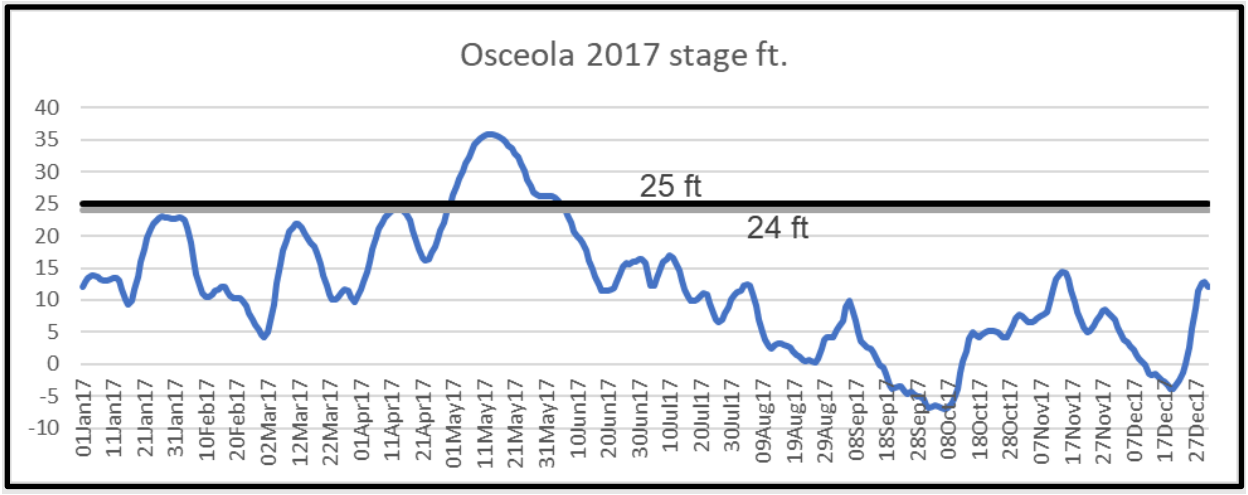


Figure 4-11. HT_10



Osceola stage (ft) profile for 2017 with the current food plot inundation elevation marked as a black line and future with inundation (grey line).

Figure 4-12. HT_10 Water Level

Table 4-10: HT_10 Description

HT_10 Description of Features			
Measure Description	Flow Restoration to Wetland		
Construction Activity	Earthwork		
Model	Bidirectional		
Restoration Activity	Altering Connectivity		
Habitat	Slough (lentic aquatic)		
HT_10 Items			
Item-Feature	**Meets Objective**	**Notes**	**Screened**
HT_10	3	Alter flowpath by excavating channel on Lower Hatchie NWR to increase connectivity to Alligator Gar habitat on Lower Hatchie NWR.	Yes – CEICA Round 1
HT_10 Construction Assumptions			
HT_10	45ftx35ftx1ft (60 CY) excavation no clearing, includes mobilization/demobilization.		

HT_10 Real Estate Assumptions	
HT_10	Assume purchase 16 floodplain acres of woodlands.
HT_10 OMRR&R Assumptions	
HT_10	Channel cleanout O&M at years 15, 30, 45 estimated at 25% of construction cost.
HT_10 Adaptive Management & Monitoring Assumptions	
HT_10	Aquatic Lidar Surveys (ROV)- Small Channels (A) at years 0,7 estimated at $2400/event; Fish & Invertebrate Surveys Monitoring - Bidirectional, Unidirectional, Isolation (A) at years 0, 3,5,7,10 estimated at $4167/event

Section 5

Hopefield Point – Big River Park Complex

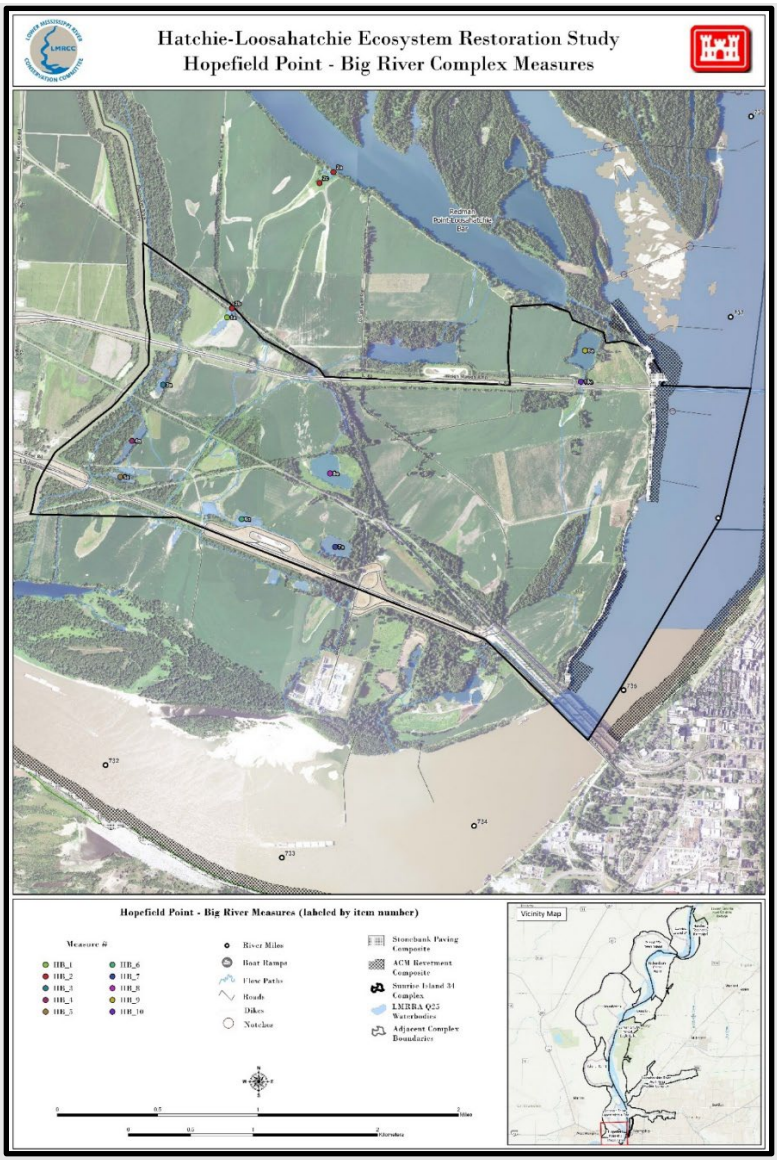


Figure 5-1 Hopefield Point Big River Complex

5.1 HOPEFIELD POINT-BIG RIVER PARK (HB_1)

The field currently ranges in elevation from 208 – 212 ft with all hydric Sharkey silty clay soils. In an average water year like 2017, low elevations would be inundated from 29 April – 8 June and high elevations 2 – 31 May. In 2017, ground with an elevation > 219 ft would have been inundated for 13 days or less. Therefore, areas with an elevation > 219 ft could be planted in river cane.

HB_1 proposes to work with the Big River Park organization to convert the agricultural field and permanent waterbody between the mainline levee, Interstate 40, and the St. Louis San Francisco Railroad into a non-forested wetland for Alligator Gar staging and spawning and to benefit other wetland species.

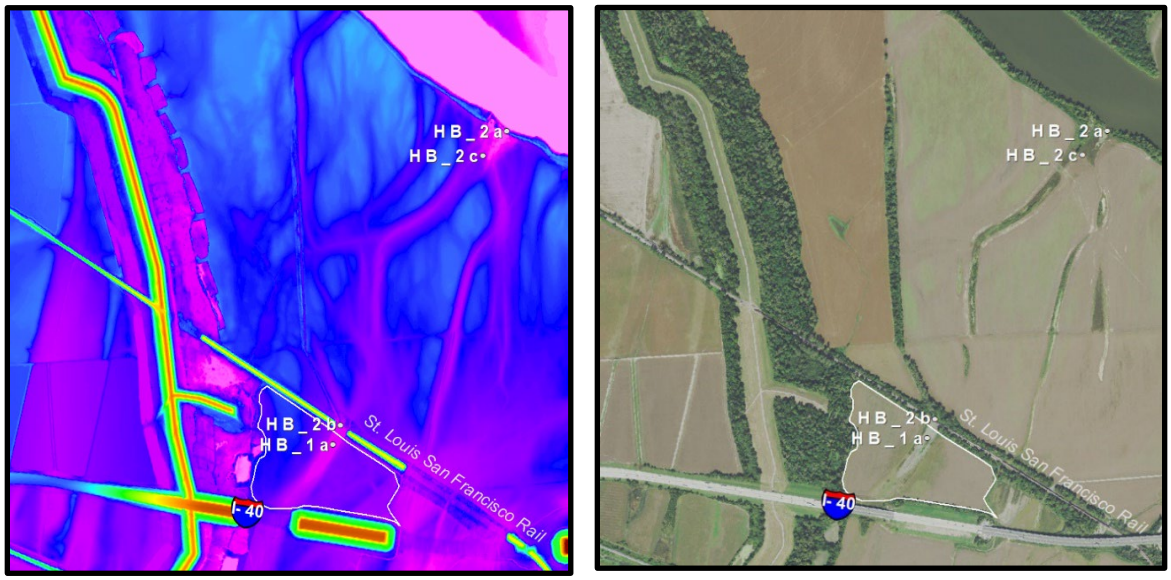


Figure 5-2. HB_1

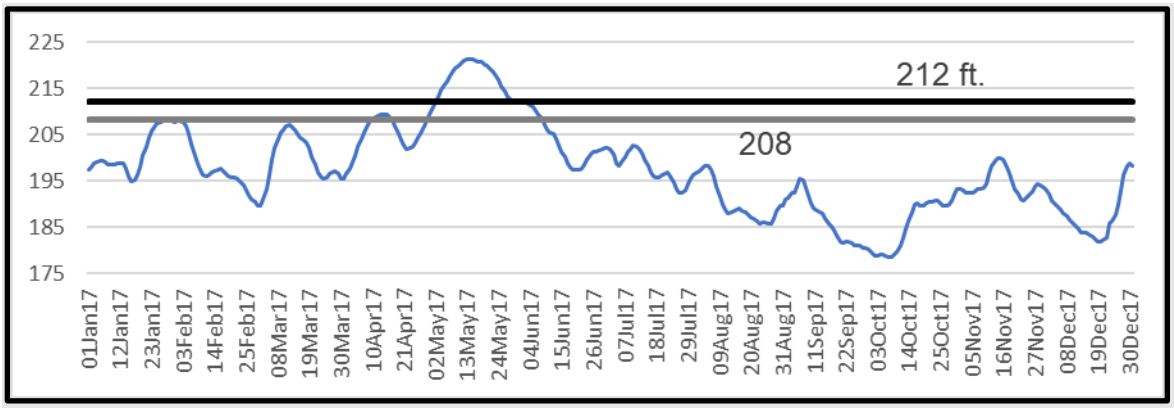


Figure. 2017 water surface at the mouth of Hopefield Chute with the minimum and maximum elevation of the proposed Alligator Gar spawning site.

Figure 5-3. HB_1 Water Level

Table 5-1: HB_1 Description

HB_1 Description of Features			
Measure Description	Wetland Complex Restoration		
Construction Activity	Floodplain Vegetative		
Model	HGM		
Restoration Activity	Enhance and Restore Natural Vegetation		
Habitat	Seasonally herbaceous wetland (aquatic & floodplain)		
HB_1 Items			
Item-Feature	**Meets Objective**	**Notes**	**Screened**
HB_1a	1 and 3	Establish non-forested wetland surrounding waterbody connected to swale. Coordinate with Big River Park to establish herbaceous (non-forest) for Alligator Gar spawn 47-acres). Establish wet prairie grass or rivercane habitat on high ridges.	No
HB_1 Construction Assumptions			
HB_1a	HGM costs provided by ERDC.		

HB_1 Real Estate Assumptions	
HB_1a	Assume purchase of 8 aquatic acres of agricultural land and 39 terrestrial acres of agricultural land
HB_1 OMRR&R Assumptions	
HB_1a	None
HB_1 Adaptive Management & Monitoring Assumptions	
HB_1a	HGM AMM costs provided by ERDC.

5.2 HOPEFIELD POINT-BIG RIVER PARK (HB_2AB)

River water flows into Hopefield Chute and then cuts across the floodplain and under the St. Louis San Francisco Railroad to reach HB_1 and the permanent waterbody. There are two obstructions that reduce connectivity. A road runs across the bank adjacent to Hopefield Chute. There is also elevated ground adjacent to the San Francisco Railroad. This measure proposes to modify these obstructions to improve connectivity. The acreage for this measure is the downstream waterbody. Supplemental acreage is Hopefield Chute and the adjacent main channel

Item HB_2a: The first obstruction is an old roadbed on the bank of Hopefield Chute with an elevation around 208.6 ft in 2014. This road has been eroded and repaired multiple times. 2021 imagery indicates it has eroded again (G. Earth). There are other roads that provide access to all surrounding ground.

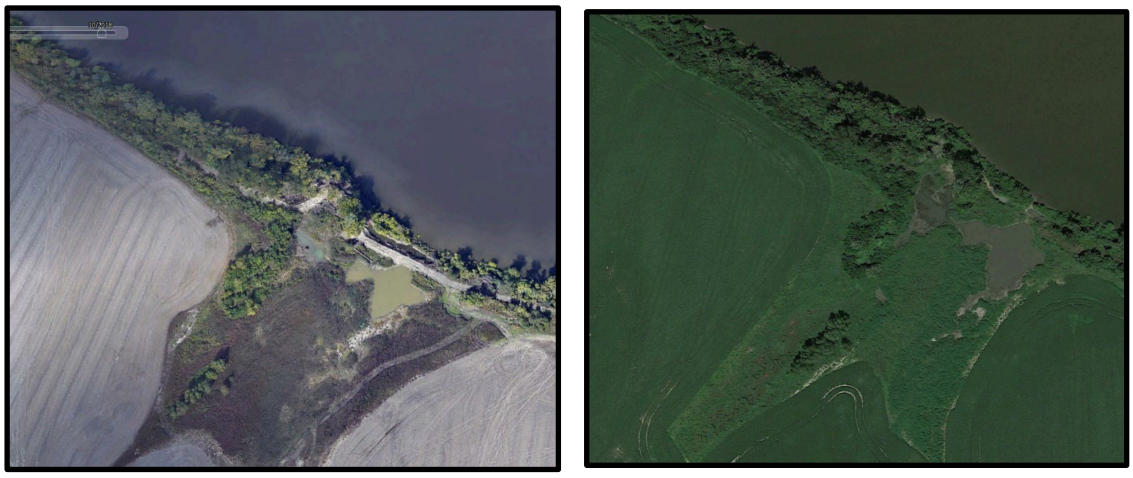


Figure 5-4. HB_2ab Imagery 1

Item HB_2b: The St. Louis San Francisco Railroad crosses over the swale right before it connects to the permanent waterbody and potential spawning area. There is a ~ 100 ft wide higher elevation forested area on the Hopefield Chute side of the crossing. This item proposes to modify the area to improve connectivity.

Figure 5-5. HB_2ab Imagery 2

HB_2ab proposes to modify two obstructions in Hopefield Chute. The two obstructions reduce connectivity of Hopefield Chute and its floodplain.

Table 5-2: HB_2ab Description

HB_2ab Description of Features			
Measure Description	Flow Restoration to Backwater Slough		
Construction Activity	Weirs and Stoplog Structures		
Model	Bidirectional		
Restoration Activity	Altering Connectivity		
Habitat	Slough (lentic aquatic)		
HB_2ab Items			
Item-Feature	**Meets Objective**	**Notes**	**Screened**
HB_2a – Degrade Rock Weir to Restore Flow to Backwater Slough	3	Degrade rock weir to connect to non-forested permanent water and non-forested wetland to HB_1. Downstream floodplain waterbody is 8 acres (Alligator Gar habitat is 47 acres).	No
HB_2b – Install Culverts to Restore Flow to Backwater Slough	3	Install larger culverts to improve connectivity to HB_1 for Alligator Gar et al. Downstream floodplain waterbody is 8 acres (Alligator Gar habitat is 47 acres).	No
HB_2ab Construction Assumptions			
HB_2a	R400 stone; degrade existing rock weir 8ft (assuming existing rock weir is 212ft). 200 LF long by 20ft. 1:1.5 side slopes. Excavation volume (20ft top, 44ft bottom), stone volume (20ft, 32ft bottom).		
HB_2b	Four 60in CMPs, 40 LF. Excavation for pipe and outlet/inlet armoring. Excavation for swale leading to bridge.		
HB_2ab Real Estate Assumptions			
HB_2a	Assume purchase of 8 aquatic acres of agricultural land.		
HB_2b			

HB_2ab OMRR&R Assumptions	
HB_2a	Channel cleanout O&M at years 15, 30, 45 estimated at 25% of construction cost; control structure O&M at year 30 estimated at 50% of construction cost.
HB_2b	
HB_2ab Adaptive Management & Monitoring Assumptions	
HB_2a	Aquatic Lidar Surveys (ROV)- Small Channels (A) at years 0,7 estimated at $2400/event; Fish & Invertebrate Surveys Monitoring - Bidirectional, Unidirectional, Isolation (A) at years 0, 3,5,7,10 estimated at $4167/event.
HB_2b	

5.3 HOPEFIELD POINT-BIG RIVER PARK (HB_2C)

The historic upstream flow path from Hopefield Chute, under the St. Louis San Francisco Railroad to the permanent waterbody still conveys water when the river is high. On the downstream end of the waterbody the flow path extends under Interstate 40, 55, two railroads and a local road. Although downstream connectivity is generally preferred, enhancing the upstream flow path (swale) for this waterbody is the more feasible option. This would involve re-creating the historic swale which has been partially leveled for agriculture. The swale would be planted with herbaceous hydrophytic plants. These plants would also remove nutrients and sediment reducing transport to the permanent waterbody and Hopefield Chute. The planting area represents the acreage.

HB_2c proposes to re-create the historic swale of the upstream flow path from Hopefield Chute.

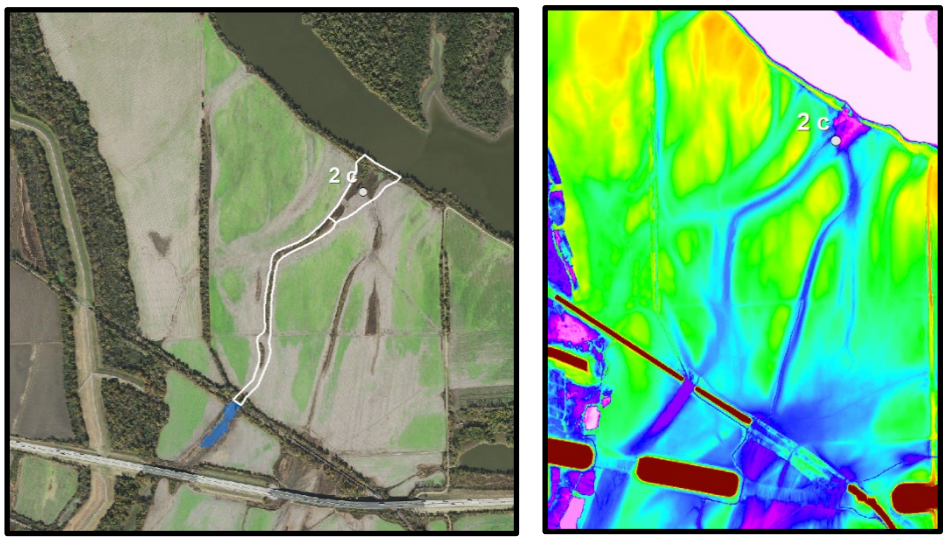


Figure 5-6. HB_2c

Table 5-3: HB_2c Description

HB_2c Description of Features			
Measure Description	Flow Restoration and Wetland Complex Restoration		
Construction Activity	Earthwork		
Model	HGM		
Restoration Activity	Enhance and Restore Natural Vegetation		
Habitat	Seasonally herbaceous wetland (aquatic & floodplain)		
HB_2c			
Item-Feature	**Meets Objective**	**Notes**	**Screened**
HB_2c	3	Establish swale/acquire non-productive farmland (22 acres = dimensions of ~4,750 ft length x ~210 ft average width) to connect non-forested downstream area to HB_1 for Alligator Gar.	No
HB_2c Construction Assumptions			

HB_2c	Assume excavation 4,750ft long, 200ft wide, 1:10 side slopes, 3ft deep at the center, no hauling (either ditch berm or spread through field). 89,722 CY.

HB_2c Real Estate Assumptions	
HB_2c	Assume purchase of 22 floodplain acres of agricultural land.
HB_2c OMRR&R Assumptions	
HB_2c	Channel cleanout O&M at years 15, 30, 45 estimated at 25% of construction cost.
HB_2c Adaptive Management & Monitoring Assumptions	
HB_2c	HGM AMM costs provided by ERDC.

5.4 HOPEFIELD POINT-BIG RIVER PARK (HB_3)

Borrow area labeled HB_3 was present in its current configuration with similar surrounding landcover in 1985 (G. Earth). The soils in this area are partially to all hydric and predominantly Commerce silt loam or Sharkey silty clay with pockets of Bowdre silty clay or Tunica clay (NWIS, SSURGO). The project team chose not to alter the connectivity of these sites. Interstate 40, 55, two railroads and numerous local roads cross the area. Additionally numerous drainage ways have been built, creating a complex system of interconnecting channels.

HB_3 proposes to deepen accessible existing borrow area to improve habitat for slack water species.

Figure 5-7. HB_3

Table 5-4: HB_3 Description

HB_3 Description of Features			
Measure Description	Restoring Habitat Complexity in Borrow Area		
Construction Activity	Earthwork		
Model	Borrow		
Restoration Activity	Waterbody Enhancement		
Habitat	Borrow areas (lentic aquatic)		
HB_3 Items			
Item-Feature	**Meets Objective**	**Notes**	**Screened**
HB_3a	3	Increase habitat complexity and depths to 6-acre borrow pit/floodplain waterbody. *Screening criteria: screened in final array of alternatives.*	Yes – Final Array
HB_3 Construction Assumptions			
HB_3a	For quantity and cost development, assume 5ft depth (for a total of 10ft) over 75% of the borrow area including mobilization/demobilization, no hauling. Should be		

	noted that during actual construction of the borrow pit, it should not be excavated deeper than the original design elevations so as to not negatively impact the levee, I-40, I-55 or railroad crossings.
HB_3 Real Estate Assumptions	
HB_3a	Assume purchase of 6 aquatic acres of woodlands.
HB_3 OMRR&R Assumptions	
HB_3a	None - borrow O&M removed from costs following benefit evaluation.
HB_3 Adaptive Management & Monitoring Assumptions	
HB_3a	Fish Survey - Borrow Areas at years 0,3,5,7,10 estimated at $5455/event.

5.5 HOPEFIELD POINT-BIG RIVER PARK (HB_4)

Borrow area labeled HB_4 was present in its current configuration with similar surrounding landcover in 1985 (G. Earth). The soils in this area are partially to all hydric and predominantly Commerce silt loam or Sharkey silty clay with pockets of Bowdre silty clay or Tunica clay (NWIS, SSURGO). The project team chose not to alter the connectivity of these sites. Interstate 40, 55, two railroads and numerous local roads cross the area. Additionally numerous drainage ways have been built, creating a complex system of interconnecting channels.

HB_4 proposes to deepen accessible existing borrow area to improve habitat for slack water species.

Figure 5-8. HB_4

Table 5-5: HB_4 Description

HB_4 Description of Features			
Measure Description	Restoring Habitat Complexity in Borrow Area		
Construction Activity	Earthwork		
Model	Borrow		
Restoration Activity	Waterbody Enhancement		
Habitat	Borrow areas (lentic aquatic)		
HB_4			
Item-Feature	**Meets Objective**	**Notes**	**Screened**
HB_4a	3	Increase habitat complexity and depths to 7-acre borrow pit/floodplain waterbody. *Screening criteria: screened in final array of alternatives.*	Yes – Final Array
HB_4 Construction Assumptions			
HB_4a	For quantity and cost development, assume 5ft depth (for a total of		

	10ft) over 75% of the borrow area including mobilization/demobilization, no hauling. Should be noted that during actual construction of the borrow pit, it should not be excavated deeper than the original design elevations so as to not negatively impact the levee, I-40, I-55 or railroad crossings.
HB_4 Real Estate Assumptions	
HB_4a	Assume purchase of 7 aquatic acres of woodlands.
HB_4 OMRR&R Assumptions	
HB_4a	None - borrow O&M removed from costs following benefit evaluation.
HB_4 Adaptive Management & Monitoring Assumptions	
HB_4a	Fish Survey - Borrow Areas at years 0,3,5,7,10 estimated at $5455/event.

5.6 HOPEFIELD POINT-BIG RIVER PARK (HB_5)

Borrow area labeled HB_5 was present in its current configuration with similar surrounding landcover in 1985 (G. Earth). The soils in this area are partially to all hydric and predominantly Commerce silt loam or Sharkey silty clay with pockets of Bowdre silty clay or Tunica clay (NWIS, SSURGO). The project team chose not to alter the connectivity of these sites. Interstate 40, 55, two railroads and numerous local roads cross the area. Additionally numerous drainage ways have been built, creating a complex system of interconnecting channels.

HB_5 proposes to deepen accessible existing borrow area to improve habitat for slack water species.

Figure 5-9. HB_5

Table 5-6: HB_5 Description

HB_5 Description of Features			
Measure Description	Restoring Habitat Complexity in Borrow Area		
Construction Activity	Earthwork		
Model	Borrow		
Restoration Activity	Waterbody Enhancement		
Habitat	Borrow areas (lentic aquatic)		
HB_5 Items			
Item-Feature	**Meets Objective**	**Notes**	**Screened**
HB_5a	3	Increase habitat complexity and depths to 6-acre borrow pit/floodplain waterbody. *Screening criteria: screened in final array of alternatives.*	Yes – Final Array
HB_5 Construction Assumptions			
HB_5a	For quantity and cost development, assume 5ft depth (for a total of 10ft) over 75% of the borrow area including mobilization/demobilization, no hauling. Should be noted that during actual construction of the borrow pit, it should not be excavated		

	deeper than the original design elevations so as to not negatively impact the levee, I-40, I-55 or railroad crossings.
HB_5 Real Estate Assumptions	
HB_5a	Assume purchase of 6 aquatic acres of woodlands.
HB_5 OMRR&R Assumptions	
HB_5a	None - borrow O&M removed from costs following benefit evaluation.
HB_5 Adaptive Management & Monitoring Assumptions	
HB_5a	Fish Survey - Borrow Areas at years 0,3,5,7,10 estimated at $5455/event.

5.7 HOPEFIELD POINT-BIG RIVER PARK (HB_6)

Borrow area labeled HB_6 was present in its current configuration with similar surrounding landcover in 1997 (G. Earth). With the upgrades to the interstates, HB_9, and Hb_8 appear in 2001 (G. Earth). The soils in this area are partially to all hydric and predominantly Commerce silt loam or Sharkey silty clay with pockets of Bowdre silty clay or Tunica clay (NWIS, SSURGO). The project team chose not to alter the connectivity of these sites. Interstate 40, 55, two railroads and numerous local roads cross the area. Additionally numerous drainage ways have been built, creating a complex system of interconnecting channels.

HB_6 proposes to deepen accessible existing borrow area to improve habitat for slack water species.

Figure 5-10. HB_6

Table 5-7: HB_6 Description

HB_6 Description of Features			
Measure Description	Restoring Habitat Complexity in Borrow Area		
Construction Activity	Earthwork		
Model	Borrow		
Restoration Activity	Waterbody Enhancement		
Habitat	Borrow areas (lentic aquatic)		
HB_6			
Item-Feature	**Meets Objective**	**Notes**	**Screened**
HB_6a	3	Increase habitat complexity and depths to 13-acre borrow pit/floodplain waterbody. *Screening criteria: screened in final array of alternatives.*	Yes – Final Array
HB_6 Construction Assumptions			
HB_6a	For quantity and cost development, assume 5ft depth (for a total of 10ft) over 75% of the borrow area including mobilization/demobilization, no hauling. Should be noted that during actual construction of the borrow pit, it should not be excavated deeper than the original design elevations so as to not negatively impact the levee, I-40, I-55 or railroad crossings.		
HB_6 Real Estate Assumptions			
HB_6a	Assume purchase of 13 aquatic acres of woodlands.		
HB_6 OMRR&R Assumptions			
HB_6a	None - borrow O&M removed from costs following benefit evaluation.		
HB_6 Adaptive Management & Monitoring Assumptions			
HB_6a	Fish Survey - Borrow Areas at years 0,3,5,7,10 estimated at $5455/event.		

5.8 HOPEFIELD POINT-BIG RIVER PARK (HB_7)

Borrow area labeled HB-7 was present in its current configuration with similar surrounding landcover in 1985 (G. Earth). The soils in this area are partially to all hydric and predominantly Commerce silt loam or Sharkey silty clay with pockets of Bowdre silty clay or Tunica clay (NWIS, SSURGO). The project team chose not to alter the connectivity of these sites. Interstate 40, 55, two railroads and numerous local roads cross the area. Additionally numerous drainage ways have been built, creating a complex system of interconnecting channels.

HB_7 proposes to deepen accessible existing borrow area to improve habitat for slack water species.

Figure 5-11. HB_7

Table 5-8: HB_7 Description

HB_7 Description of Features	
Measure Description	Restoring Habitat Complexity in Borrow Area
Construction Activity	Earthwork
Model	Borrow
Restoration Activity	Waterbody Enhancement
Habitat	Borrow areas (lentic aquatic)
HB_7 Items	

Item-Feature	Meets Objective	Notes	Screened
HB_7a	3	Increase habitat complexity by deepening to 8-acre borrow pit/floodplain waterbody. (can increase connectivity or not) *Screening criteria: screened in final array of alternatives.*	Yes – Final Array
HB_7 Construction Assumptions			
HB_7a	For quantity and cost development, assume 5ft depth (for a total of 10ft) over 75% of the borrow area including mobilization/demobilization, no hauling. Should be noted that during actual construction of the borrow pit, it should not be excavated deeper than the original design elevations so as to not negatively impact the levee, I-40, I-55 or railroad crossings.		
HB_7 Real Estate Assumptions			
HB_7a	Assume purchase of 8 aquatic acres of woodlands.		
HB_7 OMRR&R Assumptions			
HB_7a	None - borrow O&M removed from costs following benefit evaluation.		
HB_7 Adaptive Management & Monitoring Assumptions			
HB_7a	Fish Survey - Borrow Areas at years 0,3,5,7,10 estimated at $5455/event.		

5.9 HOPEFIELD POINT-BIG RIVER PARK (HB_8)

Borrow area labeled HB_8 appear in 2001 (G. Earth) with the upgrades to the interstates. The soils in this area are partially to all hydric and predominantly Commerce silt loam or Sharkey silty clay with pockets of Bowdre silty clay or Tunica clay (NWIS, SSURGO). The project team chose not to alter the connectivity of these sites. Interstate 40, 55, two railroads and numerous local roads cross the area. Additionally numerous drainage ways have been built, creating a complex system of interconnecting channels.

HB_8 proposes to deepen accessible existing borrow area to improve habitat for slack water species.

Figure 5-12. HB_8

Table 5-9: HB_8 Description

HB_8 Description of Features			
Measure Description	Restoring Habitat Complexity in Borrow Area		
Construction Activity	Earthwork		
Model	Borrow		
Restoration Activity	Waterbody Enhancement		
Habitat	Borrow areas (lentic aquatic)		
HB_8 Items			
Item-Feature	**Meets Objective**	**Notes**	**Screened**
HB_8a – Restore Depth and Complexity to Borrow Pit	3	Increase habitat complexity and depth to 16 acre borrow pit/floodplain waterbody. Don't need to alter connectivity. *Screening criteria: screened in final array of alternatives.*	Yes – Final Array

HB_8 Construction Assumptions	
HB_8a	For quantity and cost development, assume 5ft depth (for a total of 10ft) over 75% of the borrow area including mobilization/demobilization, no hauling. Should be noted that during actual construction of the borrow pit, it should not be excavated deeper than the original design elevations so as to not negatively impact the levee, I-40, I-55 or railroad crossings.
HB_8 Real Estate Assumptions	
HB_8a	Assume purchase of 16 aquatic acres of woodlands.
HB_8 OMRR&R Assumptions	
HB_8a	None - borrow O&M removed from costs following benefit evaluation.
HB_8 Adaptive Management & Monitoring Assumptions	
HB_8a	Fish Survey - Borrow Areas at years 0,3,5,7,10 estimated at $5455/event.

5.10 HOPEFIELD POINT-BIG RIVER PARK (HB_9)

Borrow area labeled HB_9 appear in 2001 (G. Earth) with the upgrades to the interstates. The soils in this area are partially to all hydric and predominantly Commerce silt loam or Sharkey silty clay with pockets of Bowdre silty clay or Tunica clay (NWIS, SSURGO). The project team chose not to alter the connectivity of these sites. Interstate 40, 55, two railroads and numerous local roads cross the area. Additionally numerous drainage ways have been built, creating a complex system of interconnecting channels.

HB_9 proposes to deepen accessible existing borrow area to improve habitat for slack water species.

Figure 5-13. HB_9

Table 5-10: HB_9 Description

HB_9 Description of Features			
Measure Description	Restoring Habitat Complexity in Borrow Area		
Construction Activity	Earthwork		
Model	Borrow		
Restoration Activity	Waterbody Enhancement		
Habitat	Borrow areas (lentic aquatic)		
HB_9 Items			
Item-Feature	**Meets Objective**	**Notes**	**Screened**
HB_9a	3	Increase habitat complexity and depth to 12-acre floodplain waterbody. *Screening criteria: screened in final array of alternatives.*	Yes – Final Array
HB_9 Construction Assumptions			
HB_9a	For quantity and cost development, assume 5ft depth (for a total of 10ft) over 75% of the borrow area including mobilization/demobilization, no hauling. Should be		

	noted that during actual construction of the borrow pit, it should not be excavated deeper than the original design elevations so as to not negatively impact the levee, I-40, I-55 or railroad crossings.
HB_9 Real Estate Assumptions	
HB_9a	Assume purchase of 12 aquatic acres of woodlands.
HB_9 OMRR&R Assumptions	
HB_9a	None - borrow O&M removed from costs following benefit evaluation.
HB_9 Adaptive Management & Monitoring Assumptions	
HB_9a	Fish Survey - Borrow Areas at years 0,3,5,7,10 estimated at $5455/event.

5.11 HOPEFIELD POINT-BIG RIVER PARK (HB_10)

Although close to the river, this borrow area is isolated by elevated roads and a berm around the borrow area. The isolation of this borrow area could be enhanced by increasing the southern outlet channel elevation. Elevation data suggests the channel is approximately 30 ft wide with an invert around 203.5 ft. The channel could be filled to around 208 ft without inundating the adjacent ground. This would promote a unique slack water species assemblage. The borrow area's proximity to the main channel would allow these species to be moved throughout the LMR during times of high flood. The borrow area would serve as a source of rare species for the riverine ecosystem. The acreage for this measure is the borrow area supplemented by Hopefield Chute and the adjacent river channel.

HB_10 proposes to enhance the isolation of this borrow area by increasing the southern outlet channel elevation.

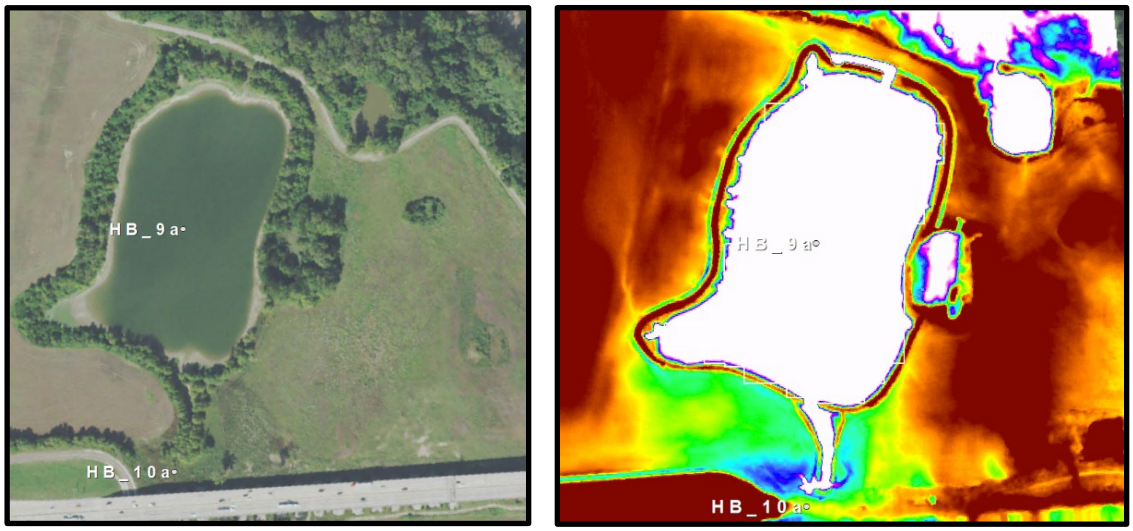


Figure 5-14. HB_10

Table 5-11: HB_10 Description

HB_10 Description of Features			
Measure Description	Isolation of a Floodplain Waterbody		
Construction Activity	Riprap Bank Protection		
Model	Isolation Floodplain		
Restoration Activity	Altering Connectivity		
Habitat	Borrow areas (lentic aquatic)		
HB_10 Items			
Item-Feature	**Meets Objective**	**Notes**	**Screened**
HB_10a	3	Enhance lake isolation by installing a control structure (12-acre floodplain waterbody). *Screening criteria: screened in final array of alternatives.*	Yes – Final Array
HB_10 Construction Assumptions			

HB_10a	20ft bank paving either side 18in thick (170 TN), R200; 5ft rock fill, 50ft structure length, 1:1.5 side slopes, 6ft crown (67.5 sq ft)..
HB_10 Real Estate Assumptions	
HB_10a	Assume purchase of 12 aquatic acres of woodlands.
HB_10 OMRR&R Assumptions	
HB_10a	Control structure O&M at year 30 estimated at 50% of construction cost..
HB_10 Adaptive Management & Monitoring Assumptions	
HB_10a	Fish Survey - Borrow Areas at years 0,3,5,7,10 estimated at $5455/event.

Section 6

Island 35 – Deans Island Complex

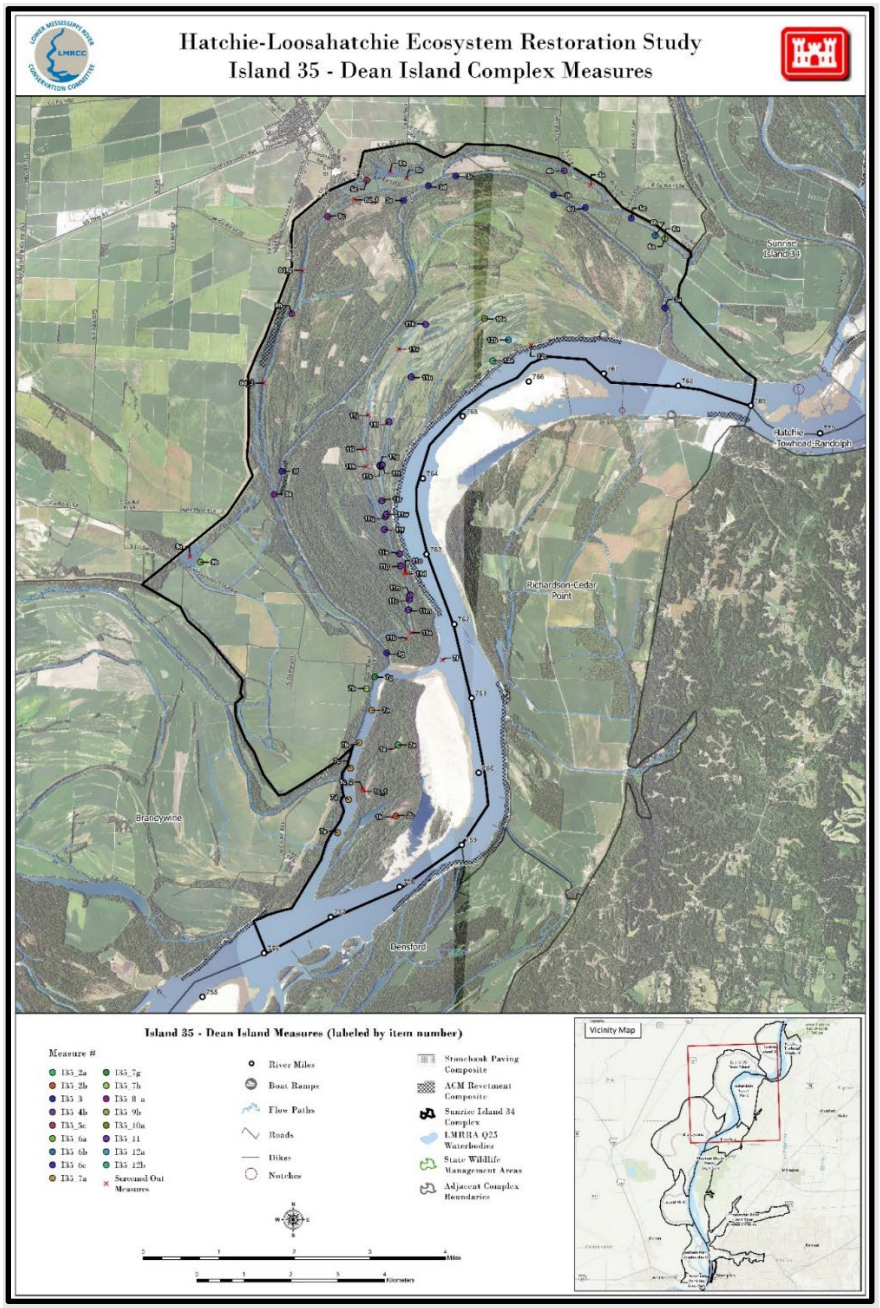


Figure 6-1 Island 35 Deans Island Complex

6.1 ISLAND 35-DEANS ISLAND (I35_1A)

Island 35-Deans Island (I35_1a) proposes to enhance connectivity to a bare area on Deans Island to improve Alligator Gar spawning habitat. The river exceeded this areas' average ground elevation from 7/8 May to 20/22 May 2017. This inundation period is too short for use by Alligator Gar. Upon further review it was determined that the area is too high to support Alligator Gar spawning habitat. Therefore, the measure was screened out.

Figure 6-2. I35_1a

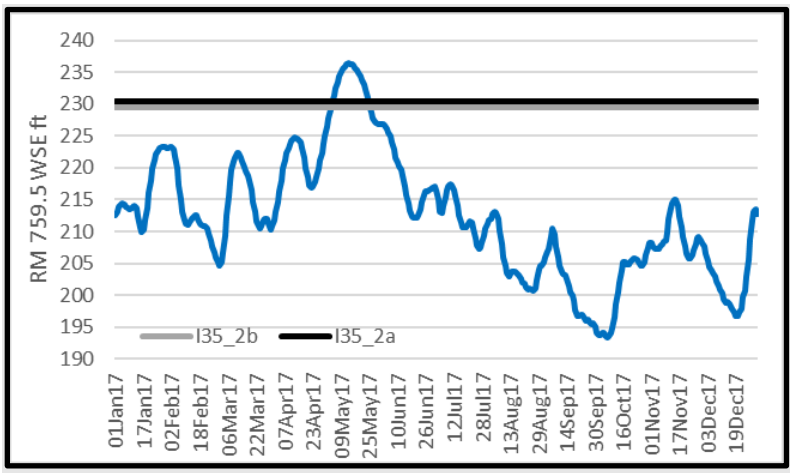


Figure 6-3. I35_1a

Table 6-1: I35_1a Description

I35_1a Description of Features			
Measure Description	Flow Restoration to Wetland		
Construction Activity	N/A		
Model	N/A		
Restoration Activity	Altering Connectivity		
Habitat	N/A		
I35_1a Items			
Item - Feature	**Meet Objective**	**Notes**	**Screened**
I35_1a	3	Either deepen or place weir at flow path to hold water in open field for Alligator Gar spawning. Cannot be done with 2a. *Screening Criteria: An average year of flow (2017), there is only 16 days of inundation which is the on the eI35_1treme low end of viability for Alligator Gar spawning success.*	Yes – Pre CEICA
I35_1a Construction Assumptions			
I35_1a	None; screened prior to construction estimation.		
I35_1a Real Estate Assumptions			
I35_1a	None; screened prior to real estate estimation.		
I35_1a OMRR&R Assumptions			
I35_1a	None; screened prior to OMRR&R estimation.		
I35_1a Adaptive Management & Monitoring Assumptions			
I35_1a	None; screened prior to AMM estimation.		

6.2 ISLAND 35-DEANS ISLAND (I35_1B)

Island 35-Deans Island (I35_1b) proposes to enhance connectivity to the southern bare area on Deans Island to improve Alligator Gar spawning habitat. The river exceeded

these areas' average ground elevation from 7/8 May to 20/22 May 2017. This inundation period is too short for use by alligator gar. Upon further review it was determined that the area is too high to support Alligator Gar spawning habitat. Therefore, the measure was screened out.

Table 6-2: I35_1b Description

I35_1b Description of Features			
Measure Description	Flow Restoration to Wetland		
Construction Activity	N/A		
Model	N/A		
Restoration Activity	Altering Connectivity		
Habitat	N/A		
I35_1b Items			
Item-Feature	**Meet Objective**	**Notes**	**Screened**
I35_1b	3	Either deepen or place weir at flow path to hold water in open field for Alligator Gar spawning. Cannot be done with 2b. *Screening Criteria: An average year of flow (2017), there is only 16 days of inundation which is the on the extreme low end of viability for alligator gar spawning success.*	Yes – Pre CEICA
I35_1b Construction Assumptions			
I35_1b	None; screened prior to construction estimation.		
I35_1b Real Estate Assumptions			
I35_1b	None; screened prior to real estate estimation.		
I35_1b OMRR&R Assumptions			
I35_1b	None; screened prior to OMRR&R estimation.		
I35_1b Adaptive Management & Monitoring Assumptions			

I35_1b	None; screened prior to AMM estimation.

6.3 ISLAND 35-DEANS ISLAND (I35_1C)

Island 35-Deans Island (I35_1c proposes to install water control structures to hold water on open areas on Deans Island to improve Alligator Gar spawning habitat. Upon further review it was determined that the area currently receives sufficient inundation for Alligator Gar spawning success. These open areas are low elevation (longer inundation) with unobstructed connectivity making them suitable habitat. Therefore, the measure was screened out.

Table 6-3: I35_1c Description

I35_1c Description of Features			
Measure Description	Flow Restoration to Wetland		
Construction Activity	N/A		
Model	N/A		
Restoration Activity	Altering Connectivity		
Habitat	N/A		
Island 35-Deans Island (I35_1c			
Item-Feature	**Meets Objective**	**Notes**	**Screened**
I35_1c1	3	Install control structure to hold water for Alligator Gar spawning. *Screening Criteria: Site already receives sufficient inundation for Alligator Gar spawning success.*	Yes – Pre CEICA
I35_1c2	3	Install control structure to hold water for Alligator Gar spawning.	Yes – Pre CEICA

		Screening Criteria: Site already receives 1.5 month of inundation on avg, year (2017 flows) and has access channel to the north	
I35_1c Construction Assumptions			
I35_1c1	None; screened prior to construction estimation.		
I35_1c2			
I35_1c Real Estate Assumptions			
I35_1c1	None; screened prior to real estate estimation.		
I35_1c2			

I35_1c OMRR&R Assumptions	
I35_1c1	None; screened prior to OMRR&R estimation.
I35_1c2	
35_1c Adaptive Management & Monitoring Assumptions	
I35_1c1	None; screened prior to AMM estimation.
I35_1c2	

6.4 ISLAND 35-DEANS ISLAND (I35_2)

There are two bare areas (outlined in white on image) on Dean Island with average elevations around 230.5 and 299.4 ft. The inundation period of the bare areas is short making them suitable for reforestation with mast producing trees. Areas 2a and 2b are classified as Entisols crevasse loamy sand (SSURGO) and 1-25% hydric (NWI).

Island 35-Deans Island (I35_2) proposes the reforestation of two bare areas from non-forest to mast producing forest to enhance the composition and size of forest on Dean Island.

Figure 6-4. I35_2

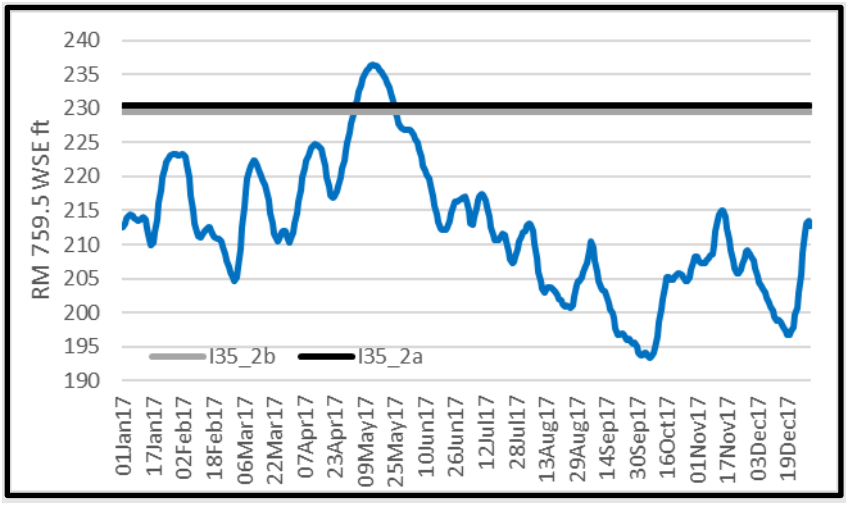


Figure 6-5. I35_2

Table 6-4: I35_2 Description

I35_2 Description of Features	
Measure Description	Reforestation – BLH

Construction Activity	Floodplain Vegetative
Model	HGM
Restoration Activity	Enhance and Restore Natural Vegetation
Habitat	BLH (floodplain)

I35_2 Items			
Item-Feature	Meets Objective	**Notes**	**Screened**
I35_2a	1	Reforest this high field in mast producers (10 acres) Cannot be done with 1a	No
I35_2b	1	Reforest this high field in mast producers (13 acres) Cannot be done with 1b	No

I35_2 Construction Assumptions	
I35_2a	HGM costs provided by ERDC.
I35_2b	

I35_2 Real Estate Assumptions	
I35_2a	Assumes purchase of 10 floodplain acres of woodlands (including floodplain waterbodies (i.e., borrow areas, lakes, etc.)).
I35_2b	Assumes purchase of 32 floodplain acres of woodlands (including floodplain waterbodies (i.e., borrow areas, lakes, etc.)).

I35_2 OMRR&R Assumptions	
I35_2a	None
I35_2b	

I35_2 Adaptive Management & Monitoring Assumptions	
I35_2a	HGM AMM costs provided by ERDC.
I35_2b	

6.5 ISLAND 35-DEANS ISLAND (I35_3)

There is a mid-channel bar in the location of Island 35 in 1765 to 1915 channel outlines (Harmar and Clifford 2006). In 1930, the left channel, destined to become the main channel, has captured more flow. The island has also been divided, more closely resembling the current day Towhead of Island 35 and Island 35 (Harmar and Clifford 2006). In 1950s and 60s topographic maps, the right channel around Island 35 and the towhead is illustrated as a series of isolated sloughs (USGS 1956-1963). The channel is illustrated as a meander scarp in the 1970s while the towhead remains a series of isolated sloughs (USGS 1972).

There is no recent bathymetric survey for the Island 35 Chute. The channel is never dry in NAIP 2010 – 2021, except for the obstructions identified. The current elevation of each obstruction (pile dike, sediment plug, or bridge) was determined from the 2012 NAIP image using the daily slope method (Oliver et al. 2022). The NAIP 2012 image was used because it was the lowest low water high resolution image available within the past ~10 years. For obstructions that showed some flow in 2012, 0.5 ft was subtracted from the calculated elevation. For the bridge (item Island 35-Deans Island (I35_3e), its invert was assumed to be the same as the nearest sediment plug. Since channel depth is unknown, project engineers proposed to remove 5 ft from each obstruction.

At first, this channel was evaluated to remove all identified obstructions resulting in items Island 35-Deans Island (I35_3a – 3e). As planning progressed, the team began to consider that the non-vegetated sediment plugs may erode if the inverts of the manmade obstructions were lowered. When other meander scarps were evaluated, the team adopted this assumption. Therefore, items Island 35-Deans Island (I35_3c, 3d, 3f, and 3g) were screened out as they represented un-vegetated sediment. The remaining items involve:

- I35_3a Dredge sediment deposition area around old pile dike
- I35_3b Dredge highest elevation sediment deposition area that has begun to vegetate
- I35_3e Lower invert of Crane Road bridge

The acreage for this measure is Island 35 Chute which would receive enhanced connectivity. The supplemental acreage is the downstream waterbodies which connect to this area of improved connectivity.

Island 35-Deans Island (I35_3) proposes removal of obstructions to increase connectivity and channel flow to Island 35 Chute.

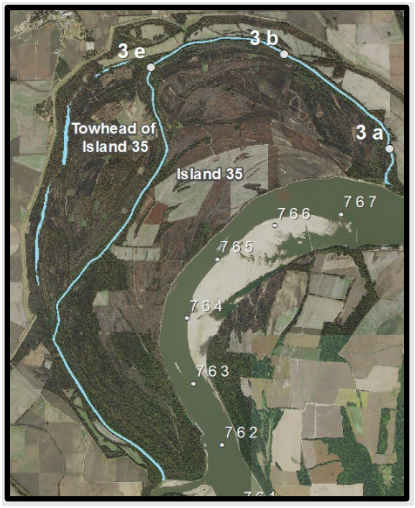


Figure 6-6. I35_3

Table 6-5: I35_3 Description

I35_3 Description of Features			
Measure Description	Meander Scarp Flow Restoration		
Construction Activity	Earthwork		
Model	Unidirectional		
Restoration Activity	Altering Connectivity		
Habitat	Meander Scarp/ tertiary channels (lotic aquatic)		
I35_3 Items			
Item-Feature	**Meets Objective**	**Notes**	**Screened**
I35_3a	3	Plug removal by dragline in Island 35 Meander Scarp (600-ft. X 150-ft width x 5-ft. width). This is also an old pile dike showing on 1937 Nav Map.	Yes – CEICA Round 1

		Screening Criteria: first iteration of CEICA showed poor performance.	
I35_3b	3	Plug removal by dragline in Island 35 Meander Scarp Highest Elevation Plug (800-ft. X 180-ft width x 5-ft. width). *Screening Criteria: first iteration of CEICA showed poor performance.*	
I35_3c	3	Plug removal by dredge in Island 35 Meander Scarp (1200-ft. X 160-ft width x 5-ft. width). *Screening criteria: Optimized with scaled analysis and updated assumptions. Screened due to erosion concerns with lowering inverts for non-vegetated sediment plugs.*	Yes – Pre CEICA
I35_3d	3	Plug removal by dredge in Island 35 Meander Scarp (1250-ft. X 180-ft width x 5-ft. width). *Screening criteria: Optimized with scaled analysis and updated assumptions. Screened due to erosion concerns with lowering inverts for non-vegetated sediment plugs.*	
I35_3e	3	Bridge Replacement (including lowering invert of bridge) in Island 35 Meander Scarp. *Screening Criteria: first iteration of CEICA showed poor performance.*	Yes – CEICA Round 1
I35_3f	3	Plug removal by dredge in Island 35 Meander Scarp (1000-ft. X 180-ft width x 5-ft. width). *Screening criteria: Optimized with scaled analysis and updated assumptions. Screened due to erosion*	Yes – Pre CEICA

		concerns with lowering inverts for non-vegetated sediment plugs.	
I35_3g	3	Plug removal by dredge in Island 35 Meander Scarp (3200-ft. X 190-ft width x 5-ft. width). *Screening criteria: Optimized with scaled analysis and updated assumptions. Screened due to erosion concerns with lowering inverts for non-vegetated sediment plugs.*	

I35_3 Construction Assumptions	
I35_3a	Assuming contract dredge based on work in Upper Yazoo Basin (MVK) for I35_3 (3a, 3b, 3c, 3f, 3g) and cleanout (600-ft. X 150-ft width x 5-ft. width = 18333 CY).
I35_3b	Assuming contract dredge based on work in Upper Yazoo Basin (MVK) for I35_3 (3a, 3b, 3c, 3f, 3g) and cleanout (800-ft. X 180-ft width x 5-ft. width= 29333 CY).
I35_3c	Assuming contract dredge based on work in Upper Yazoo Basin (MVK) for I35_3 (3a, 3b, 3c, 3f, 3g) and cleanout (1200-ft. X 160-ft width x 5-ft. width = 39111 CY).
I35_3d	Assuming contract dredge based on work in Upper Yazoo Basin (MVK) for I35_3 (3a, 3b, 3c, 3f, 3g) and cleanout (1250-ft. X 180-ft width x 5-ft. width = 45833 CY).
I35_3e	Bridge Replacement cost based off of AR DOT bridge replacement assuming competitive bid contract and 15% contingency.
I35_3f	Assuming contract dredge based on work in Upper Yazoo Basin (MVK) for I35_3 (3a, 3b, 3c, 3f, 3g) and cleanout (1000-ft. X 180-ft width x 5-ft. width = 36667 CY).
I35_3g	Assuming contract dredge based on work in Upper Yazoo Basin (MVK) for I35_3 (3a, 3b, 3c, 3f, 3g) and cleanout (3200-ft. X 190-ft width x 5-ft. width = 123852 CY).

I35_3 Real Estate Assumptions	
I35_3a	Assumes purchase of 35 aquatic acres of agricultural land for construction activities.
I35_3b	
I35_3c	
I35_3d	
I35_3e	
I35_3f	

I35_3g	
I35_3 OMRR&R Assumptions	
I35_3a	Channel cleanout O&M at years 15, 30, 45 estimated at 25% of initial construction cost.
I35_3b	
I35_3c	
I35_3d	
I35_3e	None
I35_3f	Channel cleanout O&M at years 15, 30, 45 estimated at 25% of initial construction cost.
I35_3g	
I35_3 Adaptive Management & Monitoring	
I35_3a	Aquatic Bathymetric Survey - Rivers/Secondary Channels (A) at years 0,1,3,5,7,10 estimated at $450/mile; Fish & Invertebrate Surveys Monitoring - Bidirectional, Unidirectional, Isolation (A) at years 0, 3,5,7,10 estimated at $4167/event.
I35_3b	
I35_3c	
I35_3d	
I35_3e	
I35_3f	
I35_3g	

6.6 ISLAND 35-DEANS ISLAND (I35_4A)

Table 6-6: I35_4a Description

I35_4a Description of Features	
Measure Description	Restoring Habitat Complexity in Borrow Area
Construction Activity	Earthwork
Model	N/A
Restoration Activity	Waterbody Enhancement

Habitat		N/A	
I35_4a Items			
Item-Feature	**Meets Objective**	**Notes**	**Screened**
I35_4a	1, 3	Restore Depths and habitat complexity of Borrow Pit but maintain isolation. Geotech to tell us how deep based on existing seepage studies. *Screening criteria: Geotech screened due to seepage concerns.*	Yes – Pre CEICA
I35_4a Construction Assumptions			
I35_4a		Assumed 75% of area will be excavated 5-ft (for total depth of ~10ft) based on Borrow Pit Recommendations at a cost of $6/cubic yard and material placed on-site. 2 ponds 5-acre and a 4.6 acres and waterbody.	
I35_4a Real Estate Assumptions			
I35_4a		None; screened prior to real estate estimation.	
I35_4a OMRR&R Assumptions			
I35_4a		None; screened prior to OMRR&R estimation.	
I35_4a Adaptive Management & Monitoring Assumptions			
I35_4a		None; screened prior to AMM estimation.	

6.7 ISLAND 35-DEANS ISLAND (I35_4B)

These borrow areas are isolated by levee and road. There is a culvert under the road, item. Island 35-Deans Island (I35_4b. The channel decreases in elevation as it goes from the culvert to its connection with Island 35 Chute so changing the culvert elevation would change the connectivity. The borrow areas connect thru a manmade channel to Island 35 Chute 11.7% of days between 2010 and 2019 with an estimated culvert invert of 229 ft. The adjacent high elevation ag field ranges in elevation from 233.6 – 236.9 ft. Because the borrow area is surrounded on all sides by levee or road, there is no sheet flow to determine a connection elevation. This measure proposes to replace and raise the culvert to isolate the borrow areas while preventing ag land inundation. Acreage for this measure

is the borrow areas with supplemental benefits to I35 Chute and the adjacent main channel.

Island 35-Deans Island (I35_4b) proposes to replace and raise the culvert to isolate the borrow areas while preventing agricultural land inundation. This will also promote slack water and wetland species and reduce invasive carp immigration.

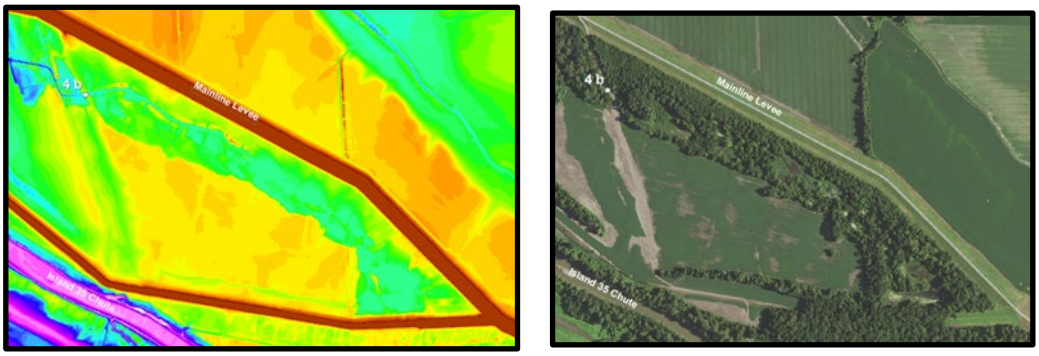


Figure 6-7. I35_4b

Table 6-7: I35_4b Description

I35_4b Description of Features			
Measure Description	Isolation of Floodplain Waterbody		
Construction Activity	Culverts; Riprap Bank Protection		
Model	Isolation		
Restoration Activity	Altering Connectivity		
Habitat	Borrow Areas (lentic aquatic)		
I35_4b Items			
Item-Feature	**Meet Objective**	**Notes**	**Screened**
I35_4b	3	Increase invert of culvert from 69.8m to 71m to maintain isolated borrow pit.	Yes – Yes CEICA Round 2

		Screening criteria: second iteration of CEICA showed poor performance.	
I35_4b Construction Assumptions			
I35_4b	Assume 36-in CMP culvert replacement for 50-ft. length, including demobilization costs. 73.5 tons R-200 riprap inlet/outlet protection.		
I35_4b Real Estate Assumptions			
I35_4b	Assumes purchase of 5 aquatic acres of woodlands (including floodplain waterbodies (i.e., borrow areas, lakes, etc.).		
I35_4b OMRR&R Assumptions			
I35_4b	For CMP, O&M at year 30 (100% of initial cost); For R-200, O&M at years 15, 30, 45 (50% of initial cost).		
I35_4b Adaptative Management and Monitoring Assumptions			
I35_4b	Fish & Invertebrate Surveys Monitoring – Bidirectional, Unidirectional, Isolation (A) at years 0, 3,5,7,10 estimated at $4167/event.		

6.8 ISLAND 35-DEANS ISLAND (I35_5A)

Island 35-Deans Island (I35_5a) proposes to restore depth and habitat complexity to Golden Lake Crevasses. The Golden Lake Crevasses is currently maintained by a flow path that connects to the Island 35 Towhead Chute to the west. This item was screened out due potential seepage issues resulting from its proximity to the levee.

Table 6-8: I35_5a Description

I35_5a Description of Features	
Measure Description	Restoring Habitat Complexity in Crevasse
Construction Activity	Earthwork
Model	N/A
Restoration Activity	Waterbody Enhancement
Habitat	N/A
I35_5a Items	

Item – Feature	Meet Objective	Notes	Screened
I35_5a	1 and 3	Restore depths and habitat complexity of the Golden Lake Crevasse. Promote emergent vegetation with material. *Screening criteria: Geotech screened due to seepage concerns that could threaten integrity of mainline levee.*	Yes – Pre CEICA
I35_5a Construction Assumptions			
I35_5a	Assumed 75% of area will be excavated 5-ft (for total depth of ~10ft) based on Borrow Pit Recommendations at a cost of $6/cubic yard and material placed on-site. 38.8-acre waterbody.		
I35_5a Real Estate Assumptions			
I35_5a	None; screened prior to real estate estimation.		
I35_5a OMRR&R Assumptions			
I35_5a	None; screened prior to OMRR&R estimation.		
I35_5a Adaptive Management & Monitoring Assumptions			
I35_5a	None; screened prior to AMM estimation.		

6.9 ISLAND 35-DEANS ISLAND (I35_5B)

Island 35-Deans Island (I35_5b) proposes to create a forested buffer for the Golden Lake Crevasse. This would be accomplished by reforesting the buffer with Oak species to mimic the meander scroll ridges. This measure was screened out because further review determined the existing forest buffer is sufficient.

Table 6-9: I35_5b Description

I35_5b Description of Features	
Measure Description	Reforestation – BLH
Construction Activity	N/A

Model		N/A	
Restoration Activity		Enhance and Restore Natural Vegetation	
Habitat		N/A	
I35_5b Items			
Item-Feature	**Meet Objective**	**Notes**	**Screened**
I35_5b	1 and 3	Create Forested Buffer for Golden Lake Crevasse (could use to mimic meander scroll ridges with Oak sp.). *Screening criteria: Golden Lake Crevasse already has 100-ft forested buffer.*	Yes – Pre CEICA
I35_5b Construction Assumptions			
I35_5b	None; screened prior to construction estimation.		
I35_5b Real Estate Assumptions			
I35_5b	None; screened prior to real estate estimation.		
I35_5b OMRR&R Assumptions			
I35_5b	None; screened prior to OMRR&R estimation.		
I35_5b Adaptive Management & Monitoring Assumptions			
I35_5b	None; screened prior to AMM estimation.		

6.10 ISLAND 35-DEANS ISLAND (I35_5C)

Golden Lake Crevasse is present on the 1939 topo and thus it formed by a levee blow out prior to 1939. This lake is isolated by high ground and the mainline levee making it a good candidate for isolation to promote a rarely connected habitat. Connectivity can be altered by modifying one or more of the three manmade drainage channels that affect the lake. The ag fields around the lake start to inundate at 228.3 ft. The adjacent forests are old borrow areas and have spots as low as 221 ft. The channel upstream of 5c has water around 225.4 ft and 5c's invert might be 227.7 ft. The eastern channel connects to Island 35 around 229.7 ft. The middle channel begins to flow around 231.6 ft and sheet flow begins around 232.3 ft. Therefore, to prevent inundation of the adjacent agriculture fields,

only the culvert at 5c will be replaced and raised. Elevation and imagery were insufficient to determine a new invert, thus 1 foot was added to the existing invert. The acreage for this measure is Golden Lake Crevasse. Island 35 Chute and the adjacent main channel would receive supplemental benefits.

Island 35-Deans Island (I35_5c) proposes replacing and raise a culvert to maintain isolation of Golden Lake Crevasse.

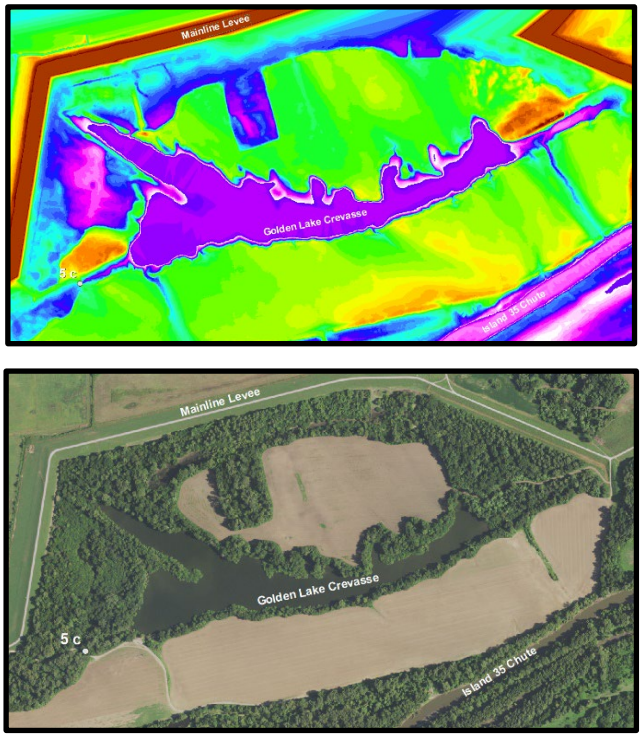


Figure 6-8. I35_5c

Table 6-10: I35_5c Description

I35_5c Description of Features	
Measure Description	Isolation of a Floodplain Waterbody
Construction Activity	Culverts; Riprap Bank Protection
Model	Isolation
Restoration Activity	Altering Connectivity

Habitat		Slough (lentic aquatic)	
I35_5c Items			
Item - Feature	**Meet Objective**	**Notes**	**Screened**
I35_5c	3 and 4	Rehabilitate culvert (replace and increase invert by 1-ft) to maintain isolation at Golden Lake Crevasse and install access ramp. *Screening criteria: Second iteration of CEICA showed poor performance.*	Yes – CEICA Round 2
I35_5c Construction Assumptions			
I35_5c		Assume 36-in CMP culvert replacement for 75-ft. length including demobilization costs. Riprap inlet/out protection R-200 at 73.5 tons.	
I35_5c Real Estate Assumptions			
I35_5c		Assumes purchase of 41 aquatic acres of woodlands (including floodplain waterbodies (i.e., borrow areas, lakes, etc.).	
I35_5c OMRR&R Assumptions			
I35_5c		For CMP, O&M at year 30 (100% of initial cost); for R-200, O&M at years 15, 30, 45 (50% of initial cost).	
I35_5c Adaptive Management & Monitoring Assumptions			
I35_5c		Fish & Invertebrate Surveys Monitoring – Bidirectional, Unidirectional, Isolation (A) at years 0, 3,5,7,10 estimated at $4167/event.	

6.11 ISLAND 35-DEANS ISLAND (I35_6A)

These borrow areas and associated scour hole were sampled by ERDC-EL in 1981, 1997, and 2019. The aquatic area is relatively shallow with a flat bottom and gently sloping sides. The project proposed to enhance the aquatic area by increasing depth by 5 ft following environmental design of borrow areas recommendations (ERDC 2021). This measure was eliminated from further consideration because there was concern that increasing depth would cause seepage under the levee

Island 35-Deans Island (I35_6a) proposes to enhance depth and habitat complexity of the aquatic borrow area. The depth would be increase by 5ft following environmental design of borrow areas recommendations.

Table 6-11: I35_6a Description

I35_6a Description of Features			
Measure Description	Restoring Habitat Complexity in Borrow Area		
Construction Activity	Earthwork		
Model	N/A		
Restoration Activity	Waterbody Enhancement		
Habitat	N/A		
I35_6a Items			
Item-Feature	**Meet Objective**	**Notes**	**Screened**
I35_6a	3	Restore depths and habitat complexity of borrow pit. *Screening criteria: Geotech screened due to seepage concerns that could threaten integrity of mainline levee.*	Yes – Pre CEICA
I35_6a Construction Assumptions			
I35_6a	Assumed 75% of area will be excavated 5-ft (for total depth of ~10ft) based on Borrow Pit Recommendations at a cost of $6/cubic yard and material placed on-site. 28.7-acre waterbody.		
I35_6a Real Estate Assumptions			
I35_6a	None; screened prior to real estate estimation.		
I35_6a OMRR&R Assumptions			
I35_6a	None; screened prior to OMRR&R estimation.		
I35_6a Adaptive Management & Monitoring Assumptions			
I35_6a	None; screened prior to AMM estimation.		

6.12 ISLAND 35-DEANS ISLAND (I35_6B)

The soils along the shore are Sharkey silty clay (SSURGO) and 76-95% hydric (NWI). The acreage for this measure is the proposed replanting area supplemented by the adjacent forest.

Island 35-Deans Island (I35_6b) proposes to reforest the southwestern shore of the borrow areas. Currently this area is farmed to the water's edge which increases sediment runoff, turbidity, and max water temperature. Reforesting the shoreline would reduce these impacts and provide additional habitat.

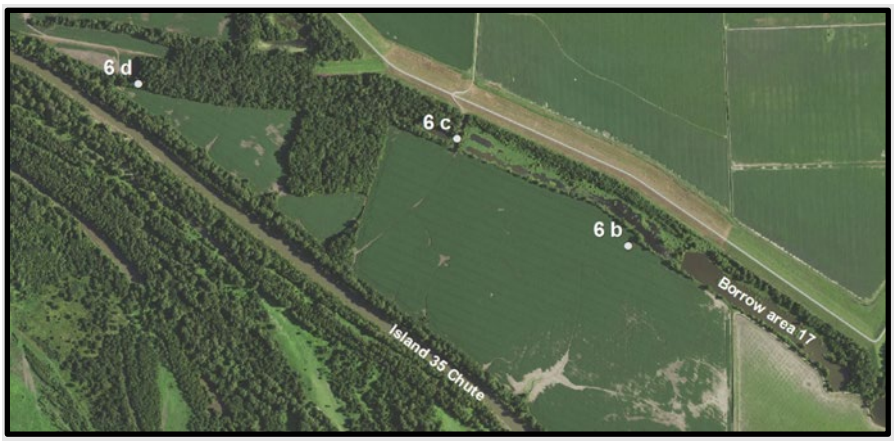


Figure 6-9. I35_6b

Table 6-2: I35_6b Description

I35_6b Description of Features	
Measure Description	Reforestation – BLH
Construction Activity	Floodplain Vegetative
Model	HGM
Restoration Activity	Enhance and Restore Natural Vegetation
Habitat	BLH (floodplain)

35_6b Items			
Item-Feature	**Meet Objective**	**Notes**	**Screened**
I35_6b	1 and 3	Create Forested Buffer for borrow pit (could use to mimic meander scroll ridges with Oak sp.). Assume 100-ft. buffer for 4900 ft. (11.25 acres).	No
I35_6b Construction Assumptions			
I35_6b		HGM AMM costs provided by ERDC (I35_6a, Island 35-Deans Island (I35_6b, and Island 35-Deans Island (I35_6c combined).	
I35_6b Real Estate Assumptions			
I35_6b		Assumes purchase of 11 floodplain acres of agricultural land.	
I35_6b OMRR&R Assumptions			
I35_6b		None	
I35_6b Adaptive Management & Monitoring Assumptions			
I35_6b		HGM AMM costs provided by ERDC (I35_6a, I35_6b, and Island 35-Deans Island (I35_6c combined).	

6.13 ISLAND 35-DEANS ISLAND (I35_6C)

The borrow areas connect to Island 35 Chute through a channel at the northwestern edge. This channel and the berm between the borrow areas have culverts obstructing connectivity. The culverts have an estimated inverts of 233.6 and 234.4 ft and do not appear perched. Elevation data and aerial imagery do not provide sufficient information to determine a new invert. We assumed the invert would be lowered by 1 foot. This would change the connectivity around 1%. The acreage for this measure is the borrow area supplemented by Island 35 and the adjacent main channel downstream.

Island 35-Deans Island (I35_6c) proposes to modify culvert obstructions to improve connectivity of the channel, at the northwestern edge, that connects the borrow areas to Island 35 Chute.

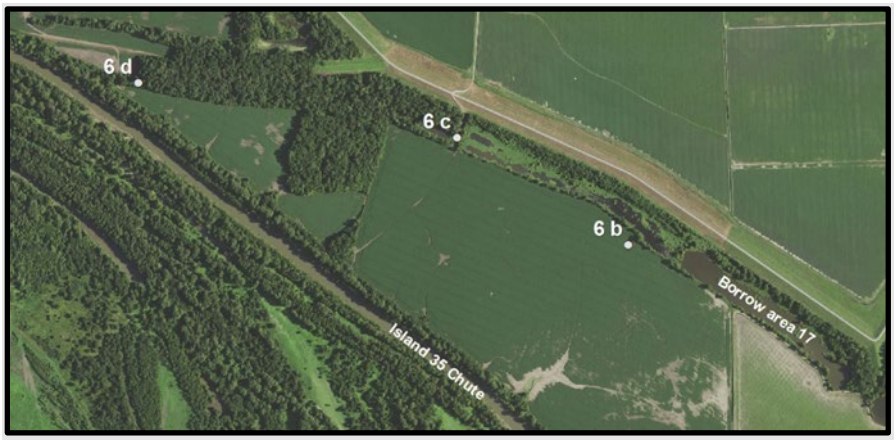


Figure 6-10. I35_6c

Table 6-13: I35_6c Description

I35_6c Description of Features			
Measure Description	Flow Restoration to Backwater Slough		
Construction Activity	Culverts; Riprap Bank Protection		
Model	Bidirectional		
Restoration Activity	Altering Connectivity		
Habitat	Borrow Areas (lentic aquatic)		
I35_6c Items			
Item-Feature	**Meet Objective**	**Notes**	**Screened**
I35_6c	3 and 4	Install/rehabilitate control structure (culvert) to increase connectivity and leave access ramp. Assume to lower culvert invert by 1-ft.	Yes – CEICA Round 1
I35_6d	3 and 4	*Screening criteria: First iteration of CEICA showed poor performance.*	
I35_6c Construction Assumptions			

I35_6c	Assume 48-in CMP culvert replacement for 50-ft. length, including demobilization costs. 123 tons R-200 riprap inlet/outlet protection.
I35_6d	Assume 48-in CMP culvert replacement for 30-ft. length, including demobilization costs. 123 tons R-200 riprap inlet/outlet protection
I35_6c Real Estate Assumptions	
I35_6c	Assumes purchase 22 aquatic acres of woodlands
I35_6d	
I35_6c OMRR&R Assumptions	
I35_6c	For CMP, O&M at year 30 (100% of initial cost); for R-200, O&M at years 15, 30, 45 (50% of initial cost).
I35_6d	
I35_6c Adaptive Management & Monitoring Assumptions	
I35_6c	Aquatic Lidar Surveys (ROV)- Small Channels (A) at years 0,7 estimated at $2400/event; Fish & Invertebrate Surveys Monitoring - Bidirectional, Unidirectional, Isolation (A) at years 0, 3,5,7,10 estimated at $4167/event.
I35_6d	

6.14 ISLAND 35-DEANS ISLAND (I35_7A)

On the 1931 USGS topographic chart, four dikes numerous sandbars are shown at the downstream end of Island 35. These dikes are likely four of the dikes found in Dean Island secondary channel. In a 1953 image, there is a vegetated island in area from RM 759 – 761 with dikes visible in the secondary channel (Guntren et al. 2016). In a 1969 image, the secondary channel has narrowed to a quarter of its 1953 width. The island continues to develop forest in subsequent years (Guntren et al. 2016).

This measure proposes to notch all of the pile dikes within Dean Island secondary channel to enhance flow. Dike elevations were determined from imagery and estimated water surface elevation (Oliver et al. 2022, NAIP 2012). Because all or no dikes will be notched, only the highest elevation (the dike at Item Island 35-Deans Island (I35_7a ~ 195 ft) is needed for analysis. Dikes will be notched to bed elevation to prevent plunge pool/deposition and allow for natural channel adjustment. Thus, with project Dean Island secondary channel should have flow year-round (100% upstream and downstream connectivity to the main channel). The dike notches will benefit the secondary channel. Supplemental acreage includes the remainder of the secondary channel and main channel within the complex.

Island 35-Deans Island (I35_7a) proposes to notch all the pile dikes within Dean Island secondary channel to enhance flow. Dikes will be notched to bed elevation to prevent plunge pool/deposition and allow for natural channel adjustment. The dike notches will benefit the secondary channel.

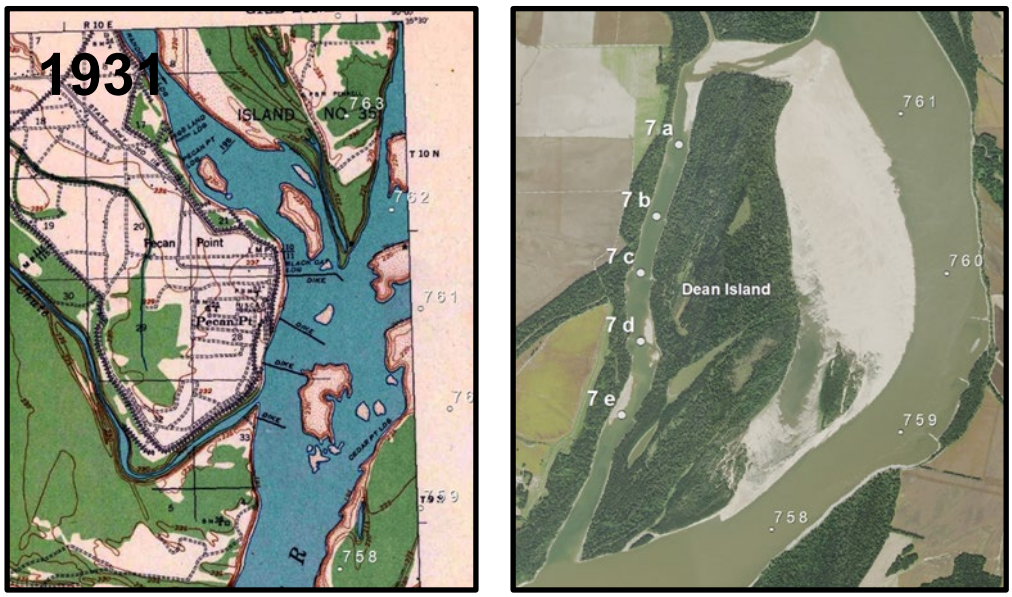


Figure 6-11. I35_7a

Table 6-14: I35_7a Description

I35_7a Description of Features	
Measure Description	Dike Notching – Pile Dike
Construction Activity	Dike Notching
Model	Unidirectional
Restoration Activity	Altering Connectivity
Habitat	Secondary Channels (lotic aquatic)
I35_7a Items	

Item-Feature	Meet Objective	Notes	Screened
l35_7a	2	Notch pile dike at Deans Island Secondary Channel. Assume 200-ft width and to depth of riverbed.	No
l35_7b	2		
l35_7c	2		
l35_7d	2		
l35_7e	2	Notch pile dike at Deans Island Secondary Channel - low priority since it is already notched. Assume 200-ft width and to depth of riverbed.	
l35_7a Construction Assumptions			
l35_7a	Assumptions based off a contractor's bid in MVS, and 30% contingency since we are further downstream and varying channel conditions		
l35_7b			
l35_7c			
l35_7d			
l35_7e			
l35_7a Real Estate Assumptions			
l35_7a	Assume work to be done in-channel below ordinary highwater and/or incidental to construction costs contingencies.		
l35_7b			
l35_7c			
l35_7d			
l35_7e			
l35_7a OMRR&R Assumptions			
l35_7a	None		
l35_7b			
l35_7c			
l35_7d			
l35_7e			

I35_7a Adaptive Management & Monitoring Assumptions	
I35_7a	Aquatic Bathymetric Survey - Rivers/Secondary Channels (A) at years 0,1,3,5,7,10 estimated at $450/mile; Fish & Invertebrate Surveys Monitoring - Bidirectional, Unidirectional, Isolation (A) at years 0, 3,5,7,10 estimated at $4167/event.
I35_7b	
I35_7c	
I35_7d	
I35_7e	

6.15 ISLAND 35-DEANS ISLAND (I35_7F)

Island 35-Deans Island (I35_7f) proposes to build a chevron to direct flow into the secondary channel and uncover/maintain exposed sandbar gravel. This will be done by orienting the chevron so that the upstream leg is parallel to Dean Island's entrance channel. To determine project acreage, a 2011 survey of the Loosahatchie Bar chevron was used. One-foot contours were created to determine the area scoured by the chevron. The highest elevation contour that outlined the scour area was used as the project acreage.

Upon further review, this measure was screened out because river engineers performed initial HEC-RAS modeling and found that the chevron would have localized effects and would not increase flow into the secondary channel. Therefore, there is no supplemental acreage for this measure.

Table 6-15: I35_7f Description

I35_7f Description of Features	
Measure Description	River Training Structures – Chevrons
Construction Activity	River Training Structures
Model	N/A
Restoration Activity	Aquatic Channel Enhancement
Habitat	N/A
I35_7f Items	

Item-Feature	Meet Objective	Notes	Screened
I35_7f	2	Install river training structure (e.g., chevron) to increase Deans Island Secondary Channel flow and uncover/maintain gravel bar. *Screening criteria: HEC-RAS model showed little change of flow into secondary channel. Existing gravel bar acts like river training structure. Some risk of worsening bank scour.*	Yes – Pre CEICA
I35_7f Construction Assumptions			
I35_7f	Assumed 24,800 tons of C-stone based off Loosahatchie Bar chevron and $37/ton and 10% contingency.		
I35_7f Real Estate Assumptions			
I35_7f	None; screened prior to real estate estimation.		
I35_7f OMRR&R Assumptions			
I35_7f	None; screened prior to OMRR&R estimation.		
I35_7f Adaptive Management & Monitoring Assumptions			
I35_7f	None; screened prior to AMM estimation.		

6.16 ISLAND 35-DEANS ISLAND (I35_7G)

Where Dean Island secondary channel turns to parallel the island, the landward bank has eroded over 200 ft since 2007. This erosion is depositing sediment within the secondary channel and reducing the forest buffer to less than 300 ft.

Three hardpoints in Duck Island secondary channel within the St. Louis District were used to determine the size of the channel bed area affected by the hardpoints. These hardpoints changed the bathymetry upstream by 1 times their length, downstream by 3.75, and outwards by 1 times their length. Thus, the aquatic acreage was the hardpoint footprint plus the additional area of bathymetric impact.

Island 35-Deans Island (I35_7g) proposes to protect the shoreline and create aquatic habitat complexity by installing hardpoints along the shoreline creating bathymetric and hydraulic diversity.

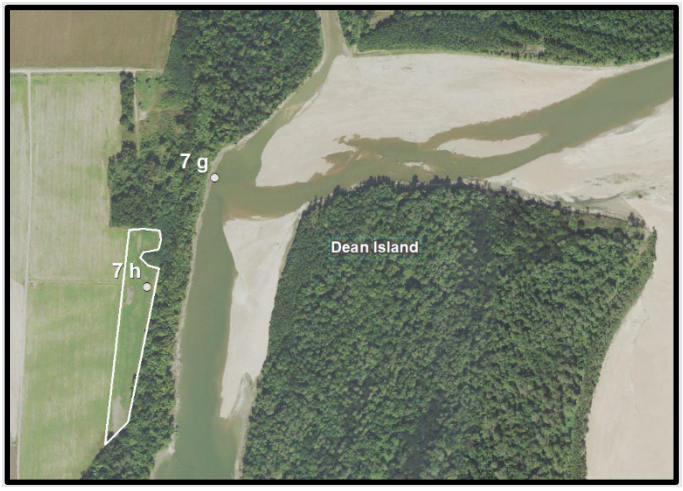


Figure 6-12. I35_7g

Table 6-16: I35_7g Description

I35_7g Description of Features			
Measure Description	Hardpoint Bank Protection		
Construction Activity	Riprap Bank Protection		
Model	Riverine Eddy		
Restoration Activity	Aquatic Channel Enhancement		
Habitat	Secondary Channels (lotic aquatic)		
I35_7g Items			
Item-Feature	**Meet Objective**	**Notes**	**Screened**
I35_7g	1 and 3	Add 10 hardpoints for 2,000 linear feet to protect eroding bankline and adjacent forested buffer. Bankline has eroded over 200ft since 2007 adding sediment to Deans secondary channel and reducing forest buffer.	No
I35_7g Construction Assumptions			

I35_7g	Assumed 10 hardpoints covering 2,000 linear feet. Assumptions include 6ft crown, 1:2.5 slopes, 30ft. Top length, 200ft spacing, 1600 tons of rock/hardpoint, and 250-lb riprap.
I35_7g Real Estate Assumptions	
I35_7g	Assume work to be done in-channel below ordinary highwater and/or incidental to construction costs contingencies.
I35_7g OMRR&R Assumptions	
I35_7g	Riprap Hardpoints O&M at years 15, 30, 45 estimated at 25% of initial construction cost.
I35_7g Adaptive Management & Monitoring Assumptions	
I35_7g	Aquatic Bathymetric Survey - Rivers/Secondary Channels (A) at years 0,1,3,5,7,10 estimated at $450/mile; Fish & Invertebrate Surveys Monitoring - Bidirectional, Unidirectional, Isolation (A) at years 0, 3,5,7,10 estimated at $4167/event.

6.17 ISLAND 35-DEANS ISLAND (I35_7H)

Landward bank erosion has reduced the secondary channel's forest buffer. Soils in this area are partially hydric 1-25, 26-50% (NWI) and Hayti or Convent fine sandy loam, or Steele silty clay loam (SSURGO). The acreage is the reforestation footprint with supplemental benefits to the adjacent forest.

Island 35-Deans Island (I35_7h) proposes to reforest the secondary channel's adjacent wet agricultural land (white outlined area) to ensure a 300ft forest buffer to reduce landward bank erosion.

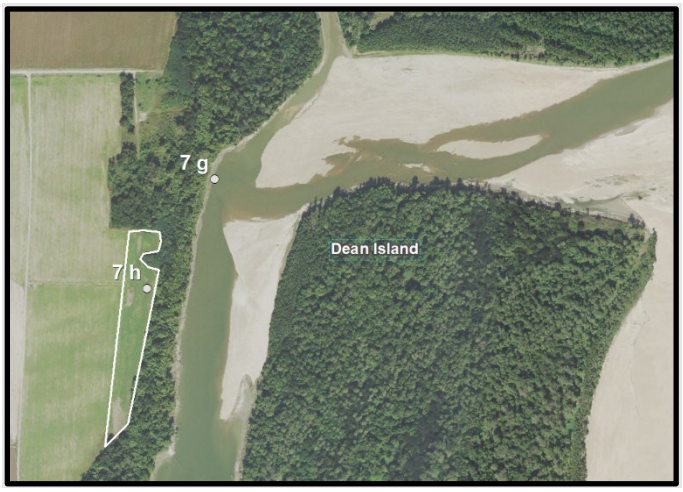


Figure 6-13. I35_7h

Table 6-17: I35_7h Description

I35_7h Description of Features			
Measure Description	MS River Riparian Buffer		
Construction Activity	Floodplain Vegetative		
Model	HGM		
Restoration Activity	Riverfront Forest – Riparian buffers (floodplain)		
Habitat	Secondary Channels (lotic aquatic)		
I35_7h Items			
Item-Feature	**Meet Objective**	**Notes**	**Screened**
I35_7h – Reforestation of MS River Riparian Buffer	1 and 3	Reforest 8-acres ag land adjacent to Dean's secondary channel to maintain 300ft forest buffer.	No
I35_7h Construction Assumptions			
I35_7h	HGM costs provided by ERDC.		
I35_7h Real Estate Assumptions			
I35_7h	Assumes purchase of 8 floodplain acres of agricultural land.		

I35_7h OMRR&R Assumptions	
I35_7h	None
I35_7h Adaptive Management & Monitoring Assumptions	
I35_7h	HGM AMM costs provided by ERDC.

6.18 ISLAND 35-DEANS ISLAND (I35_8_A)

In 1939, the Mississippi's main channel flowed around Island 35 and Island 35 Towhead. Island 35 Towhead Chute was visible as a sand channel (USGS 1939). Between 1939 and the 1960s, Island 35 Towhead Chute became a meander scarp. By 1969 Island 35 Towhead Chute was a series of three isolated sloughs as shown in 1969 imagery. The upstream end is cutoff by County Rd 1006/Crane Rd., very similar to today's conditions. This measure proposes to deepen the three narrow shallow channels and replace the culvert (Item Island 35-Deans Island (I35_8_a_8c) across the most upstream channel to improve connectivity and bidirectional flow. The current high elevation for each of the three channels was captured in USGS 2014 LiDAR. The culvert invert was assumed to be the same as the adjacent channel bed. With project, each area of sediment between the isolated permanent waterbodies would be excavated approximately 5 ft. This depth was determined in consideration of the low elevations in the channels and the depth of the sloughs. This would improve connectivity to Island 35 Towhead Chute by over 10%. The acreage for this measure was the isolated sloughs supplemented by Island 35 Chute and the complex's adjacent main channel.

Island 35-Deans Island (I35_8_a) proposes to deepen three narrow shallow channels and replace the culvert across the most upstream channel to improve connectivity and bidirectional flow of Island 35 Towhead Chute.

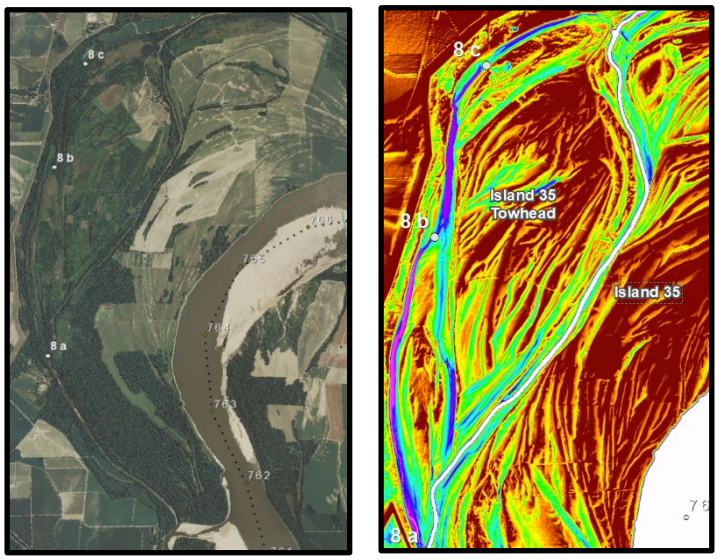


Figure 6-14. I35_8a

Table 6-18: I35_8a Description

I35_8a Description of Features			
Measure Description	Flow Restoration to Backwater Slough		
Construction Activity	Earthwork; Culverts		
Model	Bidirectional		
Restoration Activity	Altering Connectivity		
Habitat	Slough (lentic aquatic)		
I35_8_a Items			
Item-Feature	**Meet Objective**	**Notes**	**Screened**
I35_8a	3	Plug removal of inlet channel (~4500ft) and install control structure at Island 35 Towhead Chute junction with Island 35 Meander Scarp but may need to do Measure 3 (improve connectivity of Island 35 Meander Scarp first).	Yes – CEICA Round 1

		Screening Criteria: First iteration of CEICA showed poor performance. Due to meander scarp being disconnected for a significant period of time, access extremely difficult and costly.	
I35_8b	3	Plug Removal in channel (~2000ft) connecting pools within Island 35 Towhead Chute. *Screening Criteria: First iteration of CEICA showed poor performance. Due to meander scarp being disconnected for a significant period of time, access extremely difficult and costly.*	
I35_8c	3	Improve culvert and cleanout channel plugs (~900ft including culvert) in Island 35 Towhead chute to connect isolated pools. *Screening Criteria: First iteration of CEICA showed poor performance. Due to meander scarp being disconnected for a significant period of time, access extremely difficult and costly.*	
I35_8a Construction Assumptions			
I35_8a	Assume working both banks (needed if excavating larger than ~20-ft width channel) using a dragline for a length of 4,500 ft-length x 100-ft width x 5-ft depth = 91,667 CY) and clearing 6.2 acres.		
I35_8b	Assume working both banks (needed if excavating larger than ~20-ft width channel) using a dragline for a length of 2,000 ft length x 100-ft width x 5-ft. depth = 40,740 CY) and clearing 2.75 acres.		
I35_8c	Assume working both banks (needed if excavating larger than ~20-ft width channel) using a dragline for a length of 900 ft. length x 150ft width ax 5-ft depth (27,500 CY) and clearing 1.25-acres and two 48-inch culverts 100-ft in length each, including demo costs.		
I35_8a Real Estate Assumptions			
I35_8a I35_8b	Assumes purchase of 80.2 aquatic acres of woodlands (including floodplain waterbodies (i.e., borrow areas, lakes, etc.)).		

I35_8c	
I35_8a OMRR&R Assumptions	
I35_8a I35_8b	Channel cleanout O&M at years 15, 30, 45 estimated at 25% of initial construction cost.
I35_8c	Channel cleanout O&M at years 15, 30, 45 estimated at 25% of initial construction cost; riprap inlet/outlet protection at culverts O&M at years 15, 30, 45 estimated at 50% of construction cost.
I35_8a Adaptive Management & Monitoring Assumptions	
I35_8a I35_8b I35_8c	Aquatic Lidar Surveys (ROV)- Small Channels (A) at years 0,7 estimated at $2400/event; Fish & Invertebrate Surveys Monitoring - Bidirectional, Unidirectional, Isolation (A) at years 0, 3,5,7,10 estimated at $4167/event

6.19 ISLAND 35-DEANS ISLAND (I35_8_D1)

Island 35-Deans Island (I35_8_d1) proposes to restore depth and habitat complexity to Island 35 Towhead Chute. This item was screened out due potential seepage issues resulting its proximity to the levee.

Table 6-19: I35_8d1 Description

I35_8d1 Description of Features			
Measure Description	Restoring Habitat Complexity in Floodplain Waterbody		
Construction Activity	Earthwork		
Model	N/A		
Restoration Activity	Waterbody Enhancement		
Habitat	N/A		
I35_8_d1 Items			
Item-Feature	**Meet Objective**	**Notes**	**Screened**

I35_8d_1	3	Restore depths and habitat complexity in Island 35 Towhead Chute waterbodies Could require tree clearing since surrounded by forest (could use material to mimic meander scroll ridges with Oak sp.). *Screening criteria: Geotech screened due to seepage concerns that could threaten integrity of mainline levee.*	Yes – Pre CEICA
I35_8d1 Construction Assumptions			
I35_8d1	Assumed 75% of area will be excavated 5-ft (for total depth of ~10ft) based on Borrow Pit Recommendations at a cost of $6/cubic yard and material placed on-site and completed in the dry. 13.4-acre waterbody		
I35_8d1 Real Estate Assumptions			
I35_8d1	None; screened prior to real estate estimation.		
I35_8d1 OMRR&R Assumptions			
I35_8d1	None; screened prior to OMRR&R estimation.		
I35_8d1 Adaptive Management & Monitoring Assumptions			
I35_8d1	None; screened prior to AMM estimation.		

6.20 ISLAND 35-DEANS ISLAND (I35_8_D2)

Island 35-Deans Island (I35_8_d2) proposes to restore depth and habitat complexity to Island 35 Towhead Chute. This item was screened out due potential seepage issues resulting its proximity to the levee.

Table 6-20: I35_8d2 Description

I35_8d2 Description of Features	
Measure Description	Restoring Habitat Complexity in Floodplain Waterbody
Construction Activity	Earthwork
Model	N/A
Restoration Activity	Waterbody Enhancement

Habitat	N/A		
I35_8_d2 Items			
Item-Feature	**Meet Objective**	**Notes**	**Screened**
I35_8d_2	3	Restore depths and habitat complexity in Island 35 Towhead Chute waterbodies. Could require tree clearing since surrounded by forest (could use material to mimic meander scroll ridges with Oak sp.). *Screening criteria: Geotech screened due to seepage concerns that could threaten integrity of mainline levee.*	Yes – Pre CEICA
I35_8d2 Construction Assumptions			
I35_8d2	Assumed 75% of area will be excavated 5-ft (for total depth of ~10ft) based on Borrow Pit Recommendations at a cost of $6/cubic yard and material placed on-site and completed in the dry. 34.6-acre waterbody.		
I35_8d2 Real Estate Assumptions			
I35_8d2	None; screened prior to real estate estimation.		
I35_8d2 OMRR&R Assumptions			
I35_8d2	None; screened prior to OMRR&R estimation.		
I35_8d2 Adaptive Management & Monitoring Assumptions			
I35_8d2	None; screened prior to AMM estimation.		

6.21 ISLAND 35-DEANS ISLAND (I35_8_D3)

Island 35-Deans Island (I35_8_d3 proposes to restore depth and habitat complexity to Island 35 Towhead Chute. This item was screened out due potential seepage issues resulting its proximity to the levee.

Table 6-21: I35_8d3 Description

I35_8d3 Description of Features			
Measure Description	Restoring Habitat Complexity in Floodplain Waterbody		
Construction Activity	Earthwork		
Model	N/A		
Restoration Activity	Waterbody Enhancement		
Habitat	N/A		
I35_8d_3 Items			
Item-Feature	**Meet Objective**	**Notes**	**Screened**
I35_8d_3	3	Restore depths and habitat complexity in Island 35 Towhead Chute waterbodies. Could require tree clearing since surrounded by forest (could use material to mimic meander scroll ridges with Oak sp.). *Screening criteria: Geotech screened due to seepage concerns that could threaten integrity of mainline levee.*	Yes – Pre CEICA
I35_8d3 Construction Assumptions			
I35_8d3	Assumed 75% of area will be excavated 5-ft (for total depth of ~10ft) based on Borrow Pit Recommendations at a cost of $6/cubic yard and material placed on-site and completed in the dry. 31-acre waterbody.		
I35_8d3 Real Estate Assumptions			
I35_8d3	None; screened prior to real estate estimation.		
I35_8d3 OMRR&R Assumptions			
I35_8d3	None; screened prior to OMRR&R estimation.		
I35_8d3 Adaptive Management & Monitoring Assumptions			
I35_8d3	None; screened prior to AMM estimation.		

6.22 ISLAND 35-DEANS ISLAND (I35_9A)

Island 35-Deans Island (I35_9a proposes to restore depth and habitat complexity to a borrow pit. This item was screened out due potential seepage issues resulting from the borrow pits proximity to the levee.

Table 6-22: I35_9a Description

I35_9a Description of Features			
Measure Description	Restoring Habitat Complexity in Floodplain Waterbody		
Construction Activity	Earthwork		
Model	N/A		
Restoration Activity	Waterbody Enhancement		
Habitat	N/A		
I35_9a Items			
Item-Feature	**Meet Objective**	**Notes**	**Screened**
I35_9a	1 and 3	Restore depths and habitat complexity in borrow area - excavate deep area riverside and place material near levee side for Emergent Vegetation. Geotech will determine how deep based on existing seepage studies. *Screening criteria: Geotech screened due to seepage concerns that could threaten integrity of mainline levee.*	Yes – Pre CEICA
I35_9a Construction Assumptions			
I35_9a	Assumed 75% of area will be excavated 5-ft (for total depth of ~10ft) based on Borrow Pit Recommendations at a cost of $5/cubic yard and material placed on-site. 39.9-acre waterbody.		
I35_9a Real Estate Assumptions			
I35_9a	None; screened prior to real estate estimation.		
I35_9a OMRR&R Assumptions			

I35_9a	None; screened prior to OMRR&R estimation.
I35_9a Adaptive Management & Monitoring Assumptions	
I35_9a	None; screened prior to AMM estimation.

6.23 ISLAND 35-DEANS ISLAND (I35_9B)

The average elevation is 229.6 ft. The soils are Sharkey silty clay (SSURGO) and 76-95% hydric (NWI). The acreage was the area proposed for reforestation (white outline in image). The adjacent forest would receive supplemental benefits (purple outline). The borrow area would also benefit from the wind protection, shade, and plant material though these benefits were no quantified.

Island 35-Deans Island (I35_9b proposes to reforest 12 acres along the southeastern side of the borrow area which currently has minimal forest. The borrow area lies against the mainline levee in an agricultural area protected by a private levee.

Figure 6-15. I35_9b

Table 6-23: I35_9b Description

I35_9b Description of Features	
Measure Description	Reforestation – BLH

Construction Activity		Floodplain Vegetative	
Model		HGM	
Restoration Activity		Enhance and Restore Natural Vegetation	
Habitat		BLH (floodplain)	
I35_9b Items			
Item-Feature	**Meet Objective**	**Notes**	**Screened**
I35_9b	1 and 3	Create BLH forested buffer for borrow pit. Area already floods from borrow area getting out of banks.	No
I35_9b Construction Assumptions			
I35_9b	HGM costs provided by ERDC.		
I35_9b Real Estate Assumptions			
I35_9b	Assumes purchase of 12 floodplain acres of agricultural lands.		

I35_9b OMRR&R Assumptions	
I35_9b	None
I35_9b Adaptive Management & Monitoring Assumptions	
I35_9b	HGM AMM costs provided by ERDC.

6.24 ISLAND 35-DEANS ISLAND (I35_10A)

Island 35 contains six sloughs with permanent water. Five of these sloughs interconnect through a series of channels terminating at Island 35 Chute. The slough in this measure has its own flow path and connects to the main channel. This flow path runs through NRCS easements, although the slough may be outside of the easements. A road crosses the flow path and reduces connectivity of the slough. This measure contains one item 10a which proposes to replace and lower the existing low water crossing. The acreage of the slough is supplemented by the adjacent main channel

Island 35-Deans Island (I35_10a) proposes to replace and lower the existing low water crossing. This would improve connectivity of the flow path to the slough.

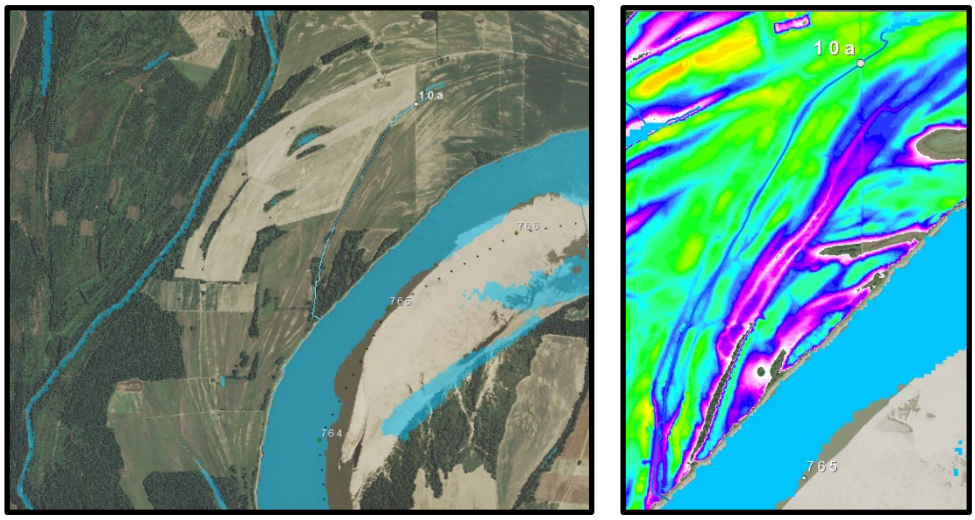


Figure 6-16. I35_10a

Table 6-24: I35_10a Description

I35_10a Description of Features			
Measure Description	Flow Restoration to Backwater Slough		
Construction Activity	Earthwork		
Model	Bidirectional		
Restoration Activity	Altering Connectivity		
Habitat	Slough (lentic aquatic)		
I35_10a Items			
Item-Feature	**Meets Objective**	**Notes**	**Screened**
I35_10a – Cleanout Low Water Crossing to Restore Flow to Backwater Slough	3	Reconnect slough by modifying obstruction. Installation of R-200 rock low water crossing ~2feet lower than existing elevation.	Yes – CEICA Round 1

		Screening criteria: First iteration of CEICA showed poor performance. Benefits are only to a small waterbody.	
I35_10a Construction Assumptions			
I35_10a	Cleanout low water crossing (200-ft length x 30-ft width x 2-ft depth – 444 CY) matching road width, 733 tons riprap for control structure.		
I35_10a Real Estate Assumptions			
I35_10a	Assumes purchase of 4 aquatic acres of woodlands (including floodplain waterbodies (i.e., borrow areas, lakes, etc.)).		
I35_10a OMRR&R Assumptions			
I35_10a	Channel cleanout O&M at years 15, 30, 45 estimated at 25% of initial construction cost; rip rap control structure O&M at year 30 estimated at 50% of construction cost.		
I35_10a Adaptive Management & Monitoring Assumptions			
I35_10a	Adaptive Management and Monitoring: Aquatic Lidar Surveys (ROV)- Small Channels (A) at years 0,7 estimated at $2400/event; Fish & Invertebrate Surveys Monitoring - Bidirectional, Unidirectional, Isolation (A) at years 0, 3,5,7,10 estimated at $4167/event.		

6.25 ISLAND 35-DEANS ISLAND (I35_11)

Island 35-Deans Island (I35_11) proposes to enhance the connectivity of the remaining five sloughs on Island 35. These sloughs interconnect through a series of flow paths terminating at Island 35 Chute. The paths cut across NRCS easements, agriculture, and forest and there are 15 obstructions the reduce connectivity and flow.

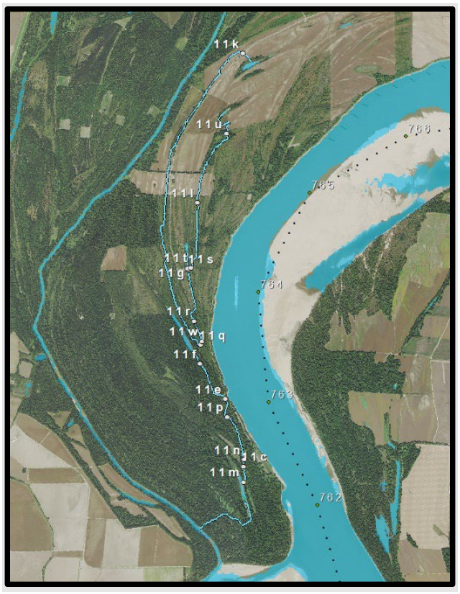


Figure 6-17. I35_11

Table 6-25: I35_11 Description

I35_11 Description of Features			
Measure Description	Flow Restoration to Backwater Slough		
Construction Activity	Earthwork; Culverts; Riprap Bank Protection		
Model	Bidirectional		
Restoration Activity	Altering Connectivity		
Habitat	Slough (lentic aquatic)		
I35_11 Items			
Item-Feature	**Meet Objectives**	**Notes**	**Screened**
I35_11a	3	Reconnect slough by modifying obstruction. *Screening criteria: Does not show enough elevation change to make a difference. It is either already low*	Yes – Pre CEICA
I35_11b	3		

		enough or obstruction was put in after the 2014 Lidar imagery.	
I35_11c	3	Reconnect slough by modifying obstruction. Cleanout low water crossing for (200-ft length x 30-ft width x 2-ft. depth) matching road width and lowering depth 2-ft, and install riprap for low water crossing. *Screening criteria: First iteration of CEICA showed poor performance. Much of this measure is on existing NRCS easements and likely could be better accomplished through other programs. Measure is located on Tennessee lands on the opposite bank of the River and is difficult to access for Tennessee sportsman.*	Yes – CEICA Round 1
I35_11d	3	Reconnect slough by modifying obstruction. *Screening criteria: Elevation is low enough compared to the invert of the channel in spots.*	Yes – Pre CEICA
I35_11e	3	Reconnect slough by modifying obstruction. Blockage removal for 140-ft x 25-ft width x 2-ft depth. *Screening criteria: First iteration of CEICA showed poor performance. Much of this measure is on existing NRCS easements and likely could be better accomplished through other programs. Measure is located on Tennessee lands on the opposite bank of the River and is difficult to access for Tennessee sportsman.*	Yes – CEICA Round 1
I335_11f	3	Reconnect slough by modifying obstruction. See Channel Profile - assume it needs 1500ft of channel cleanout about 3ft depth x 25ft width. *Screening criteria: First iteration of CEICA showed poor performance. Much of this measure is on existing NRCS easements and likely could be better accomplished through other programs. Measure is located on Tennessee lands on the opposite bank of*	

		the River and is difficult to access for Tennessee sportsman.	
I35_11g	3	Reconnect slough by modifying obstruction. Channel cleanout ~2000 ft length x 2 ft depth x 50 ft width. *Screening criteria: First iteration of CEICA showed poor performance. Much of this measure is on existing NRCS easements and likely could be better accomplished through other programs. Measure is located on Tennessee lands on the opposite bank of the River and is difficult to access for Tennessee sportsman.*	
I35_11h	3	Reconnect slough by modifying obstruction.	Yes – Pre CEICA
I35_11i	3	*Screening criteria: There is an obvious road crossing here, but no elevation restriction. It looks to follow natural low contours.*	
I35_11j	3	Reconnect slough by modifying obstruction. *Screening criteria: Screened out due to following existing contours (just slightly higher) and not modifying downstream natural contours Items 11i and 11h*	Yes – Pre CEICA
I35_11k	3	Low water crossing for 130-ft length x 40-ft width x 2-ft depth (matching road width). *Screening criteria: First iteration of CEICA showed poor performance. Much of this measure is on existing NRCS easements and likely could be better accomplished through other programs. Measure is located on Tennessee lands on the opposite bank of the River and is difficult to access for Tennessee sportsman*	Yes – CEICA Round 1
I35_11l	3	Excavate high spot in swale through fields/woods 1,000-ft length x 60-ft width x 1-ft depth.	Yes – Pre CEICA

		Screening criteria: First iteration of CEICA showed poor performance. Much of this measure is on existing NRCS easements and likely could be better accomplished through other programs. Measure is located on Tennessee lands on the opposite bank of the River and is difficult to access for Tennessee sportsman	
I35_11m	3	Reconnect slough by modifying obstruction, includes installing culvert lowering invert 1-ft. *Screening criteria: First iteration of CEICA showed poor performance. Much of this measure is on existing NRCS easements and likely could be better accomplished through other programs. Measure is located on Tennessee lands on the opposite bank of the River and is difficult to access for Tennessee sportsman*	Yes – CEICA Round 1
I35_11n	3	Reconnect slough by modifying obstruction. Cleanout and install R-200 rock low water crossing ~2ft lower than existing elevation. *Screening criteria: First iteration of CEICA showed poor performance. Much of this measure is on existing NRCS easements and likely could be better accomplished through other programs. Measure is located on Tennessee lands on the opposite bank of the River and is difficult to access for Tennessee sportsman*	Yes – CEICA Round 1
I35_11o	3	Reconnect slough by modifying obstruction. *Screening criteria: Item screened out because Item 11p captures this. 11p was reworded to remove the ~1,500ft long plug/higher elevation of the flow path.*	Yes – Pre CEICA
I35_11p	3	Reconnect slough by degrading the (1,500 ft length x 30-ft width x 4-ft) depth plug/high elevation in slough.	Yes – CEICA Round 1

		Screening criteria: First iteration of CEICA showed poor performance. Much of this measure is on existing NRCS easements and likely could be better accomplished through other programs. Measure is located on Tennessee lands on the opposite bank of the River and is difficult to access for Tennessee sportsman	
I35_11q	3	Reconnect slough by modifying obstruction. Excavate plug/high elevation in slough (30-ft length x 20-ft width x 1.5-ft depth). *Screening criteria: First iteration of CEICA showed poor performance. Much of this measure is on existing NRCS easements and likely could be better accomplished through other programs. Measure is located on Tennessee lands on the opposite bank of the River and is difficult to access for Tennessee sportsman*	
I35_11r	3	Reconnect slough by modifying obstruction. Excavate plug/high elevation in slough (100-ft length x 60-ft width x 1-ft depth). *Screening criteria: First iteration of CEICA showed poor performance. Much of this measure is on existing NRCS easements and likely could be better accomplished through other programs. Measure is located on Tennessee lands on the opposite bank of the River and is difficult to access for Tennessee sportsman*	
I35_11s	3	Reconnect slough by modifying obstruction. Two culvert replacements and lowering inverts ~2ft to elevation 230ft. *Screening criteria: First iteration of CEICA showed poor performance. Much of this measure is on existing NRCS easements and likely could be better accomplished through other programs. Measure is*	

		located on Tennessee lands on the opposite bank of the River and is difficult to access for Tennessee sportsman	
I35_11t	3	Reconnect slough by modifying obstruction. Excavate plug/high elevation in slough (135-ft length x 45-ft width x 1.5-ft depth). *Screening criteria: First iteration of CEICA showed poor performance. Much of this measure is on existing NRCS easements and likely could be better accomplished through other programs. Measure is located on Tennessee lands on the opposite bank of the River and is difficult to access for Tennessee sportsman*	
I35_11u	3	Reconnect slough by modifying obstruction. Reconnect slough by modifying obstruction. Excavate plug/high elevation in slough (190ft length x 20-ft width x 2-ft depth). *Screening criteria: First iteration of CEICA showed poor performance. Much of this measure is on existing NRCS easements and likely could be better accomplished through other programs. Measure is located on Tennessee lands on the opposite bank of the River and is difficult to access for Tennessee sportsman*	
I35_11v	3	Reconnect slough by modifying obstruction. *Screening criteria: There is an obvious road crossing here, but no elevation restriction. It looks to follow natural low contours.*	Yes – Pre CEICA
I35_11w	3	Reconnect slough by modifying obstruction. Excavate plug/high elevation in slough (50ft length x 25-ft width x 1-ft depth). *Screening criteria: First iteration of CEICA showed poor performance. Much of this measure is on existing*	Yes – CEICA Round 1

		NRCS easements and likely could be better accomplished through other programs. Measure is located on Tennessee lands on the opposite bank of the River and is difficult to access for Tennessee sportsman	

I35_11 Construction Assumptions	
I35_11a	None; screened prior to construction estimation.
I35_11b	
I35_11c	Cleanout low water crossing for (200-ft length x 30-ft width x 2-ft. depth - 444 CY) matching road width, 733 tons riprap for control structure.
I35_11d	None; screened prior to construction estimation.
I35_11e	Excavate blockage for 140-ft length x 25-ft. width x 2-ft. depth - 285 CY; Clearing Costs = 140ft x 30-ft both banks = 0.25 acres; No hauling of material.
I335_11f	Assume 1500 ft. of channel cleanout x 3-ft. depth x 25 ft. (4166.67 CY) and 2.25 acres cleanout.
I35_11g	Channel cleanout ~2000 ft length x 2 ft. depth x 50 ft. width (4166.7 CY); clearing 2.3 acres.
I35_11h	None; screened prior to construction estimation.
I35_11i	
I35_11j	
I35_11k	Cleanout low water crossing for 130-ft length x 40-ft width x 2-ft. depth - 423 CY matching road width; 635 tons R-200 riprap.
I35_11l	Excavate high spot in fields/woods 1000-ft Length x 60-ft width x 1-ft depth = 2444 CY and 1.4 acres of clearing. No hauling of material.
I35_11m	2-36" CMP culvert ~100 ft long, 90.8 tons; R-200 Riprap inlet and outlet (30" thick)
I35_11n	Cleanout low water crossing for 200-ft length x 30-ft width x 2-ft. depth - 444 CY matching road width. Total 733 tons riprap for control structure.
I35_11o	None; screened prior to construction estimation.
I35_11p	Assume working both banks (needed if excavating larger than ~20-ft width channel) using an excavator for a length of 1500 ft length x 30-ft width x 4-ft depth =7333 CY. Clearing costs 30ft. Both sides = 2.1acres. No hauling of material.

I35_11q	Excavate high spot in forest/old road 30-ft x 20-ft x 1.5-ft depth = 37 CY, 0.25 acres clearing.
I35_11r	Excavate high spot in forest/old road 100-ft x 60-ft x 1-ft depth = 244 CY, 0.25 acres clearing.
I35_11s	Assume 360 LF for 2 culverts and 109 tons of R-200 riprap inlet/outlet protection.
I35_11t	Excavate high spot in forest/old road 135-ft x 45-ft x 1.5-ft depth = 338 CY, 0.25 acres clearing.
I35_11u	Excavate high spot in forest/old road 190ft x 20-ft x 2-ft depth = 281 CY, clearing 0.25 acres.
I35_11v	None; screened prior to construction estimation.
I35_11w	Excavate high spot in forest 50ft x 25-ft x 1-ft depth = 46 CY; clearing 0.25 acres.
I35_11 Real Estate Assumptions	
I35_11c	For I35_11, assumes purchase of 24.3 aquatic acres of woodlands (including floodplain waterbodies IE borrow areas, lakes, etc.).
I35_11e	
I335_11f	
I35_11g	
I35_11k	
I35_11l	
I35_11m	
I35_11n	
I35_11p	
I35_11q	
I35_11r	
I35_11s	
I35_11t	
I35_11u	
I35_11w	
I35_11 OMRR&R Assumptions	

I35_11a	None; screened prior to OMRR&R estimation.
I35_11b	
I35_11c	Channel cleanout O&M at years 15, 30, 45 estimated at 25% of initial construction cost; rip rap control structure O&M at year 30 estimated at 50% of construction cost.
I35_11d	None; screened prior to OMRR&R estimation.
I35_11e	Channel cleanout O&M at years 15, 30, 45 estimated at 25% of initial construction cost.
I335_11f	Channel cleanout O&M at years 15, 30, 45 estimated at 25% of initial construction cost.
I35_11g	Channel cleanout O&M at years 15, 30, 45 estimated at 25% of initial construction cost.
I35_11h	None; screened prior to OMRR&R estimation.
I35_11i	
I35_11j	
I35_11k	Channel cleanout O&M at years 15, 30, 45 estimated at 25% of initial construction cost; rip rap control structure O&M at year 30 estimated at 50% of construction cost.
I35_11l	Channel cleanout O&M at years 15, 30, 45 estimated at 25% of initial construction cost.
I35_11m	For CMP, O&M at year 30 (100% of initial cost); For R-200, O&M at years 15, 30, 45 (50% of initial cost)
I35_11n	Channel cleanout O&M at years 15, 30, 45 estimated at 25% of initial construction cost; rip rap control structure O&M at year 30 estimated at 50% of construction cost.
I35_11o	None; screened prior to OMRR&R estimation.
I35_11p	Channel cleanout O&M at years 15, 30, 45 estimated at 25% of initial construction cost; rip rap control structure O&M at year 30 estimated at 50% of construction cost.
I35_11q	Channel cleanout O&M at years 15, 30, 45 estimated at 25% of initial construction cost.
I35_11r	
I35_11s	Channel cleanout O&M at years 15, 30, 45 estimated at 25% of initial construction cost; riprap inlet/outlet protection at culverts O&M at years 15, 30, 45 estimated at 50% of construction cost.
I35_11t	

I35_11u	Channel cleanout O&M at years 15, 30, 45 estimated at 25% of initial construction cost.
I35_11v	None; screened prior to OMRR&R estimation.
I35_11w	Channel cleanout O&M at years 15, 30, 45 estimated at 25% of initial construction cost.
I35_11 Adaptive Management & Monitoring Assumptions	
I35_11c	Aquatic Lidar Surveys (ROV)- Small Channels (A) at years 0,7 estimated at $2400/event; Fish & Invertebrate Surveys Monitoring - Bidirectional, Unidirectional, Isolation (A) at years 0, 3,5,7,10 estimated at $4167/event.
I35_11e	
I335_11f	
I35_11g	
I35_11k	
I35_11l	
I35_11m	
I35_11n	
I35_11p	
I35_11q	
I35_11r	
I35_11s	
I35_11t	
I35_11u	
I35_11w	

6.26 ISLAND 35-DEANS ISLAND (I35_12A)

For water to reach the planting site it must flow over the natural levee which is slightly higher. In 2017, water would begin to move onto the proposed site on 6 May and by 23 May the river dropped below the natural levee. The site's minimum elevation is 227.9 while the natural levee is 232.3 ft. Thus, when disconnection occurs there could be 4 ft of water remaining on the site which would evaporate or be fed by rainwater. The soils are

Tunica clay and Commerce Silt Loam (SSURGO) and all hydric (NWI). The project acreage is the planting site, and the supplemental acreage is the adjacent forest.

Island 35-Deans Island (I35_12a) proposes to plant cypress and tupelo in a low area that ponds water and is rarely farmed (outlined in white). Cypress/tupelo forest communities are relatively rare within the Lower Mississippi River floodplain.

Figure 6-18. I35_12a

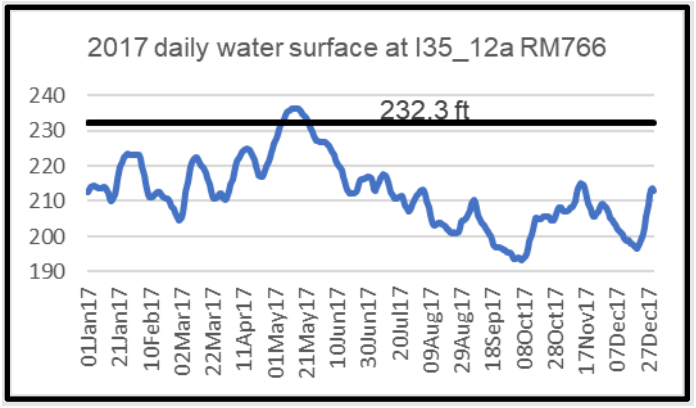


Figure 6-19. I35_12a

Table 6-26: I35_12a Description

I35_12a Description of Features			
Measure Description	Reforestation – Cypress/Tupelo		
Construction Activity	Floodplain Vegetative		
Model	HGM		
Restoration Activity	Enhance and Restore Natural Vegetation		
Habitat	Cypress – Tupelo (floodplain)		
I35_12a Items			
Item-Feature	**Meets Objective**	**Notes**	**Screened**
I35_12a	1 and 3	Plant Cypress/Tupelo on this ponded area (14 acres) at RM766R.	No
I35_12a Construction Assumptions			
I35_12a	HGM costs provided by ERDC.		
I35_12a Real Estate Assumptions			
I35_12a	Assumes purchase of 14 floodplain acres of agricultural land.		
I35_12a OMRR&R Assumptions			
I35_12a	None		
I35_12a Adaptive Management & Monitoring Assumptions			
I35_12a	HGM AMM costs provided by ERDC.		

6.27 ISLAND 35-DEANS ISLAND (I35_12B)

The bank soils are predominantly non-hydric (NWI) Crevasse sand with some hydric (NWI) Sharkey clay and Commerce/Robinsonville silt loam further from the river (SSURGO).

Island 35-Deans Island (I35_12b) proposes to plant a 300 ft wide forest strip just above the revetment and bendway weirs to create a continuous forested bank. There is very little forest along the right descending bank of the main channel from river mile 765.5 to

767. Imagery shows this bankline has been farmed since at least the 1960s likely leading to considerable erosion, bank loss, and revetment maintenance.

Figure 6-20. I35_12b

Table 6-27: I35_12b Description

I35_12b Description of Features			
Measure Description	MS River Riparian Buffer		
Construction Activity	Floodplain Vegetative		
Model	HGM		
Restoration Activity	Enhance and Restore Natural Vegetation		
Habitat	Riverfront Forest – Riparian buffers (floodplain)		
I35_12b Items			
Item-Feature	**Meets Objective**	**Notes**	**Screened**
I35_12b	1	Reforest 300ft tree screen/buffer strip adjacent to MS River /revetment/bendway weirs between RM767R -765.5R. Two spots (total length 8,000-ft length x 300-ft width).	No
I35_12b Construction Assumptions			
I35_12b	HGM costs provided by ERDC.		

I35_12b Real Estate Assumptions	
I35_12b	Assumes purchase of 55 floodplain acres of agricultural land.
I35_12b OMRR&R Assumptions	
I35_12b	None
I35_12b Adaptive Management & Monitoring Assumptions	
I35_12b	HGM AMM costs provided by ERDC.

6.28 ISLAND 35-DEANS ISLAND (I35_12C

Island 35-Deans Island (I35_12c) proposes to improve floodplain connectivity to a wetland by modifying a natural levee. This item was screened out due concerns with scour potential behind the existing revetment.

Table 6-28: I35_12c Description

I35_12c Description of Features			
Measure Description	Flow Restoration to Wetland		
Construction Activity	Floodplain Vegetative		
Model	N/A		
Restoration Activity	Enhance and Restore Natural Vegetation		
Habitat	N/A		
I35_12c Items			
Item-Feature	**Meet Objective**	**Notes**	**Screened**
I35_12c	1 and 3	Lower this spot in natural levee (~0.06ac) on NRCS land by 0.5ft to increase connectivity from 6.7% to 7.6% of time into the low spot near 12c. *Screening criteria: Screened due to River Engineering concerns with scour potential behind existing revetment.*	Yes – Pre CEICA

I35_12c Construction Assumptions	
I35_12c	None; screened prior to construction estimation.
I35_12c Real Estate Assumptions	
I35_12c	None; screened prior to real estate estimation.

I35_12c OMRR&R Assumptions	
I35_12c	None; screened prior to OMRR&R estimation.
I35_12b Adaptive Management & Monitoring Assumptions	
I35_12c	None; screened prior to AMM estimation.

Section 7

Island 40 41 Complex

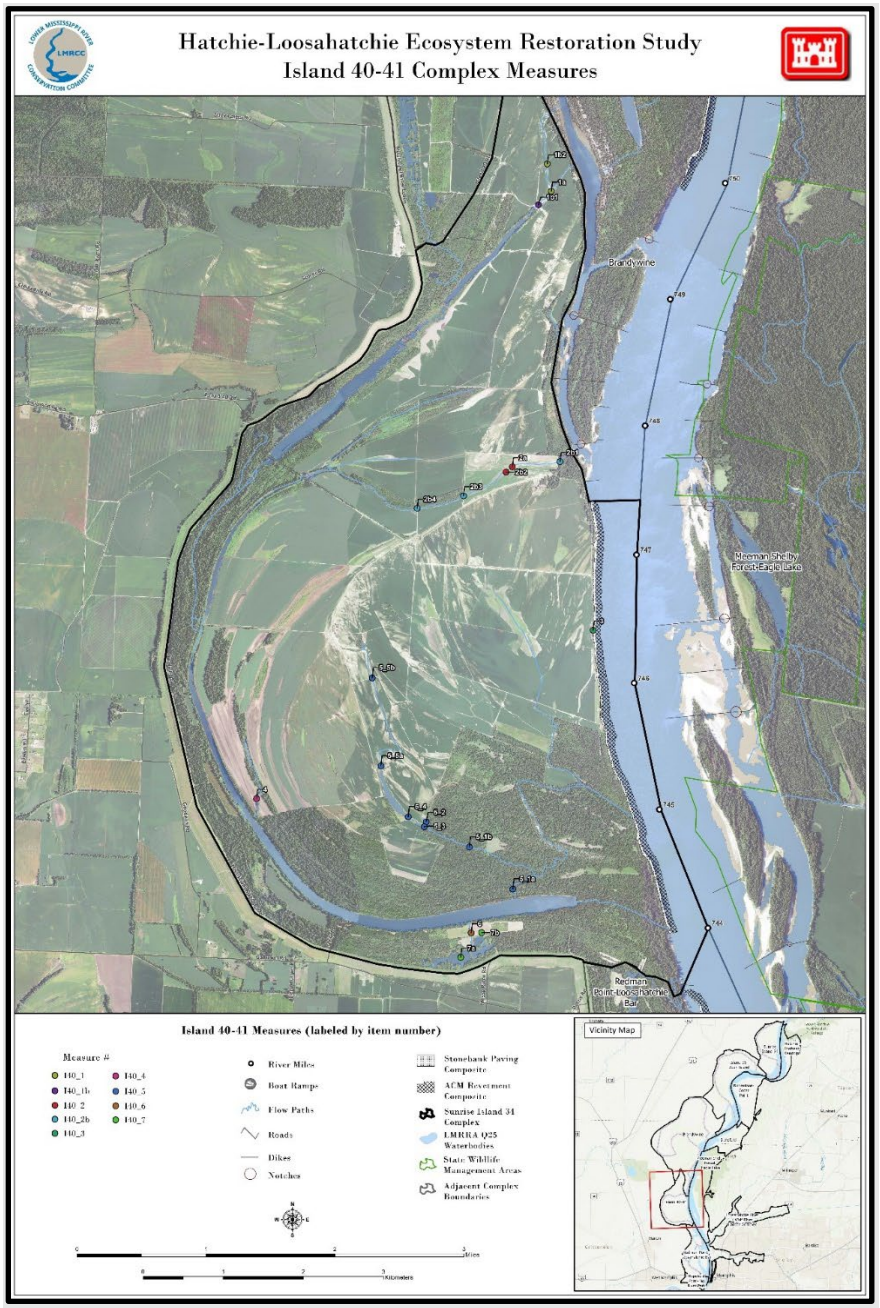


Figure 7-1 Island 40 41 Complex

7.1 ISLAND 40-41 (I40_1A)

From at least 1765-1915, a large mid-channel bar was present in the Island 40/41 area (Harmar and Clifford 2006, MRC 1879). Between 1915 and 1930, the two branches of the upstream channel around the island's right descending bank were cutoff. The northern branch (I40_1) now connects to Danner Lake. The southern branch (I40_2) connects to remnants of the I40/41 meander scarp. In the northern channel path, the somewhat hydric Bowdre silty clay and Commerce silt loam (NWIS, SSURGO) has been farmed since at least 1969 (USGS 11Apr1969 image). Additional forest was cleared at the upstream and downstream ends of the channel in 2014 to allow unobstructed pivot irrigation (G. Earth 22Apr2014). Water flows across the farmland through the old channel paths during high water. This measure proposes to reforest a 300 ft wide buffer (white outline on image) around these flow paths (blue line on image). Flow paths were buffered by 150 ft to determine project reforestation acreage. Supplemental floodplain acreage is the adjacent forest.

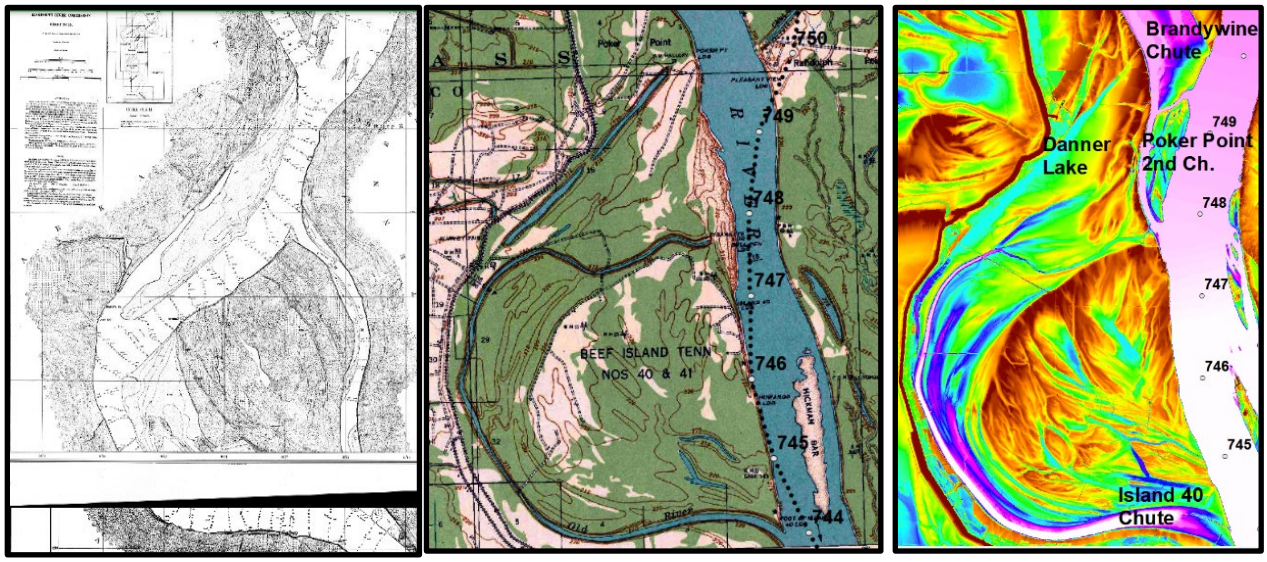
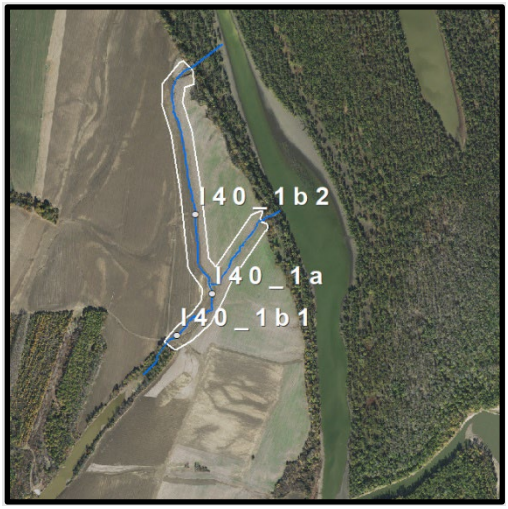


Figure 7-1. I40_1a Imagery 1

I40_1a proposes to reforest a 300 ft wide buffer (white outline on image) around these flow paths (blue line on image). This forest would connect the forested high bank to the interior forested sloughs. It will also filter and reduce the nutrients and sediment flowing into the sloughs increasing their longevity.



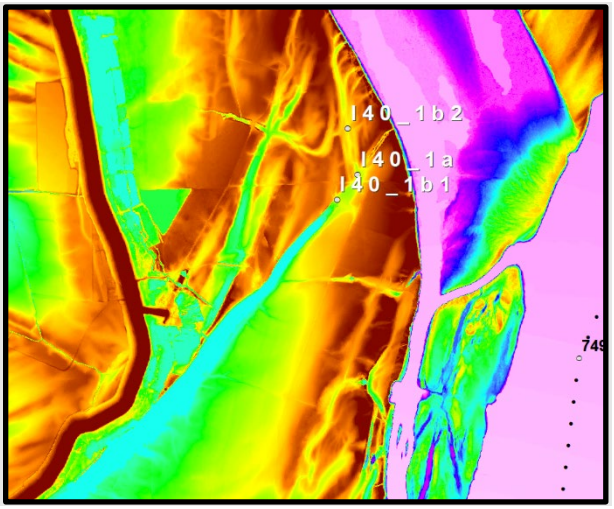


Figure 7-2. I40_1a Imagery 2

Table 7-1: I40_1a Description

I40_1a Description of Features			
Measure Description	Reforestation – BLH		
Construction Activity	Floodplain Vegetative		
Model	HGM		
Restoration Activity	Enhance and Restore Natural Vegetation		
Habitat	BLH (floodplain)		
I40_1a Items			
Item-Feature	**Meets Objective**	**Notes**	**Screened**
I40_1a	1 and 3	Reforest channel enhance habitat and reduce sediment and nutrient inputs. Reforest ~2,700 ft and ~3,200 ft to fac wet or obligate species in flow paths to River.	No
I40_1a Construction Assumptions			
I40_1a	HGM costs provided by ERDC.		
I40_1a Real Estate Assumptions			

I40_1a	Assume purchase of 37 floodplain acres of agricultural land.

I40_1a OMRR&R Assumptions	
I40_1a	None
I40_1a Adaptive Management & Monitoring Assumptions	
I40_1a	HGM AMM costs provided by ERDC.

7.2 ISLAND 40-41 (I40_1B)

Between 1915 and 1930, the upstream end of the Island 40/41 secondary channel was cutoff. There are several flow paths that persist at the historic island's upper end. When the river is higher, water from Brandywine Chute flows into these channels across agricultural land and into the remnant sloughs. This measure proposes to alter obstructions in the historic flow paths (blue line on I40_1a image) to improve connectivity. This will allow fish to access and better utilize the remnant channel, now called Danner Lake. Aquatic acreage was the waterbody with increased connectivity. Supplemental aquatic acreage is Brandywine Chute, Poker Point secondary channel and adjacent main channel.

Item I40_1b1 is a culvert under the road that crosses over the flow path at the upstream end of Danner Lake. Imagery indicates the ground in this area has been reworked several times within the last decade (G. Earth). This item proposes to replace the culvert to improve connectivity and fish passage.

I40_1b proposes to alter obstructions in the historic flow paths to improve connectivity.

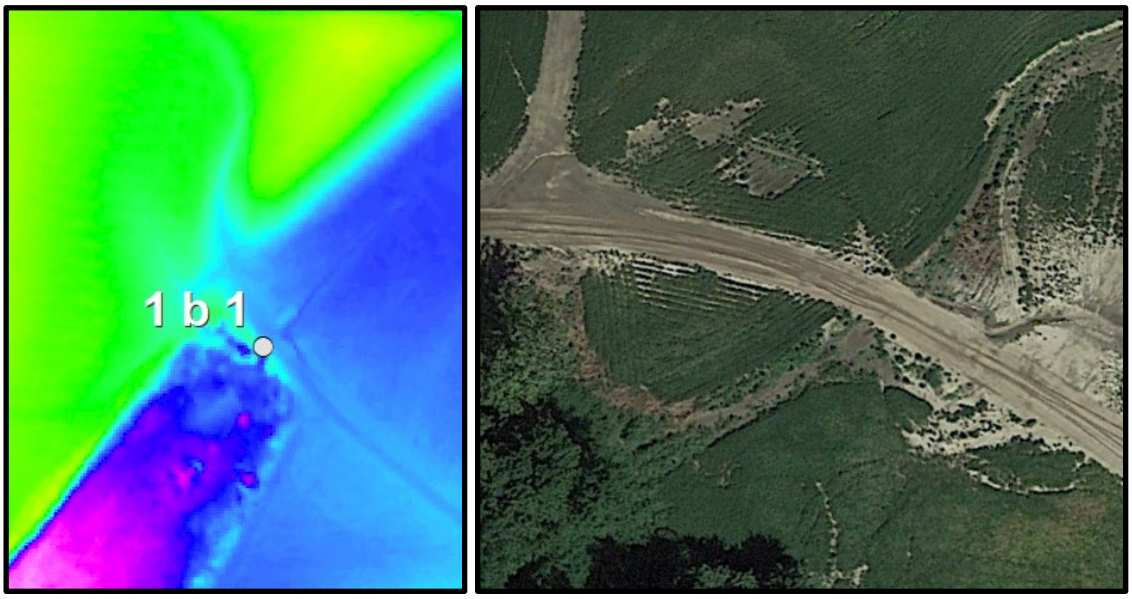


Figure 7-3. I40_1b1

Item I40_1b2 proposes to deepen the higher elevation area of the existing flow path to improve connectivity between Brandywine Chute and Danner Lake.

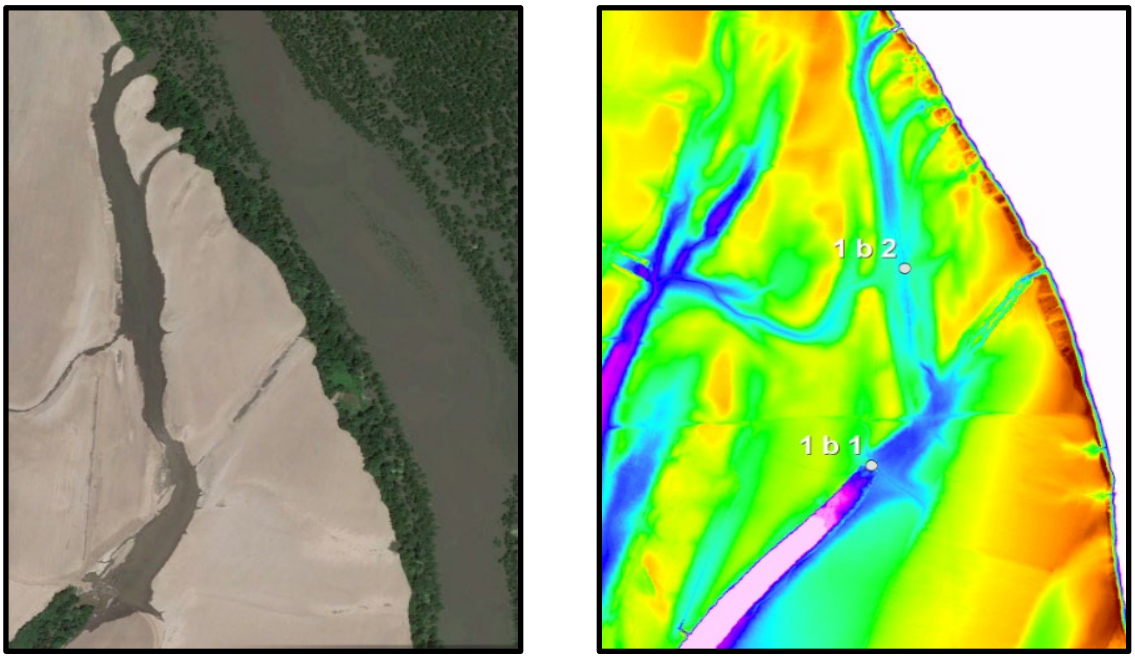


Figure 7-4. I40_1b2

Table 7-2: I40_1b Description

I40_1b Description of Features			
Measure Description	Flow Restoration to Backwater Slough		
Construction Activity	Culverts; Earthwork		
Model	Bidirectional		
Restoration Activity	Altering Connectivity		
Habitat	Slough (lentic aquatic)		
I40_1b Items			
Item-Feature	**Meets Objective**	**Notes**	**Screened**

I40_1b1	3	Improve upstream connectivity to increase fish access, enhance habitat, and reduce sediment and nutrient inputs. Lower culvert invert to increase connectivity.	No
I40_1b2	3	Improve upstream connectivity to increase fish access, enhance habitat, and reduce sediment and nutrient inputs. Excavate swale.	No

I40_1b Construction Assumptions	
I40_1b1	Single 48in CMP 50 LF, 123 TN riprap inlet/outlet protection for R-125, includes mobilization/demobilization.
I40_1b2	1,500 LF swale ($6/CY), 150 wide, 1 foot deep (8,333 CY).
I40_1b Real Estate Assumptions	
I40_1b1	Assume purchase of 161 aquatic acres of woodlands (including floodplain waterbodies (i.e., borrow areas, lakes, etc.)).
I40_1b2	O&M:
I40_1b OMRR&R Assumptions	
I40_1b1	Blockage removal O&M at years 10, 20 and 40; riprap inlet/outlet protection at culverts at years 15, 30, 45 at 50% of construction
I40_1b2	Channel cleanout O&M at years 15, 30, 45 estimated at 25% of initial construction cost.
I40_1b Adaptive Management & Monitoring Assumptions	
I40_1b1	Aquatic Lidar Surveys (ROV)- Small Channels (A) at years 0,7 estimated at $2400/event; Fish & Invertebrate Surveys Monitoring - Bidirectional, Unidirectional, Isolation (A) at years 0, 3,5,7,10 estimated at $4167/event.
I40_1b2	

7.3 ISLAND 40-41 (I40_2A)

This measure proposes to improve the southern upstream flow path of the historic island; I40_1 improves the northern path. In 1969, the upstream end of the channel was buffered by around 35 ft of forest on each side as shown in USGS 11Apr1969 imagery. Sometime prior to 1985, part of this forest was removed, and the somewhat hydric Commerce silt loam and Sharkey/Tunica silty clay (NWIS, SSURGO) was farmed (G. Earth). After the

2011 flood, the remaining forest buffer was widened to its current extent (G. Earth). There is an opportunity to reforest the remainder of the upstream flow path (white outline on image). This would provide another connection between the riverbank forest and Island 40 Chute's Forest. The forest would also remove nutrients and sediment improving water quality and possibly increasing the longevity of Island 40 Chute. The project's acreage is the floodplain reforestation area (outlined in white on image). The supplemental acreage is the adjacent forest.

I4_2a proposes to improve the southern upstream flow path of the historic island by reforesting the remainder of the upstream flow path. This would provide another connection between the riverbank forest and Island 40 Chute's Forest. The forest would also remove nutrients and sediment improving water quality and possibly increasing the longevity of Island 40 Chute.

Figure 7-5. I40_2a

Table 7-3: I40_2a Description

I40_2a Description of Features	
Measure Description	Reforestation – BLH
Construction Activity	Floodplain Vegetative
Model	HGM
Restoration Activity	Enhance and Restore Natural Vegetation
Habitat	BLH (floodplain)

I40_2a Items			
Item-Feature	**Meets Objective**	**Notes**	**Screened**
I40_2a	1 and 3	Re-create and reforest the upstream channel of Island 40 Chute to improve connectivity and remnant meander scarp longevity. Reforest ~4,300 ft (29 acres) to fac wet or obligate species in swale to River *Screening criteria: First iteration of CEICA showed poor performance.*	Yes – CEICA Round 1
I40_2a Construction Assumptions			
I40_2a	HGM costs provided by ERDC.		
I40_2a Real Estate Assumptions			
I40_2a	Assume purchase of 29 floodplain acres of agricultural land.		
I40_2a OMRR&R Assumptions			
I40_2a	None		
I40_2a Adaptive Management & Monitoring Assumptions			
I40_2a	HGM AMM costs provided by ERDC.		

7.4 ISLAND 40-41 (I40_2B)

Over 90 years ago, as the river's flow diverted to the left descending bank of Island 40 & 41, the Island 40 Chute along the right descending bank narrowed (MRC 1897, USGS 1931). Eventually the flow paths forming the channel's upper end became high elevation channels, flowing only when river levels rose. The upstream disconnection was accelerated as roads were built across the channels to access the island's interior. The middle part of Island 40 Chute holds permanent water with a downstream connection like an oxbow lake. Meander scarps, like Island 40 Chute, no longer form within the Mississippi River Valley. The channel between I40_2b3 and I40_2b1 is higher than the adjacent channel and item I40_2b2 proposes to deepen this section of channel. Items 2b1, 2b3, and 2b4 propose to improve the connectivity at the three obstructions across the channel. This measure's acreage is the upstream waterbody. The supplemental acreage is Poker Point secondary channel and the river's main channel.

I40_2b proposes to alter the road crossings and deepen the upstream channel to increase connectivity and flow. Improving flow could also scour sediment from the permanent waterbody, further prolonging its longevity.

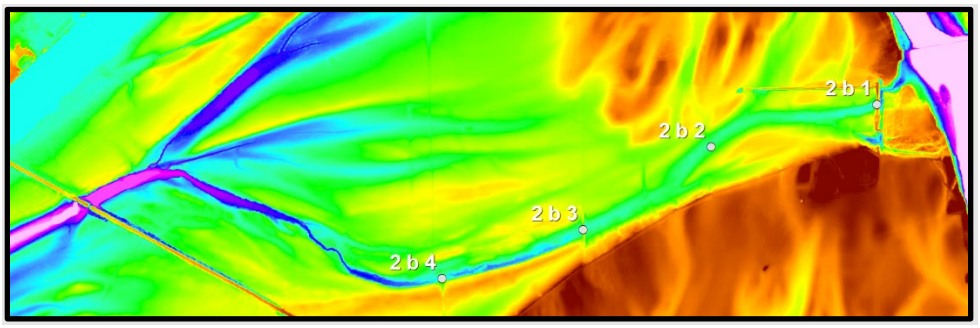


Figure 7-6. I40_2b

Table 7-4: I40_2b Description

I40_2b Description of Features			
Measure Description		Flow Restoration to Backwater Slough	
Construction Activity		Riprap Weir; Earthwork; Culverts	
Model		Bidirectional	
Restoration Activity		Altering Connectivity	
Habitat		Slough (lentic aquatic)	
I40_2b Items			
Item-Feature	**Meets Objective**	**Notes**	**Screened**
I40_2b1	3	Improve upstream connectivity of Island 40 Chute to increase fish access, enhance habitat, and reduce sediment and nutrient inputs. Modify obstruction/lower invert to increase connectivity through installation of rock weir.	Yes – CEICA Round 1

		Screening criteria: First iteration of CEICA showed poor performance. Benefits only accrue to small waterbody due to existing road.	
I40_2b2	3	Improve upstream connectivity of Island 40 Chute to increase fish access, enhance habitat, and reduce sediment and nutrient inputs. Create ~4,300 ft low flow channel to match depth of channel to the west. *Screening criteria: First iteration of CEICA showed poor performance. Benefits only accrue to small waterbody due to existing road.*	
I40_2b3	3	Improve upstream connectivity of Island 40 Chute to increase fish access, enhance habitat, and reduce sediment and nutrient inputs. Install weir. *Screening criteria: First iteration of CEICA showed poor performance. Benefits only accrue to small waterbody due to existing road.*	
I40_2b4	3	Improve upstream connectivity of Island 40 Chute to increase fish access, enhance habitat, and reduce sediment and nutrient inputs. Lower culvert invert to increase connectivity. *Screening criteria: First iteration of CEICA showed poor performance. Benefits only accrue to small waterbody due to existing road.*	

I40_2b Construction Assumptions	
I40_2b1	R-200 riprap weir, excavate 8ft (50LF by 25 LF - 370 CY), 139 TN of R-200 (includes mobilization/demobilization), 0.5 acres of clearing.
I40_2b2	4,300 LF, 2ft deep, 80' wide BW, 1:3 side slope (27,400 CY), includes mobilization and demobilization.
I40_2b3	R-200 riprap weir, excavate 7ft (150LF BW by 30 LF - 1330 CY), 2ft thick 640 TN of R-200 (includes mobilization/demobilization).
I40_2b4	Four 36in CMPS, 40ft per CMP, total 160LF of CMP, R-125 inlet/outlet protection (2ft thick, 24x25) - 133TN.

I40_2b Real Estate Assumptions	
I40_2b1	Assume purchase of 5.5 floodplain acres of woodlands (including floodplain waterbodies (i.e., borrow areas, lakes, etc.)) (for I40_2b1, 2b2, 2b3, 2b4).
I40_2b2	
I40_2b3	
I40_2b4	
I40_2b OMRR&R Assumptions	
I40_2b1	Channel cleanout O&M at years 15, 30, 45 estimated at 25% of initial construction cost; rip rap control structure O&M at year 30 estimated at 50% of construction cost.
I40_2b2	Channel cleanout O&M at years 15, 30, 45 estimated at 25% of initial construction cost.
I40_2b3	Channel cleanout O&M at years 15, 30, 45 estimated at 25% of initial construction cost; rip rap control structure O&M at year 30 estimated at 50% of construction cost.
I40_2b4	Blockage removal O&M at years 10, 20 and 40; riprap inlet/outlet protection at culverts at years 15, 30, 45 at 50% of construction cost.
I40_2b Adaptive Management & Monitoring Assumptions	
I40_2b1	Aquatic Lidar Surveys (ROV)- Small Channels (A) at years 0,7 estimated at $2400/event; Fish & Invertebrate Surveys Monitoring - Bidirectional, Unidirectional, Isolation (A) at years 0, 3,5,7,10 estimated at $4167/event.
I40_2b2	
I40_2b3	
I40_2b4	

7.5 ISLAND 40-41 (I40_3)

The bank soils are non-hydric (NWI) Robinsonville silt loam (SSURGO). The acreage for the measure is the 8,500 x 300 ft planting area and supplemental acreage is the adjacent forest.

I40_3 proposes to plant an 8,500ft long by 300ft wide forest strip along the high bank. The riverward high bank of Islands 40 and 41 has had minimal forest for decades. Reforestation from river mile 745.7 to 747.6 along the right descending bank would improve forest connectivity between Brandywine and Poker Point Island forests and the forest at the lower end of Island 40 and 41. The forest would also protect the high bank and reduce the impacts of scouring flood flows reducing sediment and nutrient runoff from the adjacent agricultural lands.

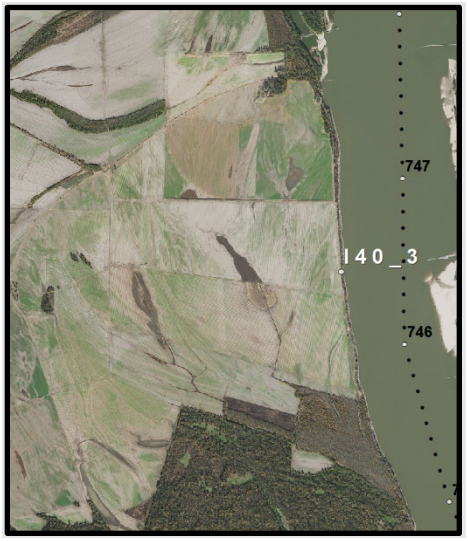


Figure 7-7. I40_3

Table 7-5: I40_3 Description

I40_3 Description of Features			
Measure Description	MS River Riparian Buffer		
Construction Activity	Floodplain Vegetative		
Model	HGM		
Restoration Activity	Enhance and Restore Natural Vegetation		
Habitat	Riverfront Forest – Riparian Buffers (floodplain)		
I40_3 Items			
Item-Feature	**Meets Objective**	**Notes**	**Screened**
I40_3	1	Reforest 8,500 ft of the historic Island 40 main channel high bank from river mile 745.7 - 747.6 to create a contiguous tree buffer strip and connect forest habitat. Include 300 ft width 8,500 ft (59 acres) long riparian buffer along the Lower Mississippi Riverbank.	No

I40_3 Construction Assumptions	
I40_3	HGM costs provided by ERDC.
I40_3 Real Estate Assumptions	
I40_3	Assume purchase of 59 floodplain acres of agricultural land.
I40_3 OMRR&R Assumptions	
I40_3	None
I40_3 Adaptive Management & Monitoring Assumptions	
I40_3	HGM AMM costs provided by ERDC.

7.6 ISLAND 40-41 (I40_4)

There are few permanent waterbodies in the interior of Island 40 and 41. The remaining four waterbodies, have obstructions that reduce their connectivity to Island 40 Chute. Three of the four waterbodies occur in hydric to mostly hydric soils while the 4th in remnant forest north of I40_5_5b is in non-hydric soil (NWIS). The soils are Tunica silty clay, Sharkey clay, Bowdre silty clay and swamp

I40_4 proposes to remove a high spot within the channel that connects to the western lake to improve connectivity to this forested waterbody.

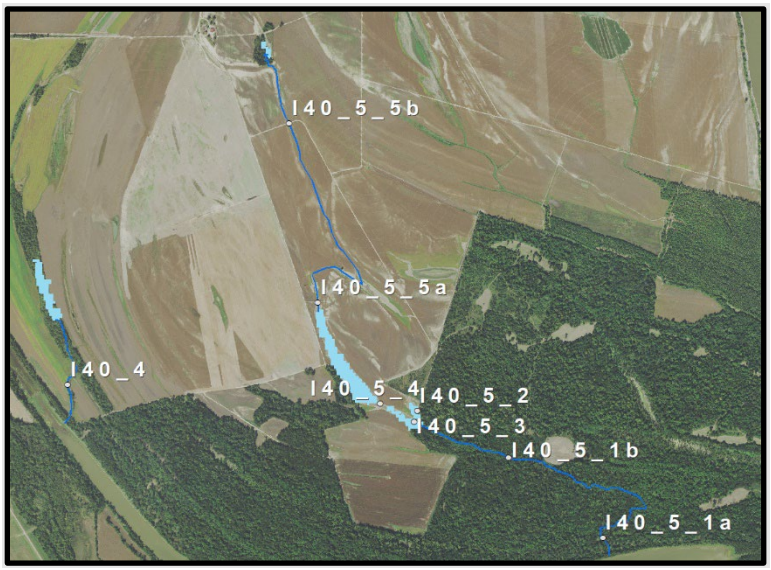


Figure 7-8. I40_4

Table 7-6: I40_4 Description

I40_4 Description of Features			
Measure Description	Flow Restoration to Backwater Slough		
Construction Activity	Earthwork		
Model	Bidirectional		
Restoration Activity	Altering Connectivity		
Habitat	Slough (lentic aquatic)		
I40_4			
Item-Feature	**Meets Objective**	**Notes**	**Screened**
I40_4	3	Modify obstruction to improve connectivity to a remnant slough on Island 40/41 interior by channel cleanout 2,400ft length x 40ft width x 1.5ft depth.	Yes – CEICA Round 2

		Screening criteria: Second iteration of CEICA showed poor performance.	
I40_4 Construction Assumptions			
I40_4	2,400 LF cleanout, 40ft wide, 1.5ft deep (5,300 CY), 4.4 acres of clearing.		
I40_4 Real Estate Assumptions			
I40_4	Assume purchase of 9.4 aquatic acres of woodlands (including floodplain waterbodies (i.e., borrow areas, lakes, etc.)).		
I40_4 OMRR&R Assumptions			
I40_4	Channel cleanout O&M at years 15, 30, 45 estimated at 25% of initial construction cost.		
I40_4 Adaptive Management & Monitoring Assumptions			
I40_4	Aquatic Lidar Surveys (ROV)- Small Channels at years 0,7 estimated at $2400/event; Fish & Invertebrate Surveys Monitoring - Bidirectional, Unidirectional, Isolation (A) at years 0, 3,5,7,10 estimated at $4167/event.		

7.7 ISLAND 40-41 (I40_5)

There are few permanent waterbodies in the interior of Island 40 and 41. The remaining four waterbodies, have obstructions that reduce their connectivity to Island 40 Chute. Three of the four waterbodies occur in hydric to mostly hydric soils while the 4th in remnant forest north of I40_5_5b is in non-hydric soil (NWIS). The soils are Tunica silty clay, Sharkey clay, Bowdre silty clay and swamp.

I40_5 proposes to remove/replace a series of obstructions to improve connectivity to waterbodies with forested and farmed shorelines.

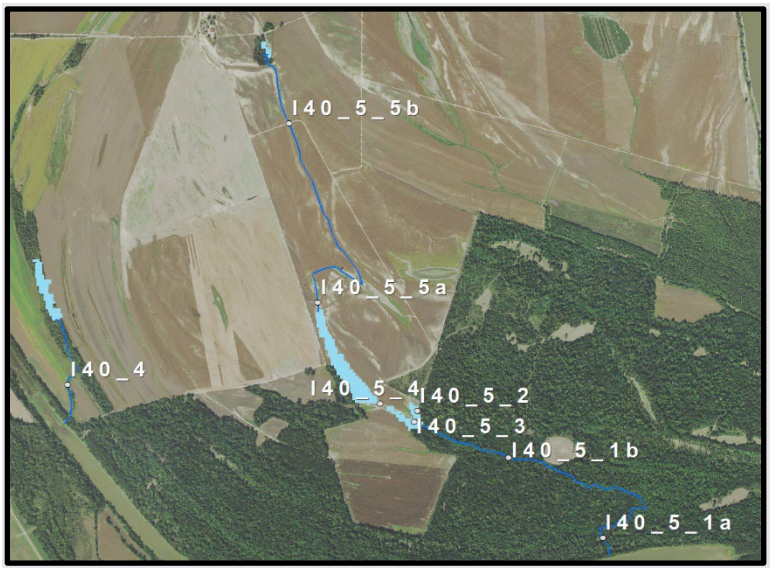


Figure 7-9. I40_5

Table 7-7: I40_5 Description

I40_5 Description of Features			
Measure Description	Flow Restoration to Backwater Slough		
Construction Activity	Earthwork		
Model	Bidirectional		
Restoration Activity	Altering Connectivity		
Habitat	Slough (lentic aquatic)		
I40_5 Items			
Item-Feature	**Meets Objective**	**Notes**	**Screened**
I40_5_1a	3	Modify obstructions to improve connectivity to three remnant sloughs on Island 40/41 interior. Lower culvert invert to increase connectivity.	Yes – CEICA Round 2

		Screening criteria: Second iteration of CEICA showed poor performance.	
I40_5_1b	3	Modify obstructions to improve connectivity to three remnant sloughs on Island 40/41 interior. Installation of lower elevation rock/low water crossing. *Screening criteria: Second iteration of CEICA showed poor performance.*	
I40_5_2	3	Modify obstructions to improve connectivity to three remnant sloughs on Island 40/41 interior. Lower culvert invert to increase connectivity. *Screening criteria: Second iteration of CEICA showed poor performance.*	
I40_5_3	3		
I40_5_4	3		
I40_5_5a	3		
I40_5_5b	3	Modify obstructions to improve connectivity to three remnant sloughs on Island 40/41 interior. Installation of lower elevation rock/low water crossing. *Screening criteria: Optimized with scaled analysis and updated assumptions.*	

I40_5 Construction Assumptions	
I40_5_1a	I40_5_1a: Two 60in CMPs 40 LF, 25ftx30ftx2ft (166 TN) riprap inlet/outlet protection for R-125, includes mobilization/demobilization.
I40_5_1b	R-200 riprap low water crossing, excavate 7ft (50LF by 20LF - 460 CY), 255 TN of R-200 (includes mobilization/demobilization), 0.5 acres
I40_5_2	30LF of single 48in CMP, R-125 inlet/outlet protection (2ft thick, 12x28) – 75TN, includes mobilization/demobilization.
I40_5_3	60LF of two 60in CMPs, 25ftx30ftx2ft (166 TN) riprap inlet/outlet protection for R-125, includes mobilization/demobilization.
I40_5_4	35LF of single 60in CMP, 12ftx15ftx2ft (83 TN) riprap inlet/outlet protection for R-125, includes mobilization/demobilization.
I40_5_5a	60LF of single 60in CMP, 12ftx15ftx2ft (83 TN) riprap inlet/outlet protection for R-125, includes mobilization/demobilization.

l40_5_5b	R-200 riprap low water crossing, excavate 3ft (120LF by 15LF - 215 CY), 230 TN of R-200 (includes mobilization/demobilization).
l40_5 Real Estate Assumptions	
l40_5_1a	Assume purchase of 17.5 aquatic acres of woodlands (including floodplain waterbodies (i.e., borrow areas, lakes, etc.)).
l40_5_1b	
l40_5_2	
l40_5_3	
l40_5_4	
l40_5_5a	
l40_5_5b	
l40_5 OMRR&R Assumptions	
l40_5_1a	
l40_5_1b	
l40_5_2	Blockage removal O&M at years 10, 20 and 40; riprap inlet/outlet protection at culverts at years 15, 30, 45 at 50% of construction cost.
l40_5_3	Channel cleanout O&M at years 15, 30, 45 estimated at 25% of initial construction cost; riprap inlet/outlet protection at culverts at years 15, 30, 45 at 50% of construction cost.
l40_5_4	Blockage removal O&M at years 10, 20 and 40; riprap inlet/outlet protection at culverts at years 15, 30, 45 at 50% of construction cost.
l40_5_5a	For CMP, O&M at year 30 (100% of initial cost); blockage removal O&M at years 10, 20 and 40; riprap inlet/outlet protection at culverts at years 15, 30, 45 at 50% of construction cost.
l40_5_5b	Channel cleanout O&M at years 15, 30, 45 estimated at 25% of initial construction cost; riprap inlet/outlet protection at culverts at years 15, 30, 45 at 50% of construction cost.
l40_5 Adaptive Management & Monitoring Assumptions	
l40_5_1a	Aquatic Lidar Surveys (ROV)- Small Channels (A) at years 0,7 estimated at $2400/event; Fish & Invertebrate Surveys Monitoring - Bidirectional, Unidirectional, Isolation (A) at years 0, 3,5,7,10 estimated at $4167/event.
l40_5_1b	
l40_5_2	

I40_5_3	
I40_5_4	
I40_5_5a	
I40_5_5b	

7.8 ISLAND 40-41 (I40_6)

Along the mainline levee within the Island 40-41 complex, there are numerous borrow areas in the partially hydric Bowdre silty clay (NWIS, SSURGO). Few retain permanent water. The remaining borrow areas with permanent water are isolated by high elevation ground along Island 40 Chute, berms between the borrow areas, and the mainline levee. One drainage way has been constructed reducing this isolation. With increased isolation, a rare wetland fish community could develop that would enhance fish diversity within the river valley. This measure proposes to fill in the drainage way to increase isolation and promote a wetland community. The drainage way bottom is around 212.3 ft while the berms which isolate the borrow areas are around 219.8 ft. In an average water year like 2017, the drainage way connected the borrow areas during two events for 45 days while the berms were exceeded once for 19 days. In a dry year like 2012, the berms were not overtopped while the drainage connected for 8 days. This measure's project area is the borrow areas. During large scale floods, the borrow areas' wetland species would supplement populations of these species throughout the area. Therefore, supplemental acreage is the I40 Chute and main channel adjacent to the complex.

I40_6 proposes to fill in drainage way between borrow areas along the mainline levee within the Island 40 and 41 complex to increase isolation and promote a wetland community.

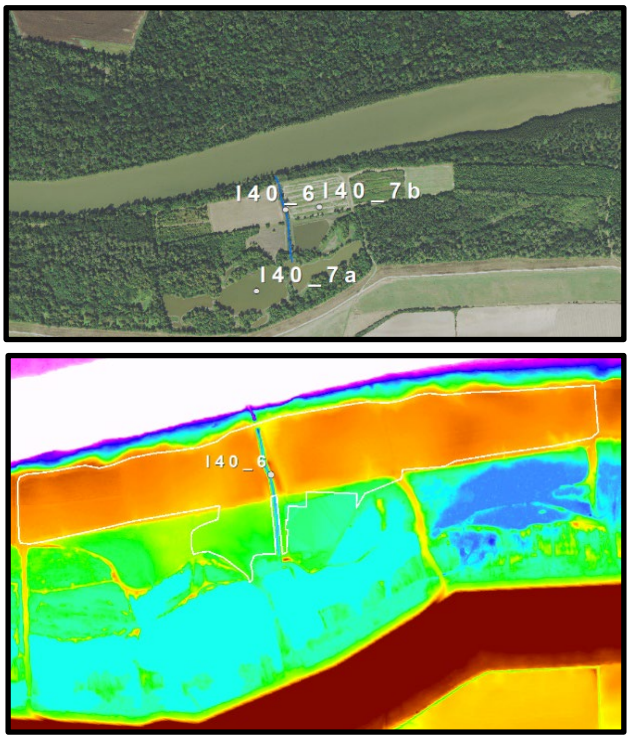


Figure 7-10. I40_6

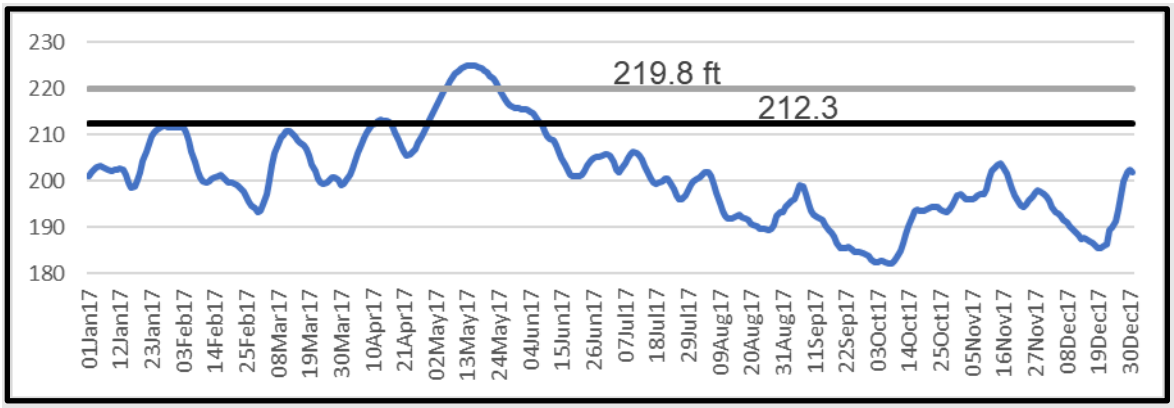


Figure 7-11. I40_6 Water Level

Figure. The river's 2017 water surface at the borrow area compared to the elevation of the drainage way (212.3) and the higher elevation berms (219.8 ft).

Table 7-8: I40_6 Description

I40_6 Description of Features	
Measure Description	Isolation of a Floodplain Waterbody
Construction Activity	Earthwork
Model	Isolation
Restoration Activity	Altering Connectivity
Habitat	Borrow Areas (lentic aquatic)

I40_6 Items			
Item-Feature	**Meets Objective**	**Notes**	**Screened**
I40_6	3	Isolate borrow area to promote wetland fish community. Fill in all/part of ditch or cutoff/collapse culvert to optimize borrow pit isolation. *Screening criteria: Screened in Final Array of Alternatives*	Yes – Final Array
I40_6 Construction Assumptions			
I40_6	850 LF by 25 top width by 6 feet deep (4450 CY). Assume material can be pushed from proposed borrow area measure 7, includes mobilization/demobilization		
I40_6 Real Estate Assumptions			
I40_6	Assume purchase of 29 aquatic acres of woodlands (including floodplain waterbodies (i.e., borrow areas, lakes, etc.)).		
I40_6 OMRR&R Assumptions			
I40_6	None - borrow O&M removed from costs following benefit evaluation		

I40_6 Adaptive Management & Monitoring Assumptions	
I40_6	Fish & Invertebrate Surveys Monitoring – Bidirectional, Unidirectional, Isolation (A) at years 0, 3,5,7,10 estimated at $4167/event.

7.9 ISLAND 40-41 (I40_7A)

The borrow areas have been present since at least 1963 and are visible in 8 March 1963 USGS imagery. The measure's acreage is the aquatic borrow area.

I40_7a proposes to alter the borrow areas connectivity by deepening them. The borrow areas maintain a mostly forested and sinuous shoreline by have likely accumulated considerable sediment over more than 50 years.

Figure 7-12. I40_7a

Table 7-9: I40_7a Description

I40_7a Description of Features	
Measure Description	Restoring Habitat Complexity in Borrow Area
Construction Activity	Earthwork; dewatering
Model	Borrow
Restoration Activity	Waterbody Enhancement

Habitat	Borrow Areas (lentic aquatic)		
I40_7a			
Item-Feature	**Meets Objective**	**Notes**	**Screened**
I40_7a	3	Deepen Borrow Pit assumed additional 5ft depth, potential to use material to fill I40_6. Geotech to review for seepage during detailed design. *Screening criteria: Screened in Final Array of Alternatives*	Yes – Final Array
I40_7a Construction Assumptions			
I40_7a	Estimate is based on excavating with no haul. Assumed depth of excavation 5ft. Survey is required to determine current borrow pit depth. Full borrow pit analysis will be required to verify the allowable excavation depth based on seepage conditions at each borrow pit. This could lead to the borrow pits not being able to be excavated at all or being able to be excavated more than 5ft. 180,000 CY (75% of the borrow area.) Unwatering – 8in Crisafulli using 1,500 GPM (200 ft3/min) - Assume 8 hr day - 96,000 ft3/day - Assume depth of water is 3 feet (3,789,720 cubic feet of water, 40 days), includes mobilization/demobilization.		
I40_7a Real Estate Assumptions			
I40_7a	Assume purchase of 29 aquatic acres of woodlands (including floodplain waterbodies (i.e., borrow areas, lakes, etc.)).		
I40_7a OMRR&R Assumptions			
I40_7a	None - borrow O&M removed from costs following benefit evaluation		
I40_7a Adaptive Management & Monitoring Assumptions			
I40_7a	Fish Survey - Borrow Areas at years 0,3,5,7,10 estimated at $5455/event.		

7.10 ISLAND 40-41 (I40_7B)

The measure's acreage is the farmland which will reforest. The supplemental acreage is the adjacent forest.

I40_7b proposes to acquire and allow natural succession on the farmland (white outline on image) adjacent to the borrow areas. Over time the farmed acreage adjacent to the

borrow areas and Island 40 Chute has decreased. Farmed fields remain adjacent to the borrow areas and likely increase the rate of sedimentation deposition. Nutrient runoff from the fields would also impact the water quality, fish and invertebrate community.

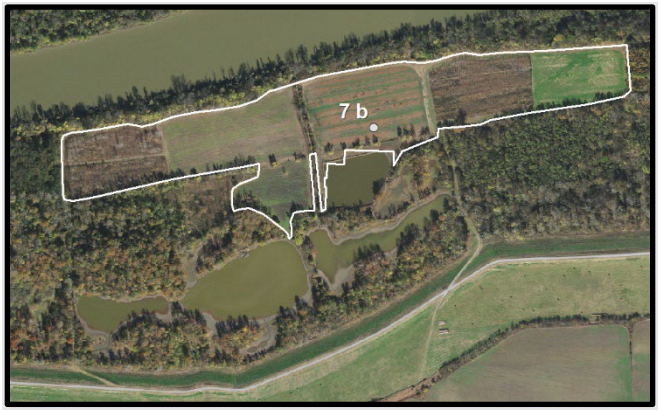


Figure 7-13. I40_7b

Table 7-10: I40_7b Description

I40_7b Description of Features			
Measure Description	Reforestation – BLH		
Construction Activity	Floodplain Vegetative		
Model	HGM		
Restoration Activity	Enhance and Restore Natural Vegetation		
Habitat	BLH (floodplain)		
I40_7b Items			
Item-Feature	**Meets Objective**	**Notes**	**Screened**
I40_7b	1	Reforestation (44-acres of agriculture land) adjacent to floodplain waterbody (identified in LMVJV priority area).	Yes – Final Array
I40_7b Construction Assumptions			
I40_7b	HGM costs provided by ERDC.		
I40_7b Real Estate Assumptions			

l40_7b	Assume purchase of 44 floodplain acres of agricultural land.
l40_7b OMRR&R Assumptions	
l40_7b	None
l40_7b Adaptive Management & Monitoring Assumptions	
l40_7b	HGM AMM costs provided by ERDC.

Section 8

Loosahatchie River – Wolf River Complex

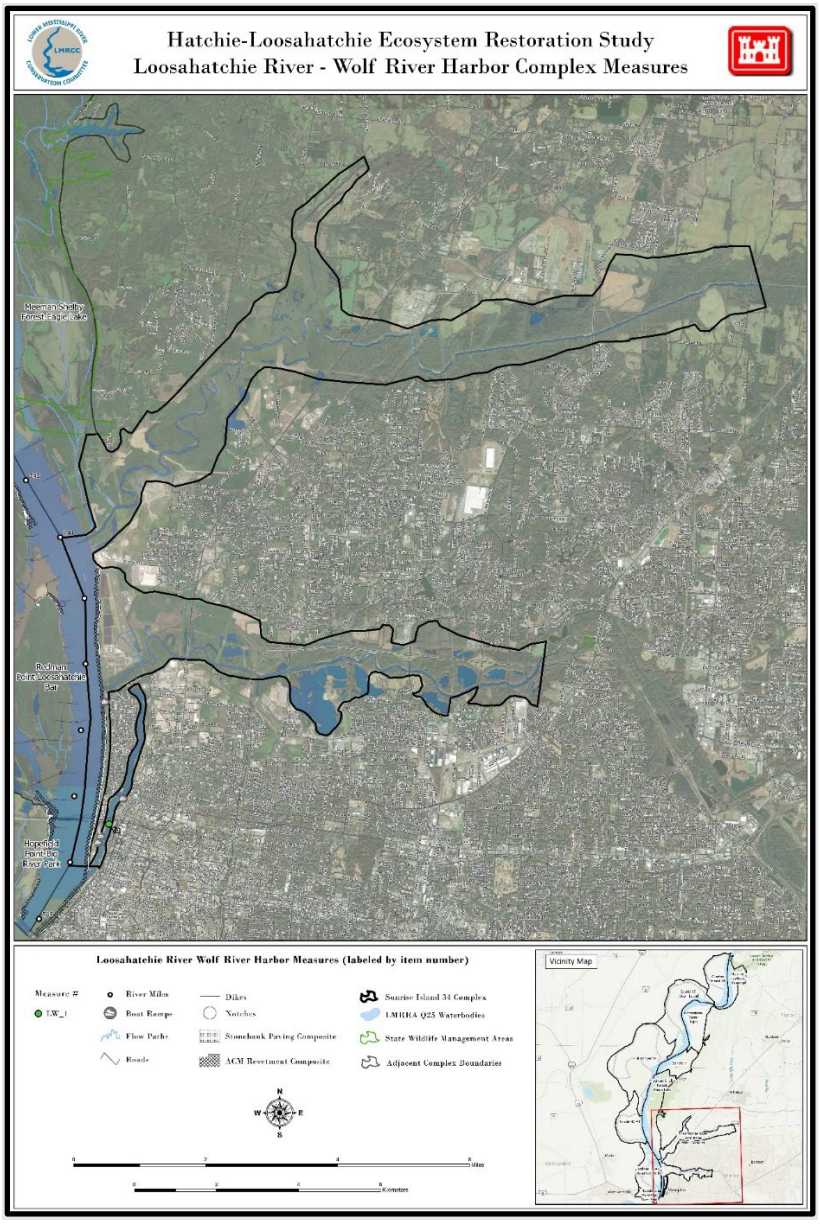


Figure 8-1 Loosahatchie Wolf River Complex

8.1 LOOSAHATCHIE RIVER – WOLF RIVER (LW_1)

LW_1 proposes educational opportunities through the installation of a display board and model of a large woody debris trap. This measure is recreational and thus had no habitat benefits.

Table 8-1: LW_1 Description

LW_1 Description of Features			
Measure Description	Recreation – Interpretative Media and Demonstration		
Construction Activity	Recreation		
Model	N/A		
Restoration Activity	N/A		
Habitat	N/A		
LW_1			
Item-Feature	**Meets Objective**	**Notes**	**Screened**
LW_1a – Creates Educational Opportunities	4	Installs display board and model of a large woody debris trap.	No
LW_1 Construction Assumptions			
LW_1a	Costs estimated per Audrey Harrison and Angie Rodgers based on Prairie Point assumed costs including contingency.		
LW_1 Real Estate Assumptions			
LW_1a	For LW-1, assume purchase of 2 acres of urban land (priced similarly to agricultural land) and assumes work to be done in-channel below OHW and/or incidental to construction costs contingencies (up to 1 acre of river channels).		
LW_1 OMRR&R Assumptions			
LW_1a	Signage O&M at year 30 estimated at 50% of initial construction cost.		
LW_1 Adaptive Management & Monitoring Assumptions			
LW_1a	None		

Section 9

Meeman Shelby Forest Eagle Lake Complex

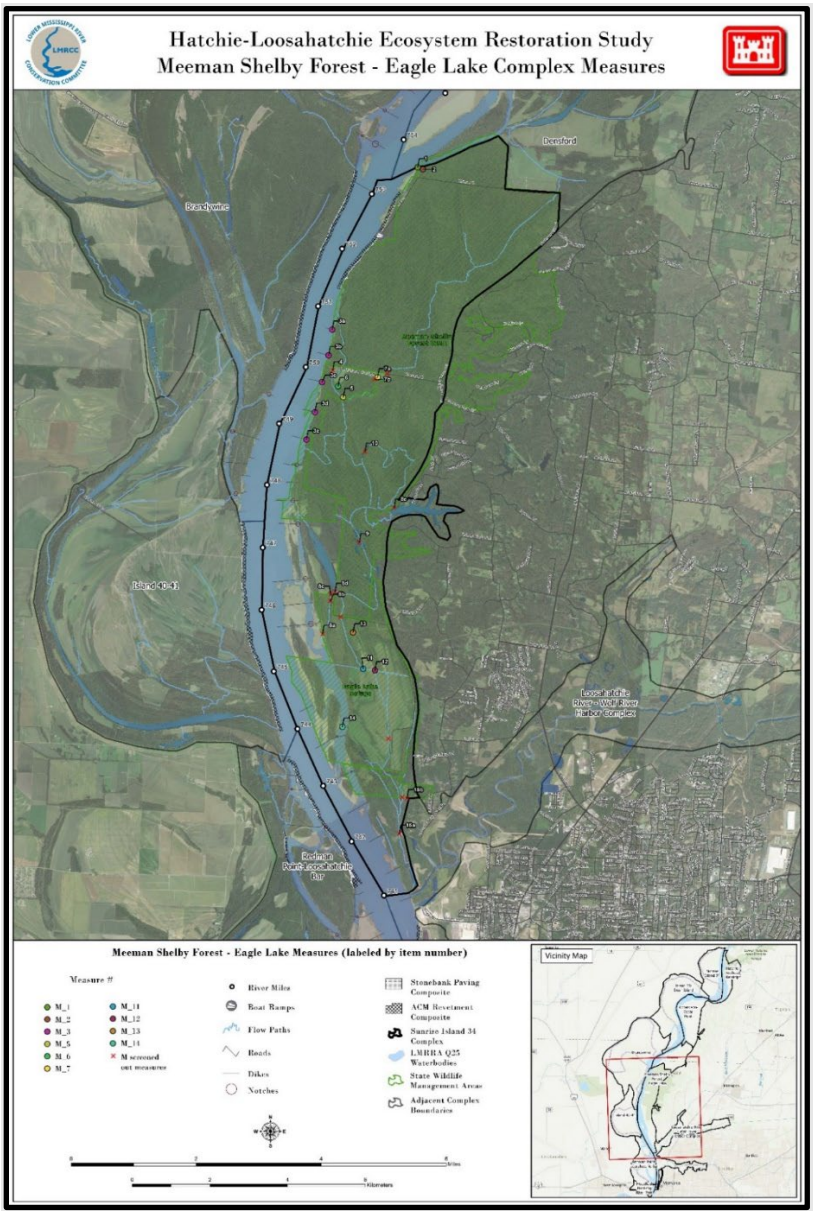


Figure 9-1 Meeman Shelby Forest Eagle Lake Complex

9.1 MEEMAN SHELBY FOREST – EAGLE LAKE (M_1)

Land managers have noted erosion along the floodplain bank just downstream of the outlet of Densford secondary channel. This erosion reduces the acreage of the large contiguous tract of valuable bottomland hardwood forest and threatens park infrastructure. Additionally, the erosion may be causing deposition downstream reducing use of the park's boat ramp. This measure proposes to construct 20 rock hardpoints which will create aquatic diversity within the main channel while reducing bank erosion and sedimentation. A forest erosion rate of 0.12 acres per year was determined by outlining the eroding area using 1997 and 2021 imagery in G. Earth. At this rate, six acres of forest could be lost over the project life. Aquatic benefit area was calculated using three area of effect polygons determined from a 2019 multibeam survey of three St. Louis District hardpoints. These hardpoints changed the bathymetry upstream by 1 time their length, downstream by 3.75, and outwards by 1 time their length. Thus, the aquatic acreage was the hardpoint footprint plus the additional area of bathymetric impact.

M_1 proposes to construct 20 rock hardpoints which will create aquatic diversity within the main channel while reducing bank erosion and sedimentation.

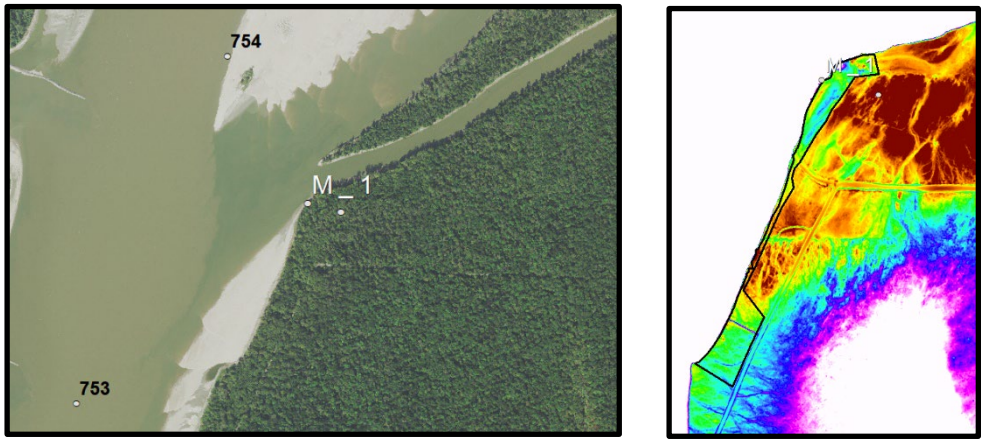


Figure. NAIP 2021 aerial imagery showing the high-quality bottomland forest. USGS 3d elevation program 2014 data showing lower elevation project area that could erode without bank protection.

Figure 9-2. M_1

Table 9-1: M_1 Description

M_1 Description of Features			
Measure Description	Hardpoint Bank Protection		
Construction Activity	Hardpoints; Riprap Bank Protection		
Model	Eddy		
Restoration Activity	Aquatic Channel Enhancement		
Habitat	Secondary Channels (lotic aquatic)		
M_1			
Item-Feature	**Meets Objective**	**Notes**	**Screened**
M_1	1 and 4	Install 20 hardpoints covering 4,000 linear feet to reduce bank erosion to protect valuable BLH forest and reduce downstream sandbar encroachment (protects hiking trails and ramp). *Screening criteria: Screened in final array of alternatives.*	Yes – Final Array
M_1 Construction Assumptions			
M_1	Assumed 20 hardpoints covering 4,000 linear feet including mobilization and de-mobilization. Assumptions include 6ft crown, 1:2.5 slopes, 30ft. Top length, 200ft spacing, 1,600 tons of rock/hardpoint, and 250-lb riprap. Ramp located at channel crossing; no feasible measure to enhance ramp access on LDB.		
M_1 Real Estate Assumptions			
M_1	Assume work to be done in-channel below ordinary highwater and/or incidental to construction costs contingencies.		
M_1 OMRR&R Assumptions			
M_1	O&M at years 15, 30, 45 estimated at 25% of construction cost.		
M_1 Adaptive Management & Monitoring Assumptions			
M_1	Aquatic Bathymetric Survey - Rivers/Secondary Channels (A) at years 0,1,3,5,7,10 estimated at $450/mile; Fish Surveys Monitoring - Velocity and Eddy at years 0, 3,5,7,10 estimated at $12000/event.		

9.2 MEEMAN SHELBY FOREST – EAGLE LAKE (M_2)

This measure is recreational and thus had no habitat benefits. It proposes to improve trail access to project measures and create information opportunities to inform the public about the presence and benefits of project measures.

M_2 proposes to improve trail access to project measures and create information opportunities to inform the public about the presence and benefits of project measures.

Table 9-2: M_2 Description

M_2 Description of Features			
Measure Description	Recreation – Trails and Signage		
Construction Activity	Recreation		
Model	N/A		
Restoration Activity	N/A		
Habitat	N/A		
M_2 Items			
Item-Feature	**Meets Objective**	**Notes**	**Screened**
M_2	4	Trail access improvements (1 mile loop paved) (note: there is an existing trail that could be refurbished, educational signage for surrounding ecosystem restoration measures to include large wood debris trap (boating hazard).	No
M_2 Construction Assumptions			
M_2	Assume 1-acre of clearing and grubbing, 1 mile loop paved 6-ft width=420 tons asphalt, with gravel base (note: there is an existing trail that could be refurbished), signage costs are incidental = signs at ramp and near LWD traps for safety/education.		
M_2 Real Estate Assumptions			
M_2	Assume purchase of 1 floodplain acre of woodlands.		

M_2 OMRR&R Assumptions	
M_2	Walking Trail/Interpretive Signage/Other recreational features at years 20 and 40 at 75% of initial construction cost.
M_2 Adaptive Management & Monitoring Assumptions	
M_2	None

9.3 MEEMAN SHELBY FOREST – EAGLE LAKE (M_3)

Dikes 1 - 5 above Hickman Bar have not been notched while the Hickman Bar dikes contain notches. There is an opportunity to create a channel through the dike field. This channel would have high bed diversity as it connects between the dikes' scour and deposition zones. It would provide a flowing channel refuge protected from boat impacts. Finally, the dike notches would likely increase velocity through Hickman Bar's secondary channel reducing deposition and improving longevity. Imagery from 2014 and 2021 showing the dikes overtopping suggests the dikes range in elevation from 190 – 195 ft. and overtop 82 – 90% of the time. The acreage for this measure is the channel with the dike notch width as the left and right extent within the 50% HEC-RAS inundation outline. The Hickman Bar secondary channel and main channel are supplementary acreage.

M_3 proposes to notch dikes 1-5 above Hickman Bar. This measure was screened out due to navigation concerns and potential impacts to downstream dredging.

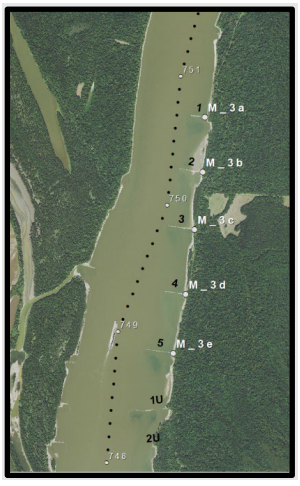


Figure 9-3. M_3

Table 9-3: M_3 Description

M_3 Description of Features			
Measure Description	Dike Notching – Stone Dikes		
Construction Activity	Dike Notching		
Model	N/A		
Restoration Activity	Altering Connectivity		
Habitat	N/A		
M_3 Items			
Item-Feature	**Meets Objective**	**Notes**	**Screened**
M_3a	2	Notch all dikes in field to create low flow channel. *Screening criteria: Navigations concerns due to proximity main channel and channel conditions downstream.*	Yes – Pre CEICA
M_3b	2		
M_3c	2		
M_3d	2		
M_3e	2		
M_3 Construction Assumptions			
M_3a	None; screened prior to construction estimation.		
M_3b			
M_3c			
M_3d			
M_3e			
M_3 Real Estate Assumptions			
M_3a	None; screened prior to real estate estimation.		
M_3b			
M_3c			
M_3d			

M_3e	
M_3 OMRR&R Assumptions	
M_3a	None; screened prior to OMRR&R estimation.
M_3b	
M_3c	
M_3d	
M_3e	
M_3 Adaptive Management & Monitoring Assumptions	
M_3a	None; screened prior to AMM estimation.
M_3b	
M_3c	
M_3d	
M_3e	

9.4 MEEMAN SHELBY FOREST – EAGLE LAKE (M_5)

The area upstream of the weir (area outlined in white on elevation figure) is already a depression with its lowest spot around 218.5 ft (66.6m). The soils are 76% to all hydric Sharkey clay and Tunica silty clay (NWI, SSURGO). With increased inundation, the project team believes Cypress and Tupelo trees will thrive. Water can reach a max elevation of 220.8 ft (67.3m) before it spreads out through the adjacent low area and follows an alternate path back to Brinkley Creek. The site for the weir is approximately 218.8 ft (66.7m). Therefore, approximately 0.3 ft of water currently ponds in the depression. With a weir at 220.8 ft, ponded water would be approximately 2.3 ft deep, and the depression would take longer to dry promoting water tolerant forest species like Cypress and Tupelo. The area inundated by the weir was used for this project's acreage and the contiguous forest would receive supplemental benefits from this community.

M_5 proposes to change existing forest composition by altering hydrology through the construction of a weir and possibly girdling trees to create light gaps for seedling germination. With a weir the water would pond deeper, and the depression would take longer to dry promoting water tolerant forest species like cypress and tupelo.

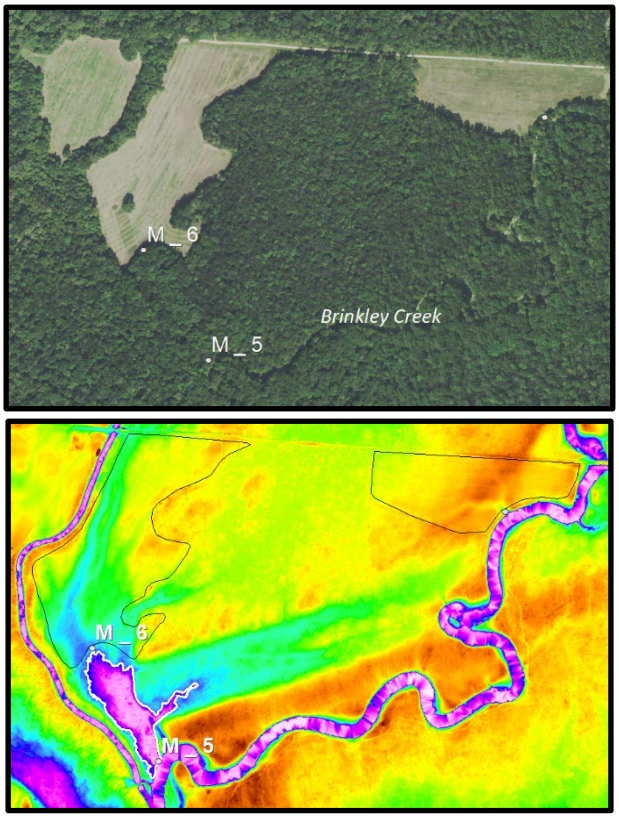


Figure 9-4. M_5

Table 9-4: M_5 Description

M_5 Description of Features	
Measure Description	Forest Stand Improvement Cypress/Tupelo
Construction Activity	Weirs and Stoplog Structures; Earthwork
Model	HGM
Restoration Activity	Enhance and Restore Natural Vegetation
Habitat	Cypress – Tupelo (Floodplain)

M_5 Items			
Item-Feature	**Meets Objective**	**Notes**	**Screened**
M_5	1 and 3	Install weir 2-ft higher to back up water onto upstream depression to promote cypress tupelo by controlling of unwanted species included with adaptive management (qualitative - while maintain Alligator Gar access).	No
M_5 Construction Assumptions			
M_5	Rock weir (60CY, 4ft thick R400, 2ft excavation for full grade and section, 40 LF, 10ft crown, 1:1.5 side slopes), and earthwork for berm across low spot (650 LF, assume 3ft average height (72 sq ft), includes mobilization/demobilization)) dimensions from seasonally flooded typical section from moist soil management guidance document. HGM Costs provided by ERDC. No planting costs assumed for M_5.		

M_5 Real Estate Assumptions	
M_5	Assume purchase of 6 floodplain acres of woodlands
M_5 OMRR&R Assumptions	
M_5	Channel cleanout O&M at years 15, 30, 45 estimated at 25% of initial construction cost; rip rap control structure O&M at year 30 estimated at 50% of construction cost.
M_5 Adaptive Management & Monitoring Assumptions	
M_5	HGM AMM costs provided by ERDC.

9.5 MEEMAN SHELBY FOREST – EAGLE LAKE (M_6)

Brinkley Creek moves water across the floodplain interior of Meeman Shelby Forest State Park. Site managers indicate that water moves onto the fields adjacent to M_6 and M_7 around a +30 – 32 ft stage on the Memphis gage. The field at M_7 encompasses the highest elevation within the immediate area. For this reason, M_7 was eliminated from further consideration for moist soil management. Because of the high inundation elevation, the field adjacent to M_6 would be suitable for Alligator Gar in high water years or if site managers maintain water on the site using water control structures. Creating other more hydrologically suitable herbaceous sites would require removing mature forest, creating access for agricultural machinery needed to control invasive species, and altering infrastructure. Thus, adding a water control structure, berms and a well to the

field at M_6 would allow the existing herbaceous site to be managed as a wetland. For M_6 water will flow in from Brinkley Creek, over the weir (M_5), across the depression to the structure. The acreage for M_6 is the digitized boundary of the moist soil management unit. The elevation range and soil for the moist soil units is:

The western edge of the proposed moist soil management unit at M_6 is 0% hydric and Commerce silt loam. If this measure is carried into plans and specifications, this area should be investigated to ensure moist soil water does not drain out through highly permeable soil.

M_6 proposes to install a water control structure, berms, and a well to the field would allow the existing herbaceous site to be managed as a wetland.

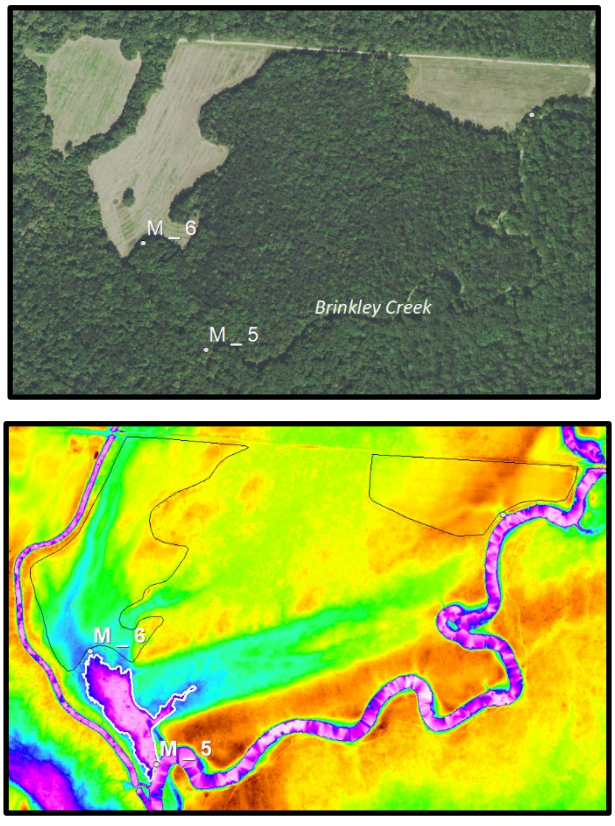


Figure 9-5. M_6

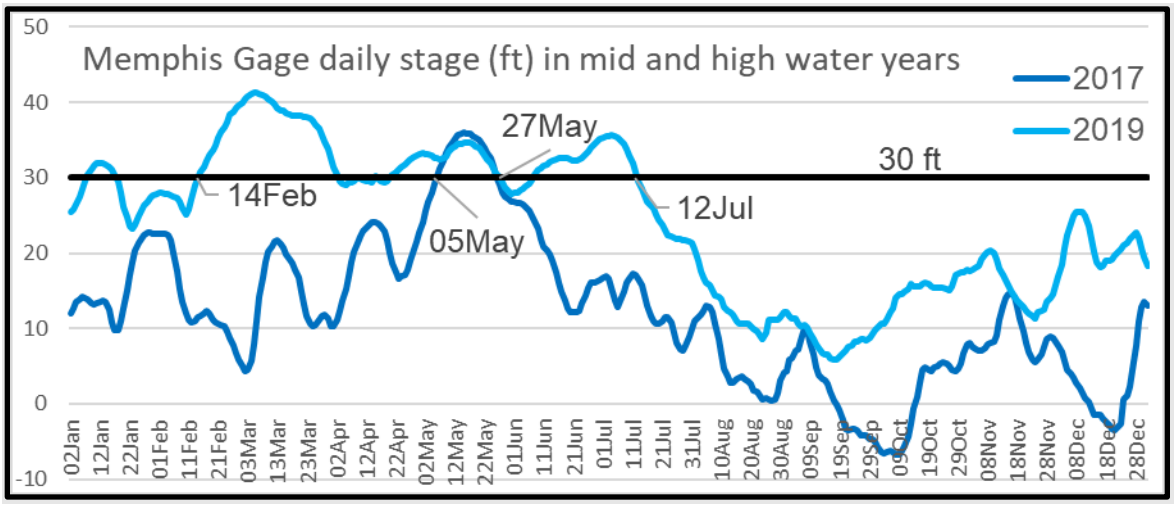


Figure 9-6. M_6 Water Level

Table 9-6: M_6 Description

M_6 Description of Features			
Measure Description	Moist Soil Management Creation		
Construction Activity	Weirs and Stoplog Structures; Earthwork		
Model	HGM		
Restoration Activity	Water Management		
Habitat	Moist Soil (aquatic & floodplain)		
M_6 Items			
Item-Feature	**Meets Objectives**	**Notes**	**Screened**
M_6	3	Stop log structure and groundwater well to control water on fallow field for waterfowl and shorebirds (qualitative-potential benefits to Alligator Gar).	No
M_6 Construction Assumptions			
M_6	Stop log structure, earthwork for berms across 2 low spots (2 berms,		

	700 LF, assume 3ft average height (72 sq ft), 975 LF, assume 2ft average height (40 sq ft) dimensions from seasonally flooded typical section from moist soil management guidance document, and installation of groundwater well and associated pumps.
M_6 Real Estate Assumptions	
M_6	Assume purchase of 30 floodplain acres of agricultural land.
M_6 OMRR&R Assumptions	
M_6	Channel cleanout O&M at years 15, 30, 45 estimated at 25% of initial construction cost; unwatering O&M at year 30 estimated at 12.5% of initial construction cost.
M_6 Adaptive Management & Monitoring Assumptions	
M_6	HGM AMM costs provided by ERDC.

9.6 MEEMAN SHELBY FOREST – EAGLE LAKE (M_7)

M_7 proposes to install a water control structure to the field to would allow the existing herbaceous site to be managed as a wetland. This field encompasses the highest elevation within the immediate area and therefore may not be suitable to maintain wetland habitat. Therefore, this measure was screened out.

Table 9-6: M_7 Description

M_7 Description of Features			
Measure Description	Moist Soil Management Creation		
Construction Activity	Weirs and Stoplog Structures; Earthwork		
Model	N/A		
Restoration Activity	Water Management		
Habitat	N/A		
M_7 Items			
Item-Feature	**Meets Objective**	**Notes**	**Screened**

M_7a	3	Water control structure (assumed box culvert) to control water on fallow field for waterfowl and shorebirds. *Screening criteria: Terrain only has a two foot elevation change from Brinkley Creek to the outlet at M5. Not enough elevation change to construct stair stepped weirs as shown in the moist soil document.*	Yes – Pre CEICA
M_7 Construction Assumptions			
M_7a	Terrain only has a two foot elevation change from Brinkley Creek to the outlet at M5. Not enough elevation change to construct stair stepped weirs as shown in the moist soil document. The stop log structure at M5 will accomplish flooding at M7.		
M_7 Real Estate Assumptions			
M_7a	None; screened prior to real estate estimation.		
M_7 OMRR&R Assumptions			
M_7a	None; screened prior to OMRR&R estimation.		
M_7 Adaptive Management & Monitoring Assumptions			
M_7a	None; screened prior to AMM estimation.		

9.7 MEEMAN SHELBY FOREST – EAGLE LAKE (M_11)

This measure proposes a well that site managers can use to move water onto the Lost Unit of Eagle Lake State Refuge during low water years. Currently, two flashboard control structures bring water to the units from the manmade east/west channel when the Memphis gage reaches +21. The river over tops the road which forms the east west channel berm at +28 ft. Without project in a typical water year, the units could be inundated in late winter and spring. In a low water year, like 2012, very little water is available. Both units have elevations ranging from 214.2 – 216.5 ft (65.3 – 65.9 m) with Sharkey clay and Tunica silty clay soils that are 76 – 100% hydric (SSURGO, NWI). The acreage for this measure is the digitized boundary of each forested wetland management unit.

M_11 proposes to provide site managers better control of hydrology on herbaceous and forested wetlands by installation of a well.


M_13
M_11

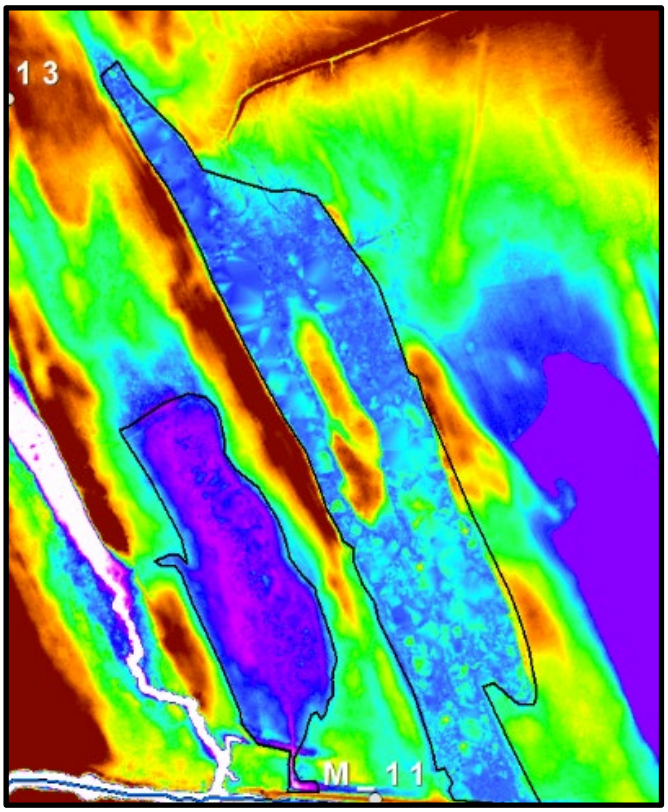

13
M_11

Figure 9-7. M_7

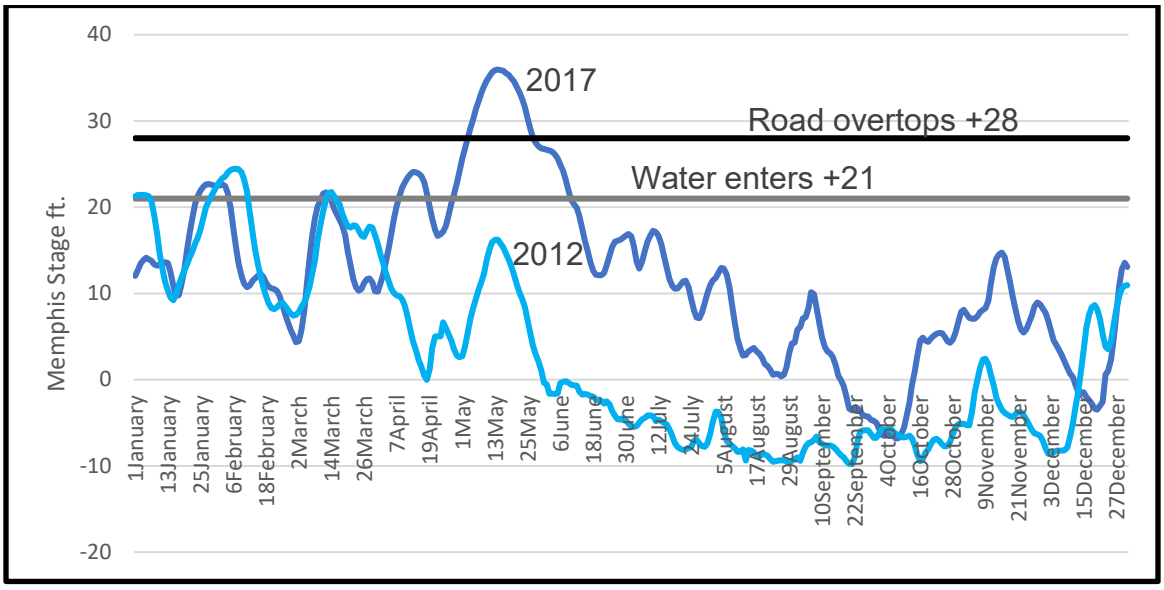


Figure 9-8. M_7 Water Level

Table 9-7: M_11 Description

M_11 Description of Features			
Measure Description	Moist Soil Management Improvements		
Construction Activity	Groundwater Well		
Model	HGM		
Restoration Activity	Water Management		
Habitat	Moist Soil (aquatic & floodplain)		
M_11 Items			
Item-Feature	**Meets Objective**	**Notes**	**Screened**
M_11	3	Install well with piping to two Eagle Lake Moist Soil Management Units to mimic natural hydrology since restoring historic flow paths would require forest	Yes – Final Array

		clearing and effect site access on Eagle Lake State Refuge property. *Screening criteria: Screened during the final array of alternatives.*	
M_11 Construction Assumptions			
M_11	Per Meeman-Shelby Forest land manager (45,000+40,000), based on other wells on nearby state property with piping, well and pump with contingency included. Other assumptions based on AR Geologist = 12in well, 100-ft depth, and 2500 gallons/min. HGM Costs provided by ERDC. No planting costs assumed for M_11.		
M_11 Real Estate Assumptions			
M_11	Assume purchase of 52 floodplain acres of woodlands		
M_11 OMRR&R Assumptions			
M_11	None.		
M_11 Adaptive Management & Monitoring Assumptions			
M_11	HGM AMM costs provided by ERDC.		

9.8 MEEMAN SHELBY FOREST – EAGLE LAKE (M_12)

M_12 proposes to provide site managers better control of hydrology on herbaceous and forested wetlands by installation of a well on the Wood Duck Unit of Eagle Lake State Refuge during low water years. Currently, two flashboard control structures bring water to the units from the manmade east/west channel when the Memphis gage reaches +21. The river over tops the road which forms the east west channel berm at +28 ft. Without project in a typical water year, the units could be inundated in late winter and spring. In a low water year, like 2012, very little water is available. Both units have elevations ranging from 214.2 – 216.5 ft (65.3 – 65.9 m) with Sharkey clay and Tunica silty clay soils that are 76 – 100% hydric (SSURGO, NWI). The acreage for this measure is the digitized boundary of each forested wetland management unit.

Upon further review it was determined that the well at measure M_11 with piping allows for flooding of both units.

Table 9-8: M_12 Description

M_12 Description of Features			
Measure Description	Moist Soil Management Improvements		
Construction Activity	Groundwater Well		
Model	N/A		
Restoration Activity	Water Management		
Habitat	N/A		
M_12 Items			
Item-Feature	**Meets Objective**	**Notes**	**Screened**
M_12	3	Install well to mimic natural hydrology. Restore flow paths = forest clearing and affects site access on Eagle Lake State Refuge (Wood Duck unit). *Screening criteria: Only one well needed per Meeman-Shelby Forest land manager. A well at Measure M11 with piping allows for flooding of both units.*	Yes – Pre CEICA
M_12 Construction Assumptions			
M_12	Only one well needed per Meeman-Shelby Forest land manager. A well at measure M11 with piping allows for flooding of both units.		
M_12 Real Estate Assumptions			
M_12	None; screened prior to real estate estimation.		
M_12 OMRR&R Assumptions			
M_12	None; screened prior to OMRR&R estimation.		
M_12 Adaptive Management & Monitoring Assumptions			
M_12	None; screened prior to AMM estimation.		

9.9 MEEMAN SHELBY FOREST – EAGLE LAKE (M_13)

In 2006, higher elevation agricultural areas in Eagle Lake Refuge were planted in a variety of species. As the forest evolved Cottonwood has become the dominant species. There is an opportunity to employ forest enhancement through tree girdling. Tree girdling would create dead standing wood benefiting insects and cavity nesting birds. The reforested areas are non-hydric or 76-95% hydric with Robinsonville and Convent silt loam, Bowdre silty clay, and Sharkey clay. There is no supplemental acreage as all reforestation areas are surrounded by roads or mowed management strips.

M_13 proposes to girdle unwanted tree species within the Eagle Lake Refuge.

Figure 9-9. M_13

Table 9-9: M_13 Description

M_13 Description of Features			
Measure Description	Forest Stand Improvement – BLH		
Construction Activity	Floodplain Vegetative		
Model	HGM		
Restoration Activity	Enhance and Restore Natural Vegetation		
Habitat	BLH (floodplain)		
M_13 Items			
Item-Feature	**Meets Objective**	**Notes**	**Screened**
M_13	1	Enhance 2006 BLH reforestation efforts to include enhancing existing forest through controlling unwanted species and monitoring and adaptive management. *Screening criteria: First iteration of CEICA showed poor performance. Recommendations to be sent to park managers for use by other programs*	Yes – CEICA Round 1
M_13 Construction Assumptions			
M_13	HGM costs provided by ERDC. No planting costs assumed for M13.		
M_13 Real Estate Assumptions			
M_13	Assume purchase of 268 floodplain acres of woodlands.		
M_13 OMRR&R Assumptions			
M_13	None; screened prior to OMRR&R estimation.		
M_13 Adaptive Management & Monitoring Assumptions			
M_13	HGM AMM costs provided by ERDC.		

9.10 MEEMAN SHELBY FOREST – EAGLE LAKE (M_14)

The benefits evaluation acreage for this measure is the secondary channel. The Hickman Bar islands were not captured in the HEC-RAS inundation GIS layer. The Q50 satellite imagery inundation GIS layer was used to remove the islands from the HEC-RAS layer and determine the riverward boundary of the secondary channel.

M_14 proposes to add wood to the lower end of Hickman Bar secondary channel where the channel maintains a year-round connection to the main channel. Wood traps would improve the aquatic invertebrate diversity in Hickman Bar secondary channel.

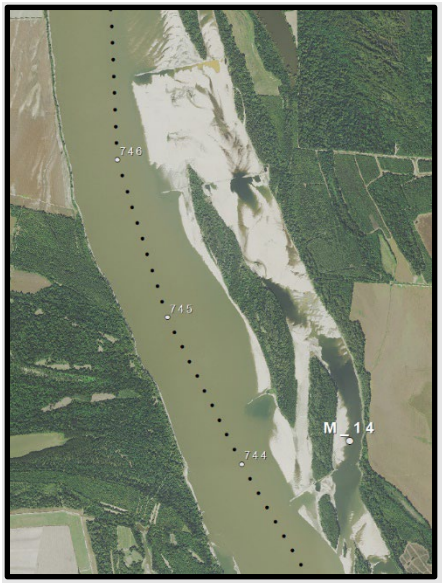


Figure 9-9. M_14

Table 9-10: M_14 Description

M_14 Description of Features	
Measure Description	Woody Debris Traps
Construction Activity	Woody Debris Traps
Model	Wood Trap
Restoration Activity	Aquatic Channel Enhancement
Habitat	Secondary Channels (lotic aquatic)

M_14 Items			
Item-Feature	**Meets Objective**	**Notes**	**Screened**
M_14	2	Install woody debris traps for aquatic invertebrates.	No
M_14 Construction Assumptions			
M_14	Per ERDC and NFS for costs of LWD traps at Prairie point.		
M_14 Real Estate Assumptions			
M_14	Assume work to be done in-channel below ordinary highwater and/or incidental to construction costs contingencies.		
M_14 OMRR&R Assumptions			
M_14	None		
M_14 Adaptive Management & Monitoring Assumptions			
M_14	Aquatic Bathymetric Survey - Rivers/Secondary Channels (A) at years 0,1,3,5,7,10 estimated at $450/mile; Large Woody Debris Traps at years 1,3,5,7,10 estimated at $6000 per structure.		

Section 10

Redman Point Loosahatchie Bar Complex

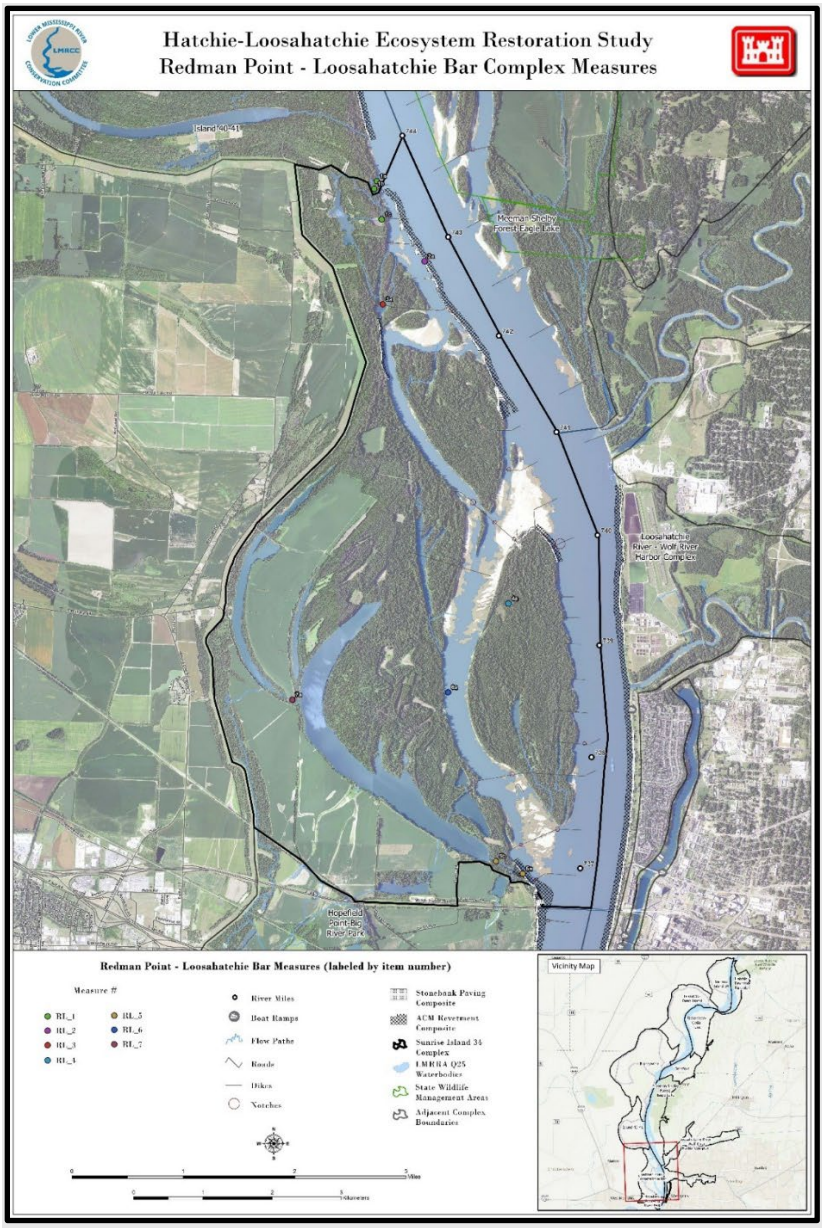


Figure 10-1. Redman Point Loosahatchie Bar Complex

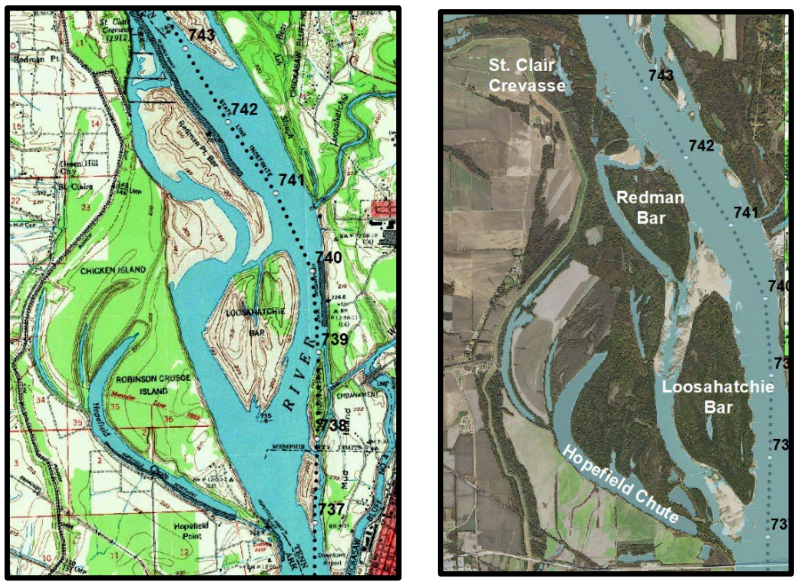


Figure 10-2. Redman Point Loosahatchie Bar Complex

10.1 REDMAN POINT LOOSAHATCHIE BAR (RL_1)

Topographic maps of the Memphis area from 1960 show the St. Clair Crevasse formed in 1912. Crevasses are low velocity deep water lakes with sinuous often forested shoreline and a ground water connection which is a very uncommon habitat in the Mississippi Valley. Although imagery from 2021 (NAIP) shows that the lake has filled with sediment, remnant aquatic habitat remains. The channel that connects the crevasse to the river has several obstructions which reduce fish movement. This measure proposed to alter these obstructions to improve connectivity. The project acreage would have been the permanent waterbody, and the supplemental acreage the adjacent main channel.

RL_1 proposes to improve connectivity by altering the obstructions in the channel that connects St. Clair Crevasse to the Mississippi River. This measure was screened out because RL_1a could not be modified and is the highest obstruction. This obstruction is formed by the Lower Mississippi River bank protection just upstream of Sycamore Chute Dike 1 ½. Modifying the obstruction could cause erosion behind the revetment and undermine the dike. Although RL_1b and RL_1c obstructions could be lowered, connectivity would not improve because RL_1a would remain to block flow. Therefore, this measure was screened out.

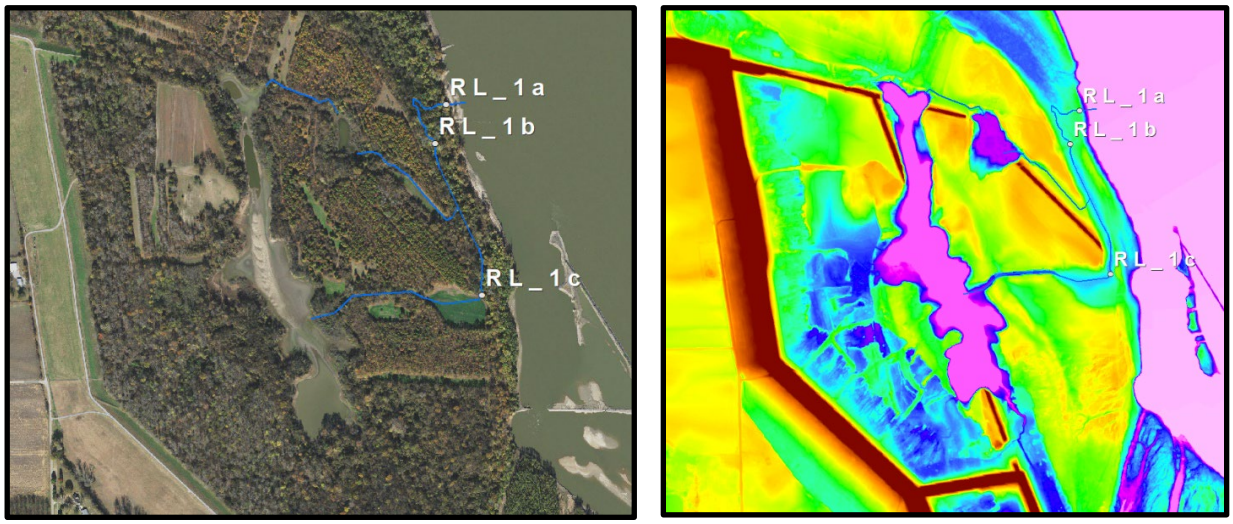


Figure 10-3. RL_1

Table 10-1: RL_1 Description

RL_1 Description of Features			
Measure Description	Flow Restoration to Backwater Slough		
Construction Activity	N/A		
Model	N/A		
Restoration Activity	Altering Connectivity		
Habitat	N/A		
RL_1 Items			
Item-Feature	**Meets Objective**	**Notes**	**Screened**
RL_1a	3	Modify obstruction/lower invert to increase connectivity *Screening criteria: Dike and dike bankhead immediately downstream. Lowering top bank elevation would create a flow path for water to scour/flank around the dike.*	Yes – Pre CEICA
RL_1b	3	Modify obstruction/lower invert to increase connectivity	Yes – Pre CEICA

		Screening criteria: Connectivity would not improve because RL_1a would remain to block flow.	
RL_1c	3	Modify obstruction/lower invert to increase connectivity (elevation set to not drain lake) *Screening criteria: Connectivity would not improve because RL_1a would remain to block flow.*	Yes – Pre CEICA
RL_1 Construction Assumptions			
RL_1a	Dike and dike bankhead immediately downstream. Lowering top bank elevation would create a flow path for water to scour/flank around the dike.		
RL_1b	Excavate 5,500 sq ft to a depth of 1ft, 0.25 acres of clearing.		
RL_1c	Single 48in CMP 40 LF, 123 TN riprap inlet/outlet protection for R-125, includes mobilization/demobilization.		
RL_1 Real Estate Assumptions			
RL_1a	None; screened prior to real estate estimation.		
RL_1b	None; screened prior to real estate estimation.		
RL_1c	None; screened prior to real estate estimation.		
RL_1 OMRR&R Assumptions			
RL_1a	None; screened prior to OMRR&R estimation.		
RL_1b	None; screened prior to OMRR&R estimation.		
RL_1c	None; screened prior to OMRR&R estimation.		
RL_1 Adaptive Management & Monitoring Assumptions			
RL_1a	None; screened prior to AMM estimation.		
RL_1b	None; screened prior to AMM estimation.		
RL_1c	None; screened prior to AMM estimation.		

10.2 REDMAN POINT LOOSAHATCHIE BAR (RL_2)

Both Redman Point Bar complex and Loosahatchie Bar first appear in the 1930s river alignment files by Harmar and Clifford (2006). In the first available imagery (1953) of the area, Redman is an unvegetated sandbar. Vegetation develops in the late 1960s after dike and Island 40 revetment construction. The island continues to develop and small islands at the top of the large island form and fill from 1978 – 2019 (Guntren et al. 2016, NAIP 2010 – 2019). Except for the notch at river mile 742.4 and the upstream opening, the Island 40 revetment acts as a trail dike separating the river from the upper end of Redman Point Bar from river mile 741.9 – 743.5. The mile of un-notched trail dike results in low velocity and relatively isolated conditions at the upstream end of Redman Point bar during lower water. The I40 revetment has a top elevation around 206.2 as captured in the 2014 digital elevation model (USGS 2014). In an average year, the trail dike is submerged periodically from late winter through late spring. There is an opportunity to create small notches in the I40 revetment to create variation in flow and diversify the aquatic habitat behind the trail dike. The project acreage is the permanent water adjacent to the I40 revetment which would benefit from the proposed notches. This measure does not alter the overall connectivity of Redman Bar; thus, there is no supplemental acreage.

RL_2 proposes to create notches in the Island 40 revetment. This measure was screened out because the adjacent main channel between river mile 739 to 756 has been dredged four times from April to September 2022. Navigation concerns require keeping as much water as possible in the main channel.

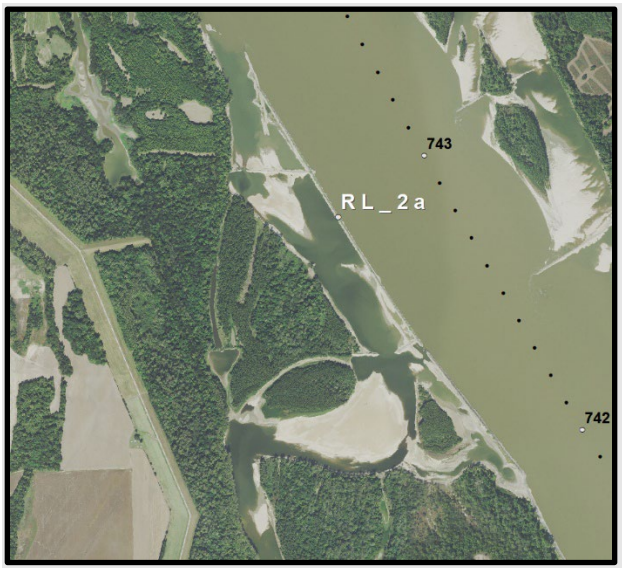


Figure 10-4. RL_2

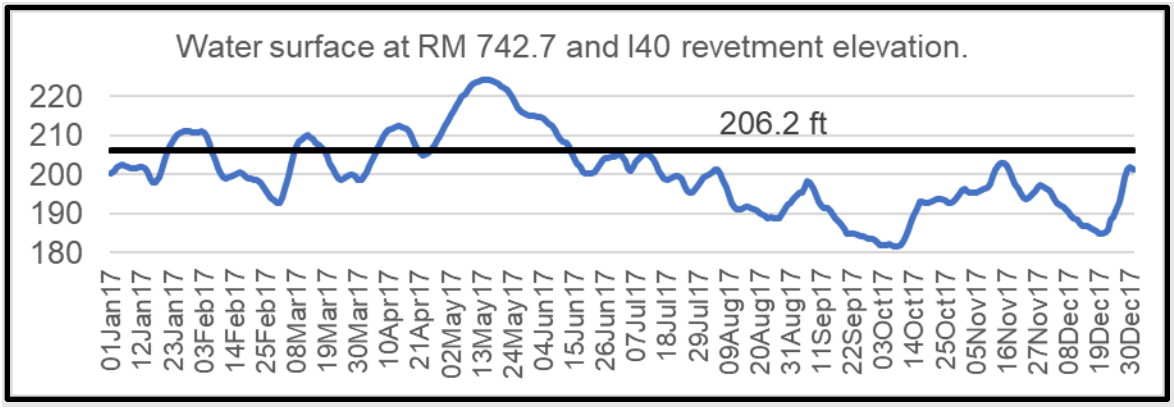


Figure 10-5. RL_2 Water Level

Table 10-2: RL_2 Description

RL_2 Description of Features			
Measure Description	Flow Restoration to Backwater Slough		
Construction Activity	Earthwork		
Model	N/A		
Restoration Activity	Altering Connectivity		
Habitat	N/A		
RL_2 Items			
Item-Feature	**Meets Objective**	**Notes**	**Screened**
RL_2a	2	Create notch(es) (even small (10 – 15ft) beneficial) in trail dike to enhance flow into secondary channel *Screening criteria: Dredged four times between RM739 to RM756 from April to September 2022. Navigation concerns require we keep as much water as possible in the main channel.*	Yes – Pre CEICA
RL_2 Construction Assumptions			

RL_2a	Dredged four times between RM739 to RM756 from April to September 2022.Navigation concerns require we keep as much water as possible in the main channel.
RL_2 Real Estate Assumptions	
RL_2a	None; screened prior to real estate estimation.
RL_2 OMRR&R Assumptions	
RL_2a	None; screened prior to OMRR&R estimation.
RL_2 Adaptive Management & Monitoring Assumptions	
RL_2a	None; screened prior to AMM estimation.

10.3 REDMAN POINT LOOSAHATCHIE BAR (RL_3)

In 1978, the island at the upstream end of Redman Point Bar complex had a well-developed secondary channel (Guntren et al 2016). Vegetation had begun to develop in the channel by 1988 (Guntren et al 2016). A narrow unforested channel is visible in 2022 (G. Earth). The dike, Dike 4, blocking the downstream end of the channel was constructed in 1958. Water begins to flow over the dike when the river exceeds 203.4 ft. This measure proposes to notch the dike to bed elevation. This will connect the permanent water in the remnant channel to Loosahatchie secondary channel. It may also lead to the remnant channel deepening improving unidirectional flow. This sediment removal is uncertain and thus this measure was evaluated with the bidirectional connectivity model. The upstream channel was inundated at the time of the elevation survey (USGS 2014). The inundated area was 100 ft wide with a water surface of 202.6 ft. A conservative bed elevation of 201.6 ft, a 2% slope, was assumed. The acreage was the permanent water upstream of Dike 4 and supplemental acreage was the remainder of Redman and Loosahatchie secondary channels and the main channel.

RL_3 proposes to notch Dike 4 to bed elevation.

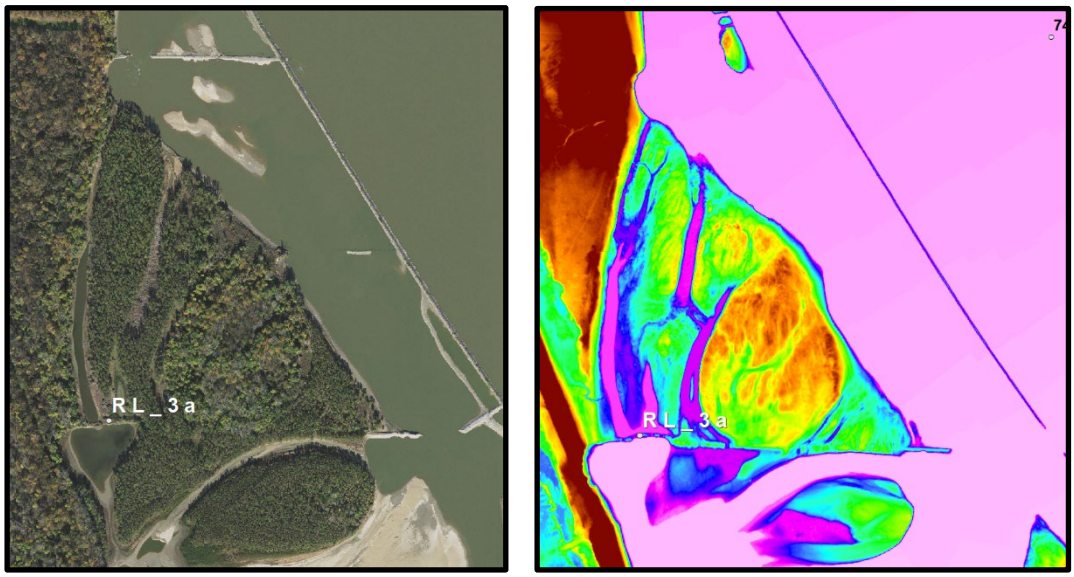


Figure 10-6. RL_3

Table 10-3: RL_3 Description

RL_3 Description of Features			
Measure Description	Dike Notching – Stone Dikes		
Construction Activity	Dike Notching		
Model	Bidirectional		
Restoration Activity	Altering Connectivity		
Habitat	Secondary Channels (lotic aquatic)		
RL_3 Items			
Item-Feature	**Meets Objective**	**Notes**	**Screened**
RL_3a	2	Notch stone dike in secondary channel.	No
RL_3 Construction Assumptions			
RL_3a	Construct stone notch in dike. Price based on most recent MATOC bid for notch.		

RL_3 Real Estate Assumptions	
RL_3a	Assume work to be done in-channel below ordinary highwater and/or incidental to construction costs contingencies.
RL_3 OMRR&R Assumptions	
RL_3a	Stone dike notch O&M at year 30 estimated at 75% of construction cost.
RL_3 Adaptive Management & Monitoring Assumptions	
RL_3a	Adaptive Management and Monitoring: Aquatic Bathymetric Survey - Rivers/Secondary Channels (A) at years 0,1,3,5,7,10 estimated at $450/mile; Fish & Invertebrate Surveys Monitoring - Bidirectional, Unidirectional, Isolation (A) at years 0, 3,5,7,10 estimated at $4167/event.

10.4 REDMAN POINT LOOSAHATCHIE BAR (RL_4)

Loosahatchie Bar's forest began to develop in the 1950s with a large stand present by 1969 (Guntren et al. 2016). In subsequent years, the forest continued to develop. Bottomland hardwoods and cypress/tupelo are uncommon within the LMR. These trees are targeted by logging operations which remove stands throughout the floodplain. This results in a limited seed supply for re-establishment. Additionally, more common species like willow and sweet gum develop dense stands which shade the forest floor and prevent seedling growth. This measure proposes to conduct forest stand management on Loosahatchie Bar using tree girdling and selective herbicide application followed by tree planting to re-establish bottomland hardwoods and cypress/tupelo on suitable elevations. Island elevations range from 199 – 225.6 ft. The low elevations are frequently flooded throughout an average year while the higher elevations are not submerged. This measure's acreage is the island area proposed for forest enhancement. There is no supplemental acreage.

RL_4 proposes to conduct forest stand management on Loosahatchie Bar.

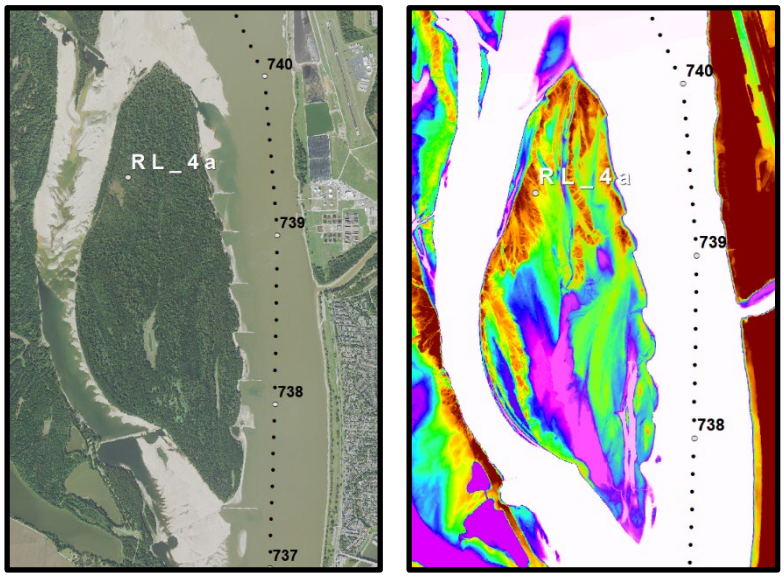


Figure 10-7. RL_4

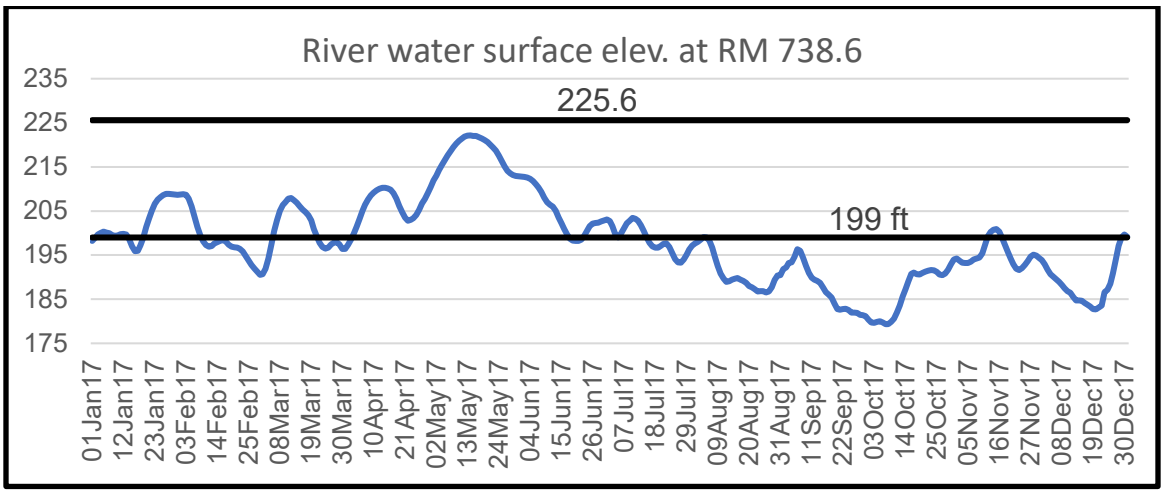


Figure 10-8. RL_4 Water Level

Table 10-4: RL_4 Description

RL_4 Description of Features

Measure Description	Forest Stand Improvement-BLH		
Construction Activity	Floodplain Vegetative		
Model	HGM		
Restoration Activity	Enhance and Restore Natural Vegetation		
Habitat	BLH (floodplain)		
RL_4 Items			
Item-Feature	**Meets Objective**	**Notes**	**Screened**
RL_4a	1	Forest stand improvements with planting mast production trees (20% of benefit area = 209.8 acres); ~98% of island inundated annually.	No
RL_4 Construction Assumptions			
RL_4a	HGM costs provided by ERDC.		
RL_4 Real Estate Assumptions			
RL_4a	Assume purchase of 1,049 floodplain acres of woodlands.		
RL_4 OMRR&R Assumptions			
RL_4a	None		
RL_4 Adaptive Management & Monitoring Assumptions			
RL_4a	HGM AMM costs provided by ERDC.		

10.5 REDMAN POINT LOOSAHATCHIE BAR (RL_5)

Hopefield Chute was historically Robinson Crusoe Island's secondary channel (USGS 1960) which developed between 1820 and 1915 and was cut off by 1930 (Harmar and Clifford 2006). This historic channel is now like an oxbow lake with a large permanent waterbody connected to the river at the downstream end through a narrow (tie) channel. Without manmade obstructions, tie channel beds naturally adjust to maintain permanent connectivity with the main channel. The Hopefield Chute tie channel has a concrete obstruction (G. Earth 31Jan2006) at the lower end which eliminates connectivity and fish passage at lower river stages. The structure acts like a dam keeping water levels in the lake higher during times of low water. Fish passage and connectivity are further affected

by the single perched culvert under Gabe Dr. (G. Earth 2022). The team felt connectivity and fish passage were more important than maintaining higher lake levels. This measure proposed to improve connectivity to Hopefield Chute by altering the concrete obstruction (RL_5a) and replacing the 80 ft x 5 ft diam perched culvert under Gabe Dr (RL_5b) (G. Earth 22Apr14 & 24Aug15).

The tie channel upstream of RL_5a is never dry and the minimum water elevation captured in the elevation survey is 204 ft the approximate elevation of the top of the concrete obstruction. The channel appears to have considerable depth below the top of the structure (G. Earth). The lake and channel bed on either side of the culvert are submerged in the elevation data (USGS 2014). The best option was to use G. Earth image dates (can be incorrect) and river gage data to determine the approximate culvert invert of 195 ft. Since the culvert is perched, the channel bed was assumed to be 193 ft at the culvert and 198 ft at the concrete obstruction. This measure's acreage would have been Hopefield Chute and supplemental acreage the adjacent main channel.

RL_5 proposes to improve connectivity to Hopefield Chute by altering the concrete obstruction (RL_5a) and replacing a perched culvert (RL_5b).

This measure was screened out because RL_5a could not be modified and it is the highest obstruction. The RL_5a obstruction is formed by the LMR bank protection at the downstream end of Loosahatchie secondary channel. At this location, the channel flows along the bankline and modifying the obstruction could cause erosion behind the revetment. This could result in bank failure and jeopardize Loosahatchie Bar dike 6 and Hopefield Point Dike 2U. Although RL_5b could be lowered, connectivity would not improve because RL_5a would remain to block flow. Therefore, this measure was eliminated.

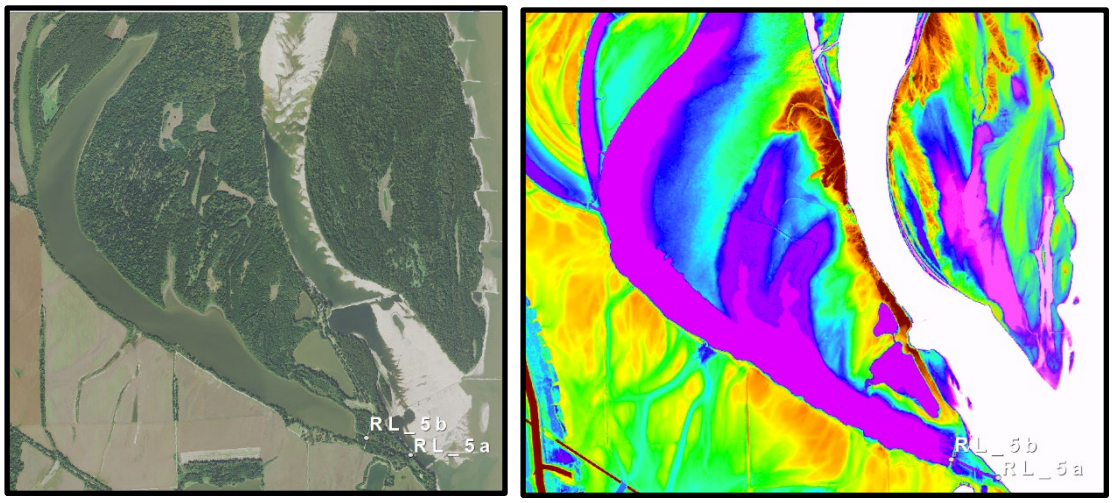


Figure 10-9. RL_5 Imagery 1

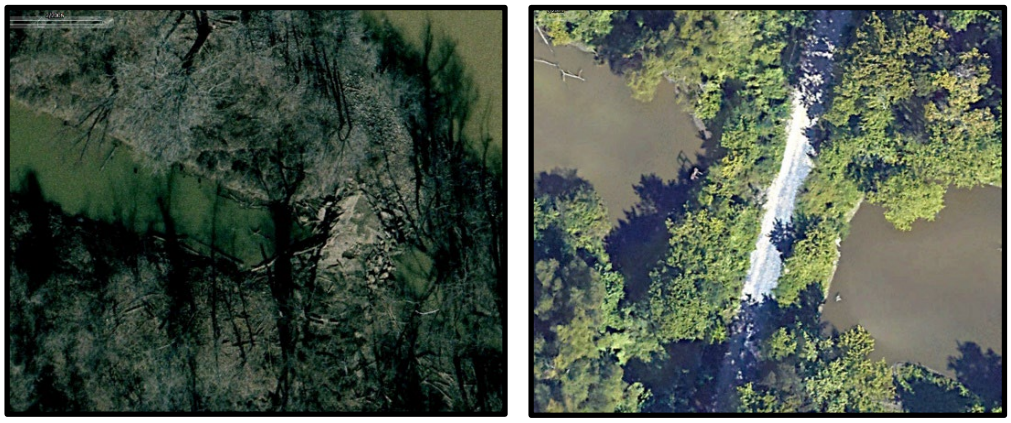


Figure 10-10. RL_5 Imagery 2

Table 10-5: RL_5 Description

RL_5 Description of Features	
Measure Description	Flow Restoration to Backwater Slough

Construction Activity	Earthwork; Culverts; Riprap Bank Protection
Model	N/A
Restoration Activity	Altering Connectivity
Habitat	N/A

RL_5 Items

Item-Feature	Meets Objective	Notes	Screened
RL_5a	3	Increase connectivity and fish passage with open weir structure. Tie channel may have revetment across opening. *Screening criteria: Historic divided flow measurements and bank scour issues during high water (removing a portion of the revetment could exacerbate that issue).*	Yes – Pre CICA
RL_5b	3	Pair new culvert with downstream weir/fish ladder *Screening criteria: Screened out since dependent on Item RL_5a.*	Yes – Pre CICA

RL_5 Construction Assumptions

RL_5a	Historic divided flow measurements and bank scour issues during high water (removing a portion of the revetment could exacerbate that issue).
RL_5b	Two 60in CMPs 90 LF, 25ftx30ftx2ft (166 TN) riprap inlet/outlet protection for R-125, includes mobilization/demobilization.

RL_5 Real Estate Assumptions

RL_5a	None; screened prior to real estate estimation.
RL_5b	None; screened prior to real estate estimation.

RL_5 OMRR&R Assumptions

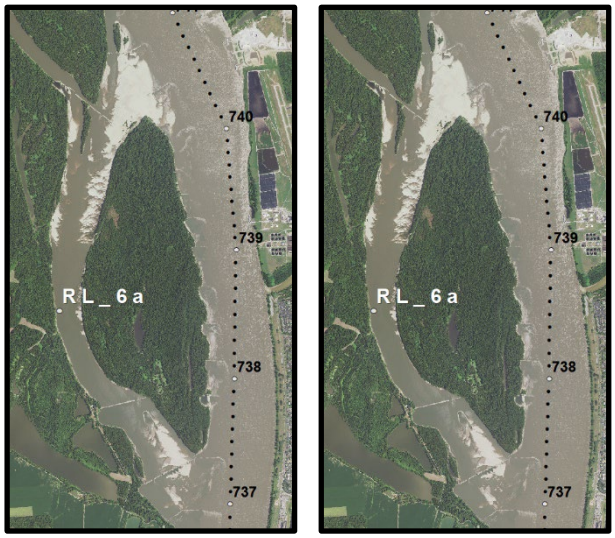
RL_5a	None; screened prior to OMRR&R estimation.
RL_5b	None; screened prior to OMRR&R estimation.

RL_5 Adaptive Management & Monitoring Assumptions	
RL_5a	None; screened prior to AMM estimation.
RL_5b	None; screened prior to AMM estimation.

10.6 REDMAN POINT LOOSAHATCHIE BAR (RL_6)

Loosahatchie Bar likely formed in the 1930s as a large complex along the left descending bank from river mile 738 – 741.3 at the mouth of the Loosahatchie River (Harmar and Clifford 2006). This area of sand and forest is also visible in 1953 (Guntren et al. 2016). By 1969, the Mississippi thalweg flows along the LDB providing Memphis access to the river and a forested Loosahatchie Bar, very similar to present, is along the RDB with closing structures in its secondary channel (Guntren et al. 2016). Except for the pile dike

RL_6 proposes to add wood traps in the secondary channel's deep permanent water.



Images taken on 8 Oct. 2021 at a river water surface elevation of 184.8 ft and 3 Aug. 2018 at 191.9.

Figure 10-11. RL_6

Table 10-6: RL_6 Description

RL_6 Description of Features

Measure Description	Woody Debris Traps		
Construction Activity	Woody Debris Traps		
Model	Wood Trap		
Restoration Activity	Aquatic Channel Enhancement		
Habitat	Secondary Channels (lotic aquatic)		
RL_6 Items			
Item-Feature	**Meets Objective**	**Notes**	**Screened**
RL_6a	3	Install large woody debris traps in Loosahatchie Bar secondary channel along erosional outside bend without causing bank scour.	No
RL_6 Construction Assumptions			
RL_6a	Costs estimated per Audrey Harrison and Angie Rodgers based on Prairie Point assumed costs including contingency.		
RL_6 Real Estate Assumptions			
RL_6a	For RL_6, assume work to be done in-channel below OHW and/or incidental to construction costs contingencies. Benefit acreage remains in real estate section in RL_6a tab.		
RL_6 OMRR&R Assumptions			
RL_6a	None		
RL_6 Adaptive Management & Monitoring Assumptions			
RL_6a	Aquatic Bathymetric Survey - Rivers/Secondary Channels (A) at years 0,1,3,5,7,10 estimated at $450/mile; Fish & Invertebrate Surveys Monitoring - Bidirectional, Unidirectional, Isolation (A) at years 0, 3,5,7,10 estimated at $4167/event.		

10.7 REDMAN POINT LOOSAHATCHIE BAR (RL_7)

Mound City Chute was likely the secondary channel for Chicken Island in the early 1800s. The river abandoned this channel and a remnant lake remains. The northern end of the lake is cutoff by Dacus Rd. The downstream end of the lake connects to Hopefield Chute through a tie channel. There is a dirt road with a culvert that appears perched (G. Earth 2017) across this channel which reduces connectivity and fish passage. A 23 Aug 2017

google earth image shows a possibly concrete 45' L x 10' diam. culvert that appears perched. There is potential to dig a deeper adjacent channel and re-use this culvert or remove this road access because alternate routes exist. This measure proposes to modify the obstruction to improve connectivity and fish passage. Acreage is Mound City Chute and supplemental acreage is Hopefield Chute and the adjacent main channel.

RL_7 proposes to modify the obstruction that appears across the channel to improve connectivity and fish passage.

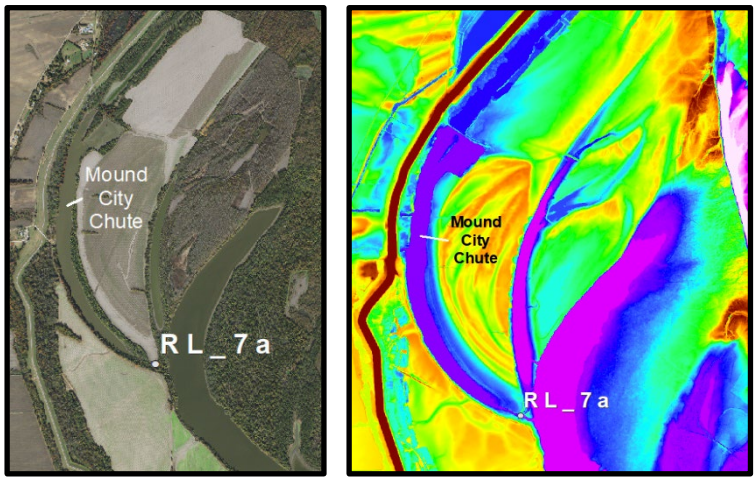


Figure 10-12. RL_7

Table 10-7: RL_7 Description

RL_7 Description of Features			
Measure Description	Flow Restoration to Backwater Slough		
Construction Activity	Culvert; Riprap Bank Protection; Earthwork		
Model	Bidirectional		
Restoration Activity	Altering Connectivity		
Habitat	Slough (lentic aquatic)		
RL_7 Items			
Item-Feature	**Meets Objective**	**Notes**	**Screened**

RL_7a	3	Increase connectivity to Mound City Chute by replacing culvert and cleaning out channel. May provide benefits to Alligator Gar in adjacent agricultural field/NRCS easement. *Screening criteria: Screened in final array of alternatives.*	Yes – Final Array

RL_7 Construction Assumptions	
RL_7a	900 LF cleanout, 40ft wide, 2ft deep (3,066 CY), 2 acres of clearing. Two 60in CMPs 60 LF, 25ftx30ftx2ft (166 TN) riprap inlet/outlet protection for R-125, includes mobilization/demobilization for both items.
RL_7 Real Estate Assumptions	
RL_7a	Assume purchase of 100 aquatic acres and 2 floodplain acres of woodlands.
RL_7 OMRR&R Assumptions	
RL_7a	Culvert O&M at year 30 estimated at 100% of construction cost; blockage removal at years 10, 20, 40 estimated at $3,000 per structure; riprap O&M at years 15, 30, 45 estimated at 50% of initial construction cost; channel cleanout O&M at years 15, 30, 45 estimated at 25% of initial construction cost.
RL_7 Adaptive Management & Monitoring Assumptions	
RL_7a	Aquatic Lidar Surveys (ROV)- Small Channels (A) at years 0,7 estimated at $2400/event; Large Woody Debris Traps at years 1,3,5,7,10 estimated at $6000 per structure

Section 11

Richardson Cedar Point Complex

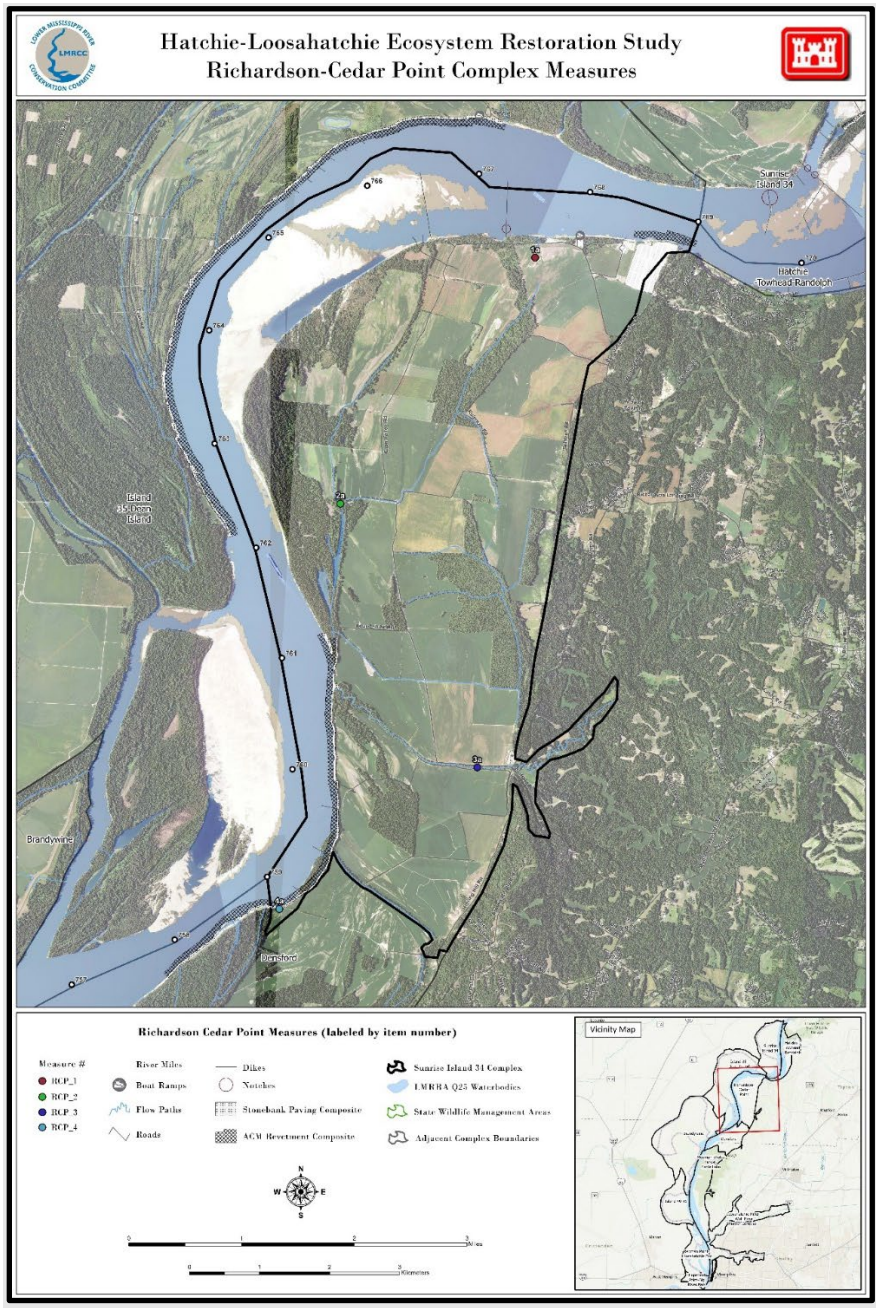


Figure 11-1 Richardson Cedar Point Complex

11.1 RICHARDSON CEDAR POINT (RCP_1)

Apart from the apex of the bend, Richardson and Cedar Point landforms have been present for over 500 years (Fisk 1944). At the upstream end of the point, the team identified an area of low ground within an agricultural field that had good potential for cypress/tupelo reforestation. This low ground is likely a scour hole that was subsequently used for borrow. The scour hole likely formed when the road overtopped during a flood prior to 1985, as it is present in 1985 imagery (G. Earth). Imagery shows the proposed planting area was inundated with a small forest buffer in 1997 and 2001 (G. Earth). In 2006, no trees remained. In subsequent years, the area is inundated, wet, and has poor crop production: 2006-2011, 2013-2021 (G. Earth). During the 2011 flood, over 900 ft of the road along the Mississippi high bank was washed out and sand and silt deposited across the entire field. By 2013, the road was rebuilt, and the field was back in production. The low area had a new shape and may have been used as a borrow source for road construction (G. Earth). The low area's soils are hydric silt loam soil (NWIS, SSURGO). The reforested area would help remove nutrients from the agricultural runoff and increase the prevalence of a rare forest community. There is no surface water connection to this area until the road overtops or water backs up over 4 miles through channels that cut across the point. Water is present in many years suggesting a ground water connection or ponding on impermeable soil. Since there is minimal surface water connection, this measure produces only floodplain benefits. The project acreage is the proposed planting area, elevations at or below the 229.0ft (69.8m) contour. There is no adjacent forest for supplemental benefits.

RCP_1 proposes reforestation of an 8-acre depressional area with cypress/tupelo. Cypress/Tupelo forest communities are relatively rare within the Lower Mississippi River floodplain.

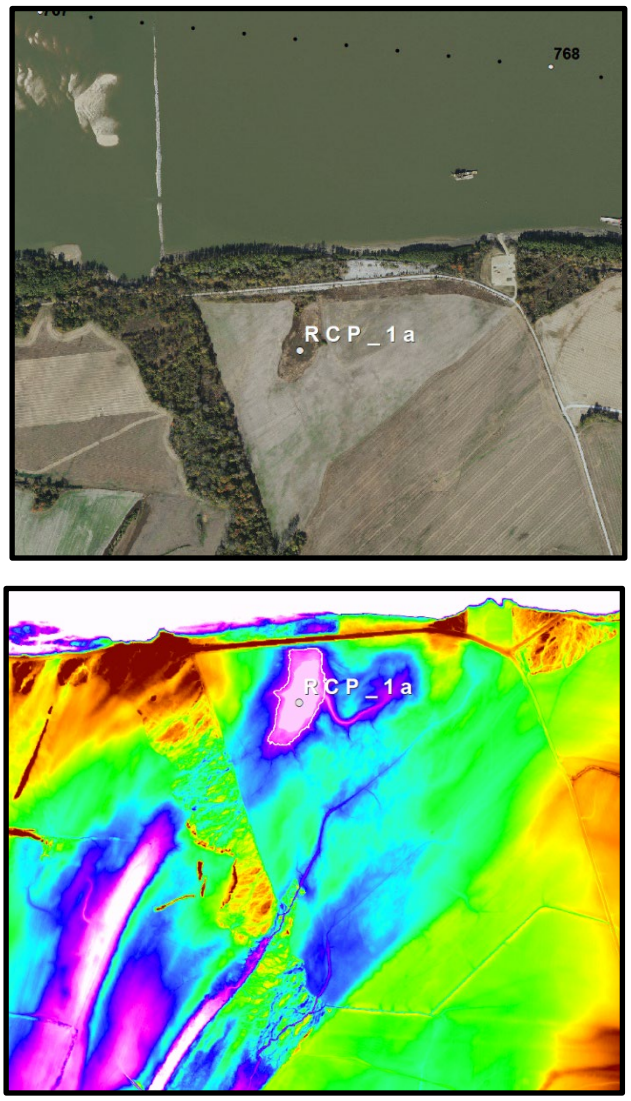


Figure 11-2. RCP_1

Table 11-1: RCP_1 Description

RCP_1 Description of Features	
Measure Description	Reforestation – Cypress/Tupelo
Construction Activity	Floodplain Vegetative

Model	HGM		
Restoration Activity	Enhance and Restore Natural Vegetation		
Habitat	Cypress – Tupelo (floodplain)		
RCP_1 Items			
Item - Feature	**Meets Objective**	**Notes**	**Screened**
RCP_1a	1	Reforest 8-acre depression with cypress/tupelo.	No
RCP_1 Construction Assumptions			
RCP_1a	HGM costs provided by ERDC.		
RCP_1 Real Estate Assumptions			
RCP_1a	Assume purchase of 8 floodplain acres of agricultural land.		

RCP_1 OMRR&R Assumptions	
RCP_1a	None
RCP_1 Adaptive Management & Monitoring Assumptions	
RL_1a	HGM AMM costs provided by ERDC.

11.2 RICHARDSON CEDAR POINT (RCP_2)

Imagery shows the agricultural land adjacent to a historic slough is frequently wet (NAIP 2015, 16, 18, & 19). The flow path leading to the slough and wet agriculture forms the boundary between the historic point bar and the more recently deposited sediments (USGS 1942; Harmar and Clifford 2006). The slough and low areas in the ag field are remnants from when the river flowed over this area. This measure proposes to plant the wet agricultural land in herbaceous wetland for spawning fishes with a forest buffer on the higher elevation eastern edge. This buffer area would reforest naturally to benefit breeding birds and filter agricultural runoff increasing the long-term persistence of the slough and herbaceous wetland. The field's Commerce silt loam and Robinsonville fine sandy loam 76 - 95% hydric soils range in elevation from 215.8 – 234.6 with an average of 220.6 ft. This average elevation was exceeded by the river from 29 April to 7 June in 2017, a suitable inundation period for spawning fishes including Alligator Gar. As the water falls, the slough in the southern end of the field and additional sloughs downstream

provide refuge for the young fish. A dirt road currently cuts across the slough's connecting channel blocking flow until the river exceeds its elevation around 216.9 ft. This happens about 32.5% of days between 2010 and 2019. This measure also proposes to improve the connectivity of the slough and field to the downstream waterbodies. HGM benefits were evaluated on the wet agricultural acreage. Because this measure includes forest regeneration the adjacent forest would benefit and represented the supplemental acreage. There would also be connectivity benefits to the slough and supplemental benefits to the downstream waterbodies, but these were not evaluated.

RCP_2 proposes the purchase of 115 acres of slough and low/wet areas of agricultural land to improve the connectivity of the slough and field to the downstream waterbodies. Ninety acres of the wet agricultural lands would be seeded with an emergent seed mix. Once established, the herbaceous wetlands would benefit spawning fishes. The remaining 25 acres would be allowed to reforest naturally (LMVJV forest) to benefit breeding birds and filter agricultural runoff increasing the long-term persistence of the slough and herbaceous wetland. The measure also proposes to lower the invert of existing culverts and cleanout channel. This would improve the connectivity of the slough and agricultural field to the downstream waterbodies.

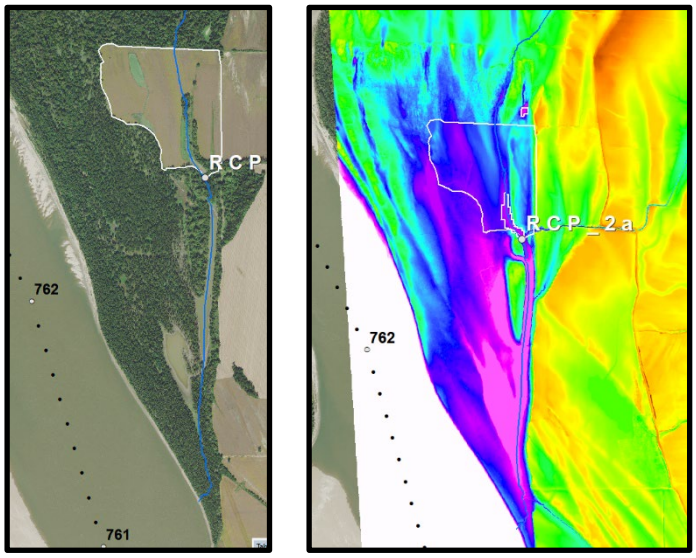


Figure 11-3. RCP_2

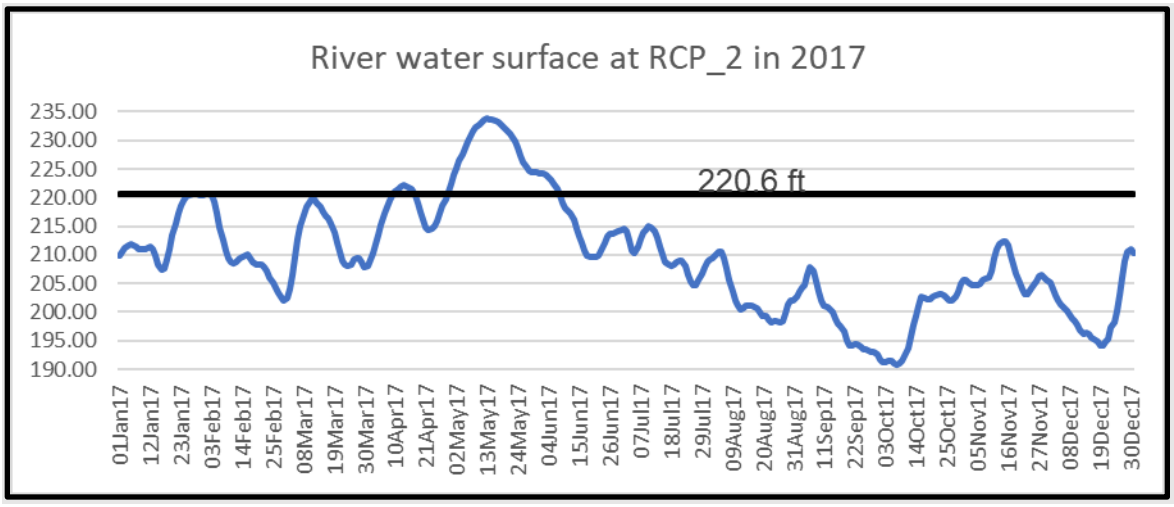


Figure 11-4. RCP_2 Water Level

Table 11-2: RCP_2 Description

RCP_2 Description of Features			
Measure Description	Wetland Complex Restoration		
Construction Activity	Culverts		
Model	HGM		
Restoration Activity	Enhance and Restore Natural Vegetation		
Habitat	Seasonally herbaceous wetland (aquatic & floodplain)		
RCP_2			
Item – Feature	**Meets Objective**	**Notes**	**Screened**
RCP_2a	1 and 3	Purchase 115 acres and seed with an emergent seed mix; (allowing for 25 acres of LMVJV forest through natural succession and 90 Acres Alligator Gar HSI-non-forest marsh); lower invert of culvert and cleanout channel (for Alligator Gar).	No
RCP_2 Construction Assumptions			

RCP_2a	Install two 60in CMP for 30 LF, including demo; 185 TN R125 riprap; cleanout 24,000 sq ft, 3ft deep (3107 CY with hydraulic excavator cleanout); 0.55 acres clearing; seed wetlands (costs provided by ERDC).
RCP_2 Real Estate Assumptions	
RCP_2a	Assume purchase of 115.6 floodplain/aquatic acres of agricultural land.
RCP_2 OMRR&R Assumptions	
RCP_2a	Channel cleanout O&M at years 15, 30, 45 estimated at 25% of initial construction cost; rip rap control structure O&M at year 30 estimated at 50% of construction cost.
RCP_2 Adaptive Management & Monitoring Assumptions	
RL_2a	HGM AMM costs provided by ERDC.

11.3 RICHARDSON CEDAR POINT (RCP_3)

Bear Creek flows out of the bluffs and traverses the agricultural floodplain through primarily non-hydric Robinsonville fine sandy loam soil to flow into the LMR. The surrounding landcover and creek's path have remained much the same from 1985 to current day (G. Earth). In the bluffs, the creek has high sinuosity and mostly forested banks (NAIP 2021). Once it reaches the floodplain, its path straightens (likely channelized), and the creek's banks are elevated above the surrounding floodplain (spoil piles from channelization). At this point, the creek plus vegetated buffer mis about 100 ft wide and surrounded by agriculture. In the last 2,500 ft the creek's sinuosity increases, slope steepens, and vegetative buffer increases (NAIP 2021). This measure proposes to set back the elevated banks on either side of the straightened creek and increase the forested buffer to create a 350 ft wide buffer. This would recreate a small floodplain for Bear Creek and provide a vegetative corridor between the bluffs and the river's bank. This buffer would also reduce erosion, and capture sediment and nutrients before it flowed into the creek and Mississippi River. With the additional shade, the creek's water temperature would likely be lower in summer and forest detritus and roots would provide additional in stream habitat. This measure's acreage is the proposed 350 x 4,500 ft planting area and supplemental acreage is the adjacent forest.

RCP_3 proposes to set back the elevated banks on either side of the straightened creek and increase the forested buffer to create a 350-foot-wide buffer.

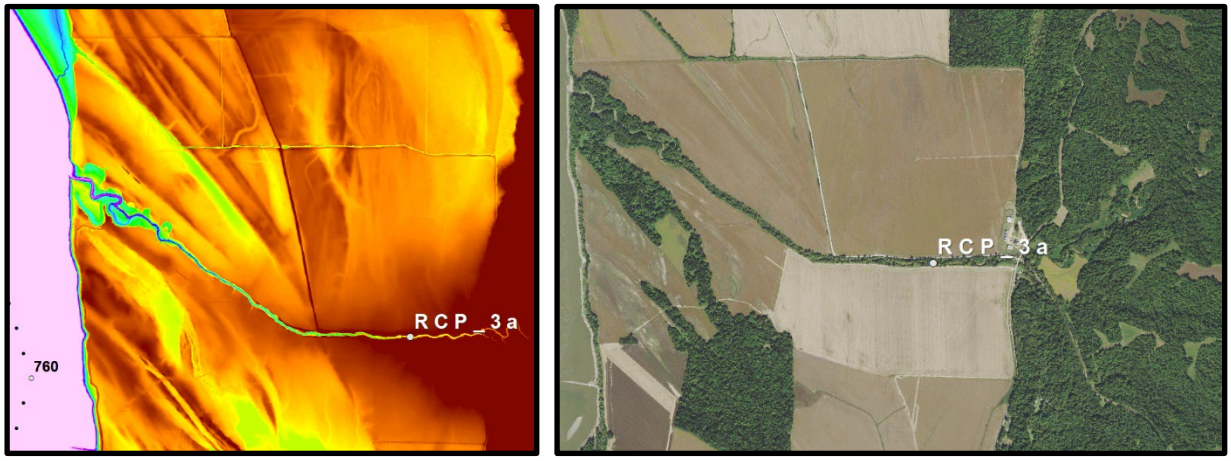


Figure 11-5. RCP_3

Table 11-3: RCP_3 Description

RCP_3 Description of Features	
Measure Description	Reforestation – BLH
Construction Activity	Floodplain Vegetative
Model	HGM
Restoration Activity	Enhance and Restore Natural Vegetation
Habitat	Riverfront Forest – Riparian Buffers (floodplain vegetative)

RCP_3 Items			
Item – Feature	**Meets Objective**	**Notes**	**Screened**
RCP_3a – Restoration of BLH	1	Set back spoil piles along Bear Creek for 100-ft each side with active reforestation (350ft width x 4500-ft. length = 36.2acres). *Screening criteria: This measure did not perform well during the first iteration of CE ICA.*	Yes – CEICA Round 1
RCP_3 Construction Assumptions			

RCP_3a	13,800 LF embankment (15ft crown, 8ft tall, 1:3 side slopes – 159,500 CY) and 7,700 LF gravel resurfacing (12ft wide, 6in thick - 2,570 TN), 24 acres of clearing.
RCP_3 Real Estate Assumptions	
RCP_3a	Assume purchase of 36.2 floodplain acres of agricultural land.
RCP_3 OMRR&R Assumptions	
RCP_3a	Channel cleanout O&M at years 15, 30, 45 estimated at 25% of initial construction cost; road surface O&M at years 15, 30, 45 estimated at 50% of initial construction cost
RCP_3 Adaptive Management & Monitoring Assumptions	
RL_3a	HGM AMM costs provided by ERDC.

11.4 RICHARDSON CEDAR POINT (RCP_4)

In 2020 the single line of trees along the steep bank around RCP_4a were removed to place stone paving along the bankline (G. Earth). Prior to this from 1985-2019, there was an approximately 50 ft wide line of trees (G. Earth), most likely on the bank's steep slope. The bank is composed of non-hydric Robinsonvile fine sandy loam (NWIS, SSURGO). This measure proposes to plant a 300 ft wide forest strip along the top bank for 1,600 ft. This would reduce sedimentation and nutrient runoff and connect two areas of floodplain forest. The acreage for the measure is the 300 x 1,600 ft planting area and supplemental acreage is the adjacent forest.

RCP_4 proposes to plant a 300-foot-wide forest strip along the top left descending bank of the Mississippi River for 1,600-feet to reduce sedimentation and nutrient runoff and connect two areas of floodplain forest.

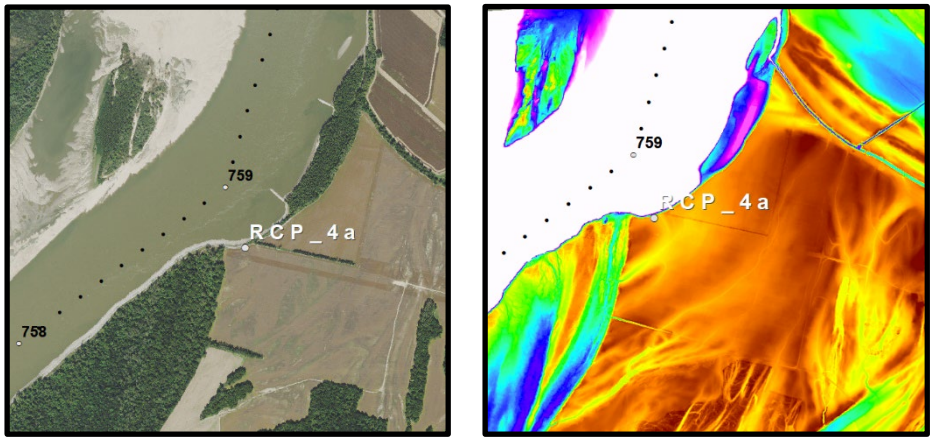


Figure 11-6. RCP_4

Table 11-4: RCP_4 Description

RCP_4 Description of Features			
Measure Description	MS River Riparian Buffer		
Construction Activity	Floodplain Vegetative		
Model	HGM		
Restoration Activity	Enhance and Restore Natural Vegetation		
Habitat	Riverfront Forest – Riparian Buffers (floodplain vegetative)		
RCP_4			
Item - Feature	**Meets Objective**	**Notes**	**Screened**
RCP_4a	1	Establish riparian buffer along MS River for 300-ft x 1600-ft width where it is lacking.	No

RCP_4 Construction Assumptions	
RCP_4a	HGM costs provided by ERDC.
RCP_4 Real Estate Assumptions	

RCP_4a	Assume purchase of 11 floodplain acres of agricultural land.
RCP_4 OMRR&R Assumptions	
RCP_4a	None
RCP_4 Adaptive Management & Monitoring Assumptions	
RL_4a	HGM AMM costs provided by ERDC.

Section 12

Sunrise Island 34 Complex

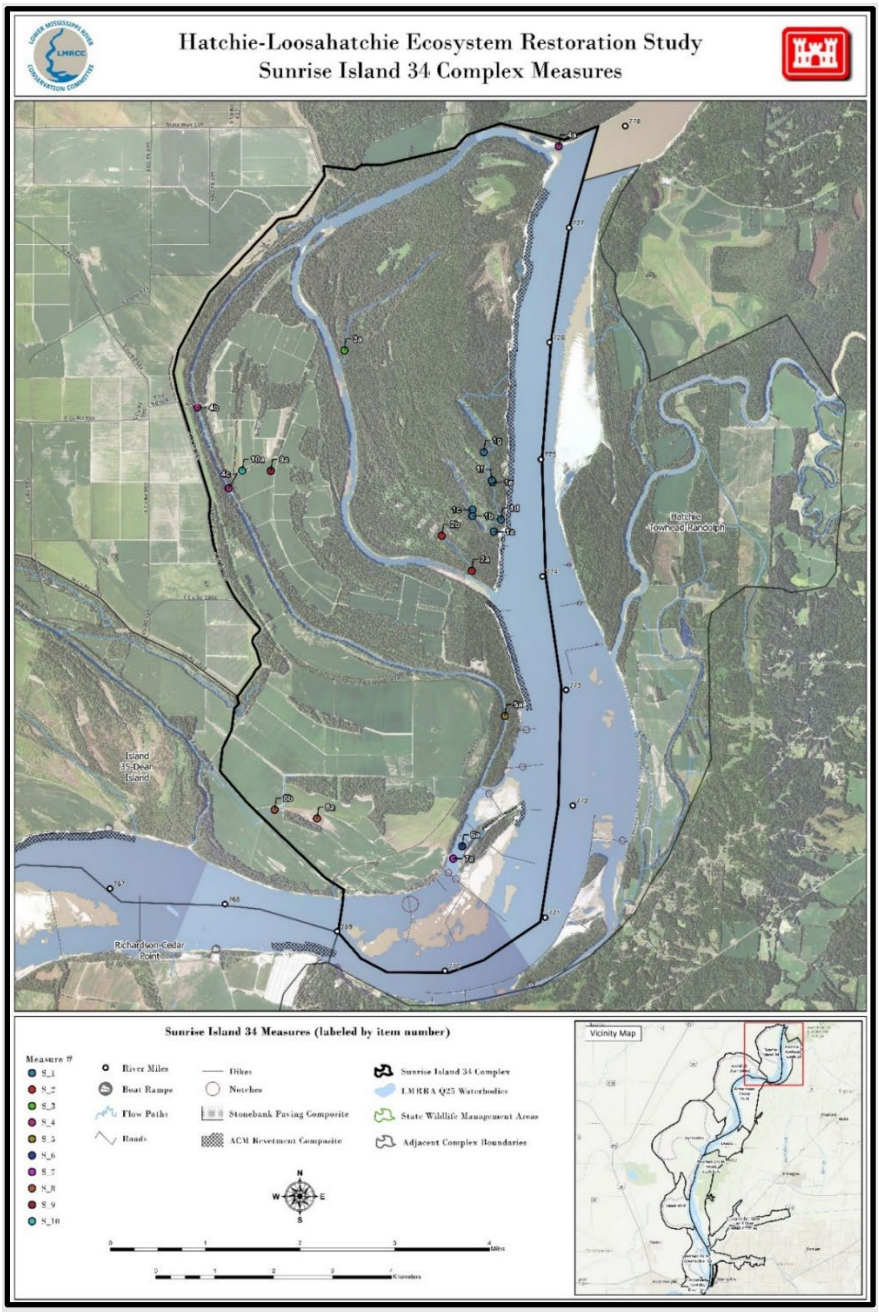


Figure 12-1 Sunrise Island 34 Complex

12.1 SUNRISE ISLAND (S_1)

Mid-channel islands existed in the Sunrise Towhead Island 34 complex area as long ago as 1795. The island that is now Sunrise Towhead developed as a midchannel bar after a point bar cutoff between 1915 and 1930 (Harmar and Clifford 2006). The abandoned main channel on the right descending bank of the island accumulated sediment narrowing over time. Prior to and after the point bar cutoff, overtopping river flows created paths across the island's area (Guntren et al. 2016). Today forest has grown up in many of the historic flow paths, but permanent waterbodies persist in several areas. These waterbodies connect to the river or Sunrise Towhead Chute through a series of small channels obstructed by roads, manmade berms, and sediment.

Measure S_1 proposes to alter up to seven obstructions to improve connectivity and fish passage between interior sloughs and the Lower Mississippi River main channel. Item S_1b was screened out because imagery and elevation data showed that it was not obstructing connectivity between the river and floodplain waterbodies.S_1 proposes to alter up to seven obstructions to improve connectivity and fish passage between interior sloughs and the Lower Mississippi River main channel.

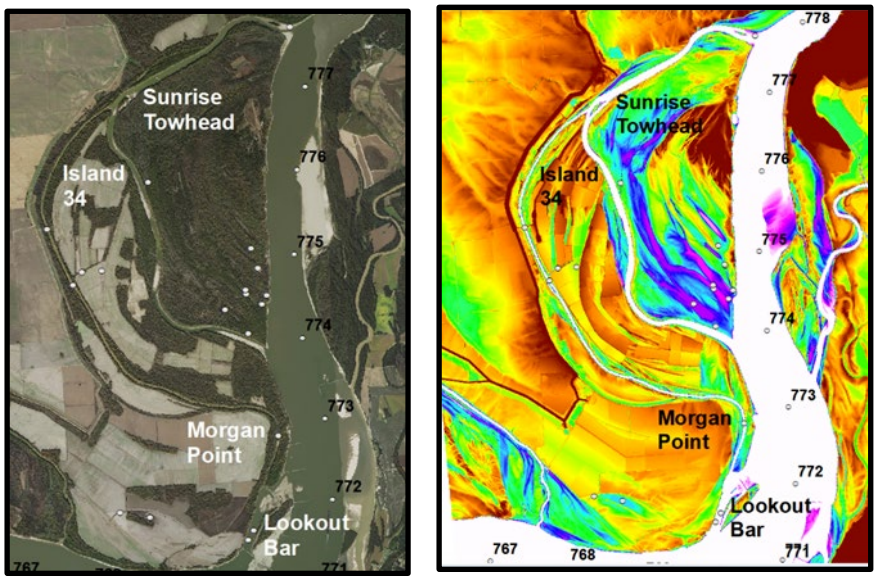


Figure 12-2. S-1 Imagery 1

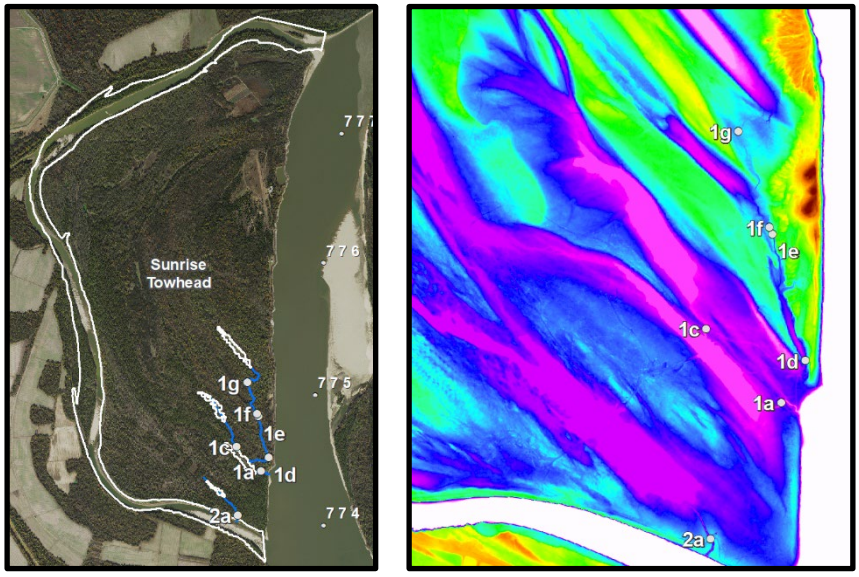


Figure 12-3. S-1 Imagery 2

Table 12-1: S_1 Description

S_1 Description of Features			
Measure Description	Flow Restoration to Backwater Slough		
Construction Activity	Culverts; Riprap Bank Protection		
Model	Bidirectional		
Restoration Activity	Altering Connectivity		
Habitat	Slough (lentic aquatic)		
S_1 Items			
Item - Feature	**Meets Objective**	**Notes**	**Screened**
S_1a	3	Lower culvert invert to improve connectivity to floodplain waterbody through culvert replacement. Culvert invert likely 220.8 feet. *Screening criteria: screened in final array of alternatives.*	Yes, Final Array

S_1b	3	Modify obstruction to improve connectivity to floodplain waterbody. *Screening criteria: Water on upstream and downstream sides of culvert. Does not appear to be the choke point for connectivity.*	Yes, Pre CEICA
S_1c	3	Channel cleanout to improve connectivity to floodplain waterbody. Two track dirt road with 20x4 ft culvert, invert ~221.8 feet. *Screening criteria: screened in final array of alternatives.*	Yes, Final Array
S_1d	3	Channel cleanout to improve connectivity to floodplain waterbody. Elevated area in channel bed currently 224.4 feet. *Screening criteria: screened in final array of alternatives.*	
S_1e	3	Channel cleanout to improve connectivity to floodplain waterbody. Elevated area in channel bed currently 227 feet. *Screening criteria: screened in final array of alternatives.*	
S_1f	3	Channel cleanout to improve connectivity to floodplain waterbody. Elevated area in channel bed currently 227 feet. *Screening criteria: screened in final array of alternatives.*	
S_1g	3	Channel cleanout to improve connectivity to floodplain waterbody. Elevated area in channel bed currently 228.3 feet. *Screening criteria: screened in final array of alternatives.*	

S_1 Construction Assumptions	
S_1a	Single 48in CMP at 30 LF including demolition costs, 123 tons riprap inlet/outlet protection for R-125, 0.5 acres of clearing.
S_1b	None; screened prior to construction estimation.

S_1c	Cleanout for 500 linear feet, 1 foot depth and 40 feet with excavator (740 CY), 80 feet wide clearing for 500 LF (1 acre of clearing).
S_1d	Cleanout for 300 linear feet, 2 foot depth and 40 feet with excavator (888 CY), 80 feet wide clearing for 300 LF (0.5 acre of clearing).
S_1e	Excavate 50x20x2 feet area, clear 0.5 acres
S_1f	
S_1g	Cleanout for 1,500 linear feet, 1.5 feet depth and 40 feet BW with excavator (3,333 CY), 80 feet wide clearing for 1,500 LF (3 acres of clearing)
S_1Real Estate Assumptions	
S_1a	Assume purchase of 27 aquatic acres of woodlands (including floodplain waterbodies (i.e., borrow areas, lakes, etc.).
S_1c	
S_1d	
S_1e	
S_1f	
S_1g	
S_1 OMRR&R Assumptions	
S_1a	For CMP, O&M at year 30 (100% of initial cost); For R-125, O&M at years 15, 30, 45 (50% of initial cost).
S_1b	None; screened prior to OMRR&R estimation.
S_1c	Channel cleanout O&M at years 15, 30, 45 estimated at 25% of initial construction cost.
S_1d	
S_1e	
S_1f	
S_1g	
S_1 Adaptive Management & Monitoring Assumptions	
S_1a	
S_1c	

S_1d	Aquatic Lidar Surveys (ROV)- Small Channels (A) at years 0,7 estimated at $2400/event; Fish & Invertebrate Surveys Monitoring - Bidirectional, Unidirectional, Isolation (A) at years 0, 3,5,7,10 estimated at $4167/event.
S_1e	
S_1f	
S_1g	

12.2 SUNRISE ISLAND (S_2)

S_2 proposed to alter two road crossings that obstruct connectivity between a historic slough and Sunrise Towhead Chute. Item S_2b was screened out because elevation data showed that the waterbodies were well connected. Item S_2a proposes to replace the existing culvert with a fish friendly culvert at a lower invert. The acreage for both measures is the sloughs whose connectivity would be enhanced.

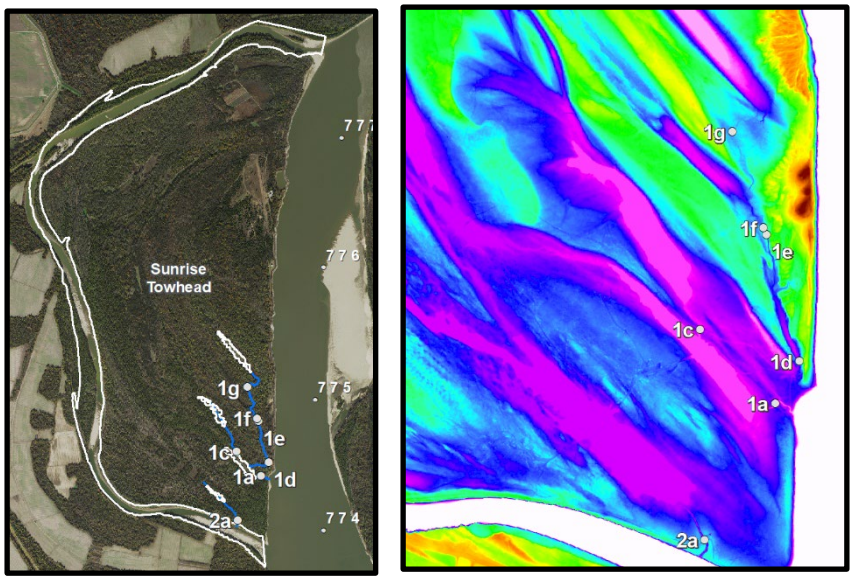


Figure 12-4. S-2

Table 12-2: S_2 Description

S_2 Description of Features	
Measure Description	Flow Restoration to Backwater Slough

Construction Activity	Culverts; Riprap Bank Protection
Model	Bidirectional
Restoration Activity	Altering Connectivity
Habitat	Slough (lentic aquatic)

S_2 Items

Item - Feature	Meets Objective	Notes	Screened
S_2a	3	Modify obstruction (lower culvert invert) to improve connectivity to floodplain waterbody through culvert replacement. *Screening Criteria: First iteration of CEICA showed poor performance. Much of this measure is on existing NRCS easements and likely could be better accomplished through other programs. Measure is located on Tennessee lands on the opposite bank of the River and is difficult to access for Tennessee sportsman.*	Yes – CEICA Round 1
S_2b	3	Modify obstruction to improve connectivity to floodplain waterbody. *Screening criteria: Water bodies appear connected based on elevation and aerial imagery. First iteration of CEICA showed poor performance*.	Yes – Pre CEICA

S_2 Construction Assumptions

S_2a	Single 48" CMP 45 LF, 123 TN riprap inlet/outlet protection for R-125, includes 0.25 acres of clearing
S_2b	Water bodies appear connected based on elevation and aerial imagery.

S_2 Real Estate Assumptions

S_2a	Assume purchase of 2.3 aquatic acres of woodlands (including floodplain waterbodies i.e., borrow areas, lakes, etc.)).
S_2b	

S_2 OMRR&R Assumptions

S_2a	For CMP, O&M at year 30 (100% of initial cost); For R-125, O&M at years 15, 30, 45 (50% of initial cost).
S_2b	None; screened prior to OMRR&R estimation.
S_2 Adaptive Management & Monitoring Assumptions	
S_2a	Aquatic Lidar Surveys (ROV)- Small Channels (A) at years 0,7 estimated at $2400/event; Fish & Invertebrate Surveys Monitoring - Bidirectional, Unidirectional, Isolation (A) at years 0, 3,5,7,10 estimated at $4167/event.
S_2b	None; screened prior to AMM estimation.

12.3 SUNRISE ISLAND (S_3)

S_3 proposes to alter a large culvert to improve fish passage between an interior slough and Sunrise Towhead Chute. Upon further review it was determined that the existing structure provided more connectivity and fish passage than what would exist naturally. Therefore, the measure was screened out.

Table 12-3: S_3 Description

S_3 Description of Features			
Measure Description	Flow Restoration to Backwater Slough		
Construction Activity	N/A		
Model	N/A		
Restoration Activity	Altering Connectivity		
Habitat	N/A		
S_3 Items			
Item - Feature	**Meets Objective**	**Notes**	**Screened**
S_3a	3	Modify obstruction (lower culvert invert) to improve connectivity to floodplain waterbody through culvert replacement.	Yes – Pre CEICA

		Screening Criteria: High uncertainty with obstruction and elevation.	
S_3 Construction Assumptions			
S_3a	Screened. Original costs included two 60" CMPs 45 LF, 25'x30'x2' (166 TN) riprap inlet/outlet protection for R-125.		

S_3 Real Estate Assumptions	
S_3a	None; screened prior to Real Estate estimation.
S_3 OMRR&R Assumptions	
S_3a	None; screened prior to OMRR&R estimation.
S_3 Adaptive Management & Monitoring Assumptions	
S_3a	None; screened prior to AMM estimation.

12.4 SUNRISE ISLAND (S_4)

Island 34 was present as a mid-channel bar or island in 1765 (Harmar and Clifford 2006). Island 34 Towhead appears in 1881. In 1915, Island 34 Towhead's channel is too small to map, and the Island 34 channel width has shrunk by half. By 1930 the channels of both islands are too small to map, and Sunrise Towhead has appeared in the main channel (Harmar and Clifford 2006). There is an opportunity to enhance flow through these historic channels to ensure their persistence into the future. This would improve connectivity of Island 34 and Sunrise Towhead Chutes whose area represents the benefit acreage.

Item S_4a proposes to construct an innovative river training structure to direct additional flow into the island's chutes which may scour and thus lower the channel bed increasing connectivity during low water.

Item S_4b proposes to enhance debris passage underneath an existing bridge and/or remove accumulated sediment. The 19 November 2021 NAIP image shows water barely flowing over the two sediment deposits around the bridge, thus the elevation of 4b is around 208.2 ft, that day's water surface elevation. This elevation is exceeded 82.8% from 2010-2019.

Item S_4c proposes to remove accumulated sediment that is developing vegetation. Of the NAIP imagery, 2017 has the lowest water surface elevation and the channel bed around 4c is nearly dry. Therefore, the elevation of 4c was assumed to be 0.5 ft less than

the 2017 NAIP imagery water surface; 4c's elevation was set at 205.3 ft exceeded 88.6%. If 4b and 4c were lowered to 195.5 and 195 ft respectively, Island 34 chute would have unidirectional flow 100% of the time between 2010-2019.

Item S_4d proposes to notch a pile dike that blocks the lower end of Island 34 Chute. During low water the pile dike ponds water upstream. Notching the dike would likely also result in removal of some of the accumulated sediment downstream. The dike was captured in the 2014 USGS 3D elevation program LiDAR survey with an elevation of 63.8 m or 209.3 ft. The 19 November 2021 NAIP image shows water traveling through the dike with a water surface elevation of 206.9 ft while a 2018 NAIP image shows the dike barely visible at 209.5. Therefore, the elevation of 209.3 ft was used to determine without project connectivity which was 74.8%. Notching the dike to 194 ft would result in 100% connectivity.

S_4 proposes to enhance flow through the historic channels to ensure their persistence into the future. This would improve connectivity of Island 34 and Sunrise Towhead Chutes.

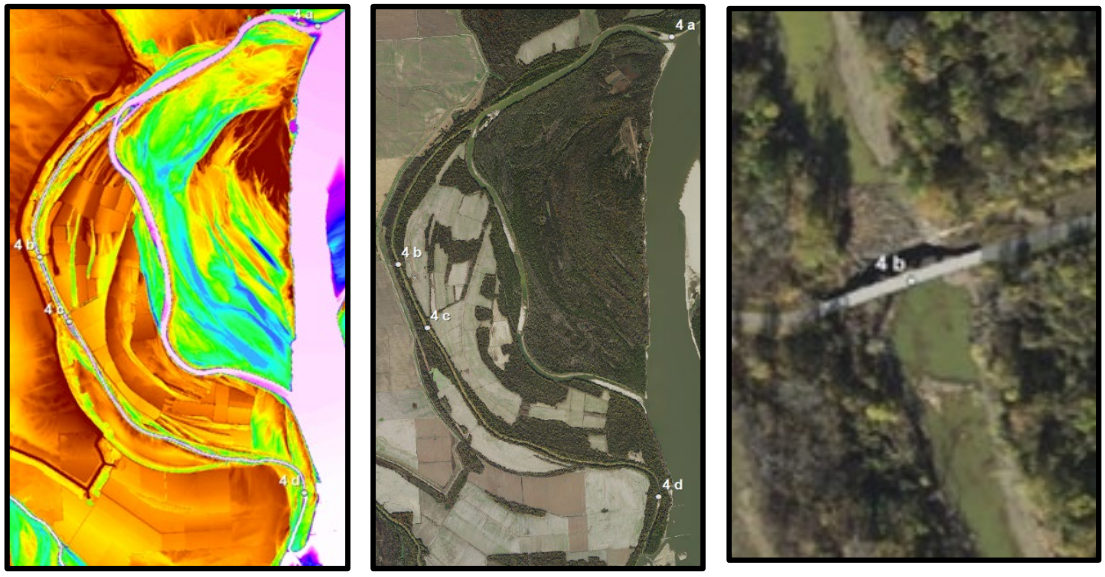


Figure 12-5. S-4 Imagery 1

Figure 12-6. S-4 Imagery 2

Table 12-4: S_4 Description

S_4 Description of Features			
Measure Description	Meander scarp Flow Restoration		
Construction Activity	River Training Structures; Bridge Replacement; Earthwork; Dike Notching		
Model	Unidirectional		
Restoration Activity	Altering Connectivity		
Habitat	Meander Scarp/tertiary channels (lotic aquatic)		
S_4 Items			
Item - Feature	**Meets Objective**	**Notes**	**Screened**
S_4a	2 and 3	Install river training structure (chevron) to divert flow into meander scarp to increase connectivity. Assuming it would affect bridge so include 4b in scaled analyses. Will likely have minimal effect.	No
S_4b	3	Increase meander scarp connectivity by enhancing debris passage underneath an existing bridge and/or remove accumulated sediment. Assumed bridge replacement.	
S_4c	3	Increase meander scarp connectivity by establishing a low flow channel but using excavated material in place.	
S_4d	3	Increase connectivity of meander scarp by notching old pile dike.	
S_4 Construction Assumptions			
S_4a	Assumed 24,800 tons of C-stone based off Loosahatchie Bar chevron (same as chevron cost for Island 35).		
S_4b	Bridge Replacement cost based off AR DOT bridge replacement assuming competitive bid contract and 15% contingency, same costs as Island 35 and Brandywine Bridge replacements.		
S_4c	Assume 5ft channel cleanout with a dragline, 324,230 sq ft (60,042 CY), 1,650 LF, 4 acres of clearing.		
S_4d	Assumptions based off a contractor's bid in MVS, and 30% contingency since we are further downstream and varying channel conditions.		

S_4 Real Estate Assumptions	
S_4a	Assume work to be done in-channel below ordinary high water and/or incidental to construction costs contingencies.
S_4b	
S_4c	
S_4d	
S_4 OMRR&R Assumptions	
S_4a	Chevron O&M at years 15, 30, 45 (25% of initial cost).
S_4b	None
S_4c	Channel cleanout O&M at years 15, 30, 45 estimated at 25% of initial construction cost.
S_4d	None
S_4 Adaptive Management & Monitoring Assumptions	
S_4a	Aquatic Bathymetric Survey - Rivers/Secondary Channels (A) at years 0,1,3,5,7,10 estimated at $450/mile; Fish & Invertebrate Surveys Monitoring – Bidirectional, Unidirectional, Isolation (A) at years 0, 3,5,7,10 estimated at $4167/event.
S_4b	
S_4c	
S_4d	

12.5 SUNRISE ISLAND (S_6)

In 1953, vegetation had developed in the area of Lookout Bar on the sediment deposited below the outlet of Island 34 (Guntren et al. 2016). The pile dike in the lower end of Island 34 (Item S_4d) had been constructed, and Lookout Bar may have formed as a result of the change in river dynamics. Dikes 1, 1.5, 2, and 3 were constructed in 1961, dikes 2 and 4 in 1992 and dike 1U in 2002. There was little change in Lookout Bar after the 1961 dike construction (Guntren et al. 2016). Dikes 1U, 1, 2.5, and 4 have been notched while wood pile dikes 1.5 and 2 have not. In the larger landward secondary channel of Lookout Bar, these pile dikes are submerged in all imagery and the secondary channel has likely flanked the dikes on the landward side. The 2015 bathymetric data suggests the landward channel has an elevation of 189 ft which is exceeded 100% of the time.

This measure proposes to notch the wood pile dikes and create a pilot channel in the small interior secondary channel. This channel starts below the riverward end of Dike 1

which is unnotched in this area. Water enters the channel by flowing along the downstream edge of Dike 1 or when Dike 1 overtops. The position of the secondary channel entrance likely results in sediment deposition and causes the upstream disconnection. The downstream end of the channel is less obstructed and notching the interior dikes would improve downstream connectivity and fish access to the channel's interior habitat. Pile dikes 1.5 and 2 block the smaller interior channel. Dike 1 is partially submerged in the 8 Oct. 2021 NAIP image suggesting an elevation around 201.7 ft exceeded 91.5%. Dike 2 is above water on 3 Aug 2018 at 208.8 ft and mostly submerged on 14 Aug. 2019 at 213 ft suggesting an elevation of 210.8 ft which would be exceeded 68%. There is considerable sediment built up around Dike 2 and a pilot channel would improve downstream connectivity. Although the upstream end of the channel is likely to stay disconnected, the overall connectivity and downstream connection would be improved by this measure. An elevation of 193.5 ft. would be exceeded 100% of the time. Project acreage is the Lookout Bar secondary channel whose aquatic species would benefit from the increase in accessible protected habitat.

S_6 proposes to notch the wood pile dikes and create a pilot channel in the small interior secondary channel.

Figure 12-7. S-6

Table 12-6: S_6 Description

S_6 Description of Features	
Measure Description	Dike Notching-Pile Dike

Construction Activity	Dike Notching
Model	Bidirectional
Restoration Activity	Altering Connectivity
Habitat	Secondary Channels (lotic aquatic)

S_6 Items			
Item - Feature	**Meets Objective**	**Notes**	**Screened**
S_6a	2	Increase secondary channel connectivity by notching old pile dike.	No

S_6 Construction Assumptions	
S_6a	Assumptions based off a contractor's bid in MVS, and 30% contingency since we are further downstream and varying channel conditions
S_6 Real Estate Assumptions	
S_6a	Assume work to be done in-channel below ordinary highwater and/or incidental to construction costs contingencies.
S_6 OMRR&R Assumptions	
S_6a	None
S_6 Adaptive Management & Monitoring Assumptions	
S_6a	Aquatic Bathymetric Survey - Rivers/Secondary Channels (A) at years 0,1,3,5,7,10 estimated at $450/mile; Fish & Invertebrate Surveys Monitoring – Bidirectional, Unidirectional, Isolation (A) at years 0, 3,5,7,10 estimated at $4167/event.

12.6 SUNRISE ISLAND (S_7)

S_7 proposes to add wood to the area between dikes 2 and 2.5 where the channel maintains a year-round connection to the main channel. The benefits evaluation acreage for this measure is the Lookout Bar secondary channel.

Table 12-7: S_7 Description

S_7 Description of Features			
Measure Description	Woody Debris Traps		
Construction Activity	Woody Debris Traps		
Model	Wood Trap		
Restoration Activity	Aquatic Channel Enhancement		
Habitat	Secondary Channels (lotic aquatic)		
S_7 Items			
Item – Feature	**Meets Objective**	**Notes**	**Screened**
S_7a – Install Woody Debris Trap	2	Install large woody debris traps to promote aquatic macroinvertebrates in secondary channels.	No
S_7 Construction Assumptions			
S_7a	Costs provided by ERDC and NFS based on Prairie Point assumed costs.		
S_7 Real Estate Assumptions			
S_7a	Assume work to be done in-channel below ordinary high water and/or incidental to construction costs contingencies.		
S_7 OMRR&R Assumptions			
S_7a	None		
S_7 Adaptive Management & Monitoring Assumptions			
S_7a	Aquatic Bathymetric Survey - Rivers/Secondary Channels (A) at years 0,1,3,5,7,10 estimated at $450/mile; Large Woody Debris Traps at years 1,3,5,7,10 estimated at $6000 per structure.		

12.7 SUNRISE ISLAND (S_8)

Morgan Point is a high elevation predominantly agricultural area within the active floodplain. The ground on the southern side of the point contains lower elevation remnant channels and half of the agricultural ground on the point drains through this area. Item S_8a proposes to reforest historic Preston Lake illustrated on the 1963 USGS

topographic map. This area is currently farmed though 2010 – 2021 NAIP imagery shows wet ground, flooding, or poor crop production in all years. The areas frequent inundation, and Sharkey and Tunica silty clay soil suggest it would be suitable for cypress/tupelo reforestation. This reforested area would help remove nutrients from the agricultural runoff and increase the prevalence of a rare forest community. The low area was inundated at the time of the elevation survey to an elevation of 227.3 ft. Therefore, the slope of the adjacent dry lakebed and the distance from the inundated edge to the center was used to calculate a minimum lakebed elevation of 225.2ft. The proposed cypress/tupelo area appears to drain around an elevation of 229.7ft. The river exceeded this elevation on 3 May 2017 and fell below the lakebed's minimum elevation on 24 May 2017. Ground water connection and rainwater drainage from the adjacent farm field may increase the proposed cypress/tupelo inundation. Ground below an elevation of 228.0 ft is isolated to the remnant Preston Lake area which shows poor crop growth and frequent inundation (NAIP 2010-2021). The 69.5m (228.0 ft) contour in the area was used to represent project acres. The adjacent forest and its inhabitants would benefit from the reforestation and its area represents the supplemental acreage.

The project team also evaluated and screened out improving the connectivity of Preston Lake. Today, the Preston Lake area and upstream farm field drain through a 5,000 ft long agricultural drainage into Island 35 Chute. There are two roads that cross the drainage and obstruct connectivity. Additionally, the 30 – 40 ft wide drainage way has minimal herbaceous buffer between it and the adjacent farmland. Near Preston Lake the drainage has an invert around 229.7 ft. Near Island 35, the drainage becomes much lower 208.3 – 212.6 ft. It appears that a head cut is moving upstream that could cause considerable erosion throughout the ag land covering Morgan Point as all the connecting channels adjust to the new elevation and channel slope. A culvert replacement was considered (item S_8b) but screened out. The existing obstructions are likely maintaining the channel and preventing erosion and channel adjustment.

S_8 proposes to reforest historic Preston Lake with cypress/tupelo. The reforested area would help remove nutrients from the agricultural runoff and increase the prevalence of a rare forest community.

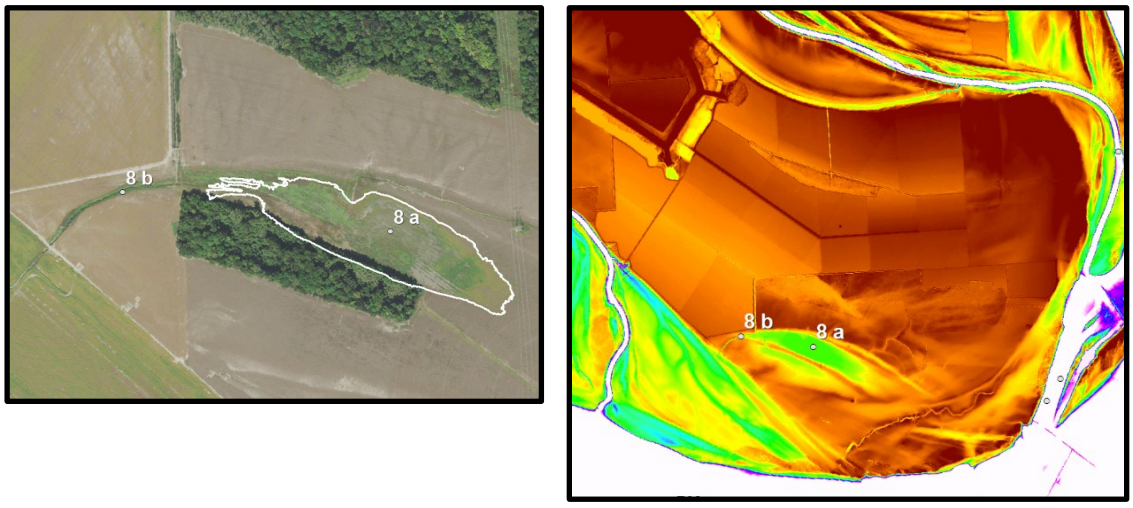


Figure 12-8. S-8

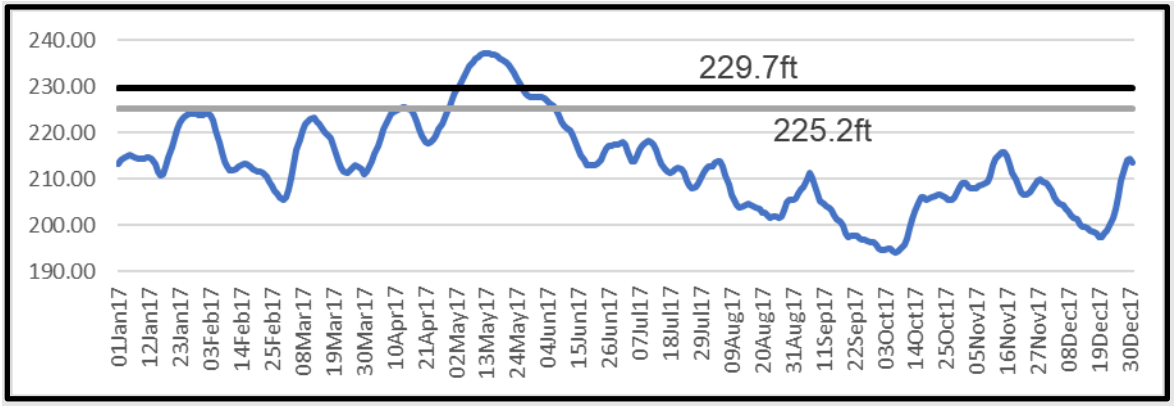


Figure 12-9. S-8 Water Level

Table 12-8: S_8 Description

S_8 Description of Features	
Measure Description	Reforestation – Cypress/Tupelo
Construction Activity	Floodplain Vegetative

Model	HGM
Restoration Activity	Enhance and Restore Natural Vegetation
Habitat	Cypress – Tupelo (floodplain)

S_8 Items			
Item - Feature	**Meets Objective**	**Notes**	**Screened**
S_8a	1 and 3	Reforest 19 acres with cypress/tupelo and surrounding bands of Fac-wet species.	No
S_8b	1 and 3	Reconnect channel after Item S_8a to restore hydrology (but maintain non-permanent water). Need channel profile from Lidar. *Screening Criteria: Culvert present, channel appears to maintain flow. Headcut should be thwarted by the existing culvert and road.*	Yes – Pre CEICA
S_8 Construction Assumptions			
S_8a	HGM costs provided by ERDC.		
S_8b	Screened. Culvert present, channel appears to maintain flow. Headcut should be thwarted by the existing culvert and road.		
S_8 Real Estate Assumptions			
S_8a	Assume purchase of 19 floodplain acres of agricultural land.		
S_8b	None; screened.		
S_8 OMRR&R Assumptions			
S_8a	None		
S_8b	None; screened.		
S_8 Adaptive Management & Monitoring Assumptions			
S_8a	HGM AMM costs provided by ERDC.		
S_8b	None; screened.		

12.8 SUNRISE ISLAND (S_9)

Mid-channel islands existed in the Sunrise Towhead Island 34 complex area prior to 1795. It appears that the 1795 mid-channel island became what is now Island 34 and began to occupy its current position in the mid to late 1800s (Harmar and Clifford 2006, MRC 1879). A 1956 topographic map shows the island as a patch work of farmland and forest. Imagery from 1971 shows a larger area of forest at the island's northern end and along its eastern edge compared to current day (USGS earth explorer). By 1985, the present areas were farmed (G. Earth). Elevation data shows that these farmed areas have been leveled and drainage channels created (USGS 2014). The predominantly silty loam soils range from fine sandy loam to clay and are mostly non-hydric with isolated areas of 1-25% and 100% hydric. This measure proposes to acquire Island 34 and return it to a more natural condition. The project acreage is the farm fields, and the supplemental acreage is the forested island areas. The adjacent 2,500+ acres of meander scarps and main channel would also benefit from the reduced sediment and nutrient influx though these benefits were not evaluated.

S_9 proposes to acquire Island 34 and return it to a more natural condition. This would involve restoring the north to south channels created as the river meandered across the island and revegetating agricultural areas with less common herbaceous and forest species. This would create a large tract of natural habitat in an area identified as high priority for breeding birds by the Lower Mississippi Valley Joint Venture. The restored habitat would also benefit a wide variety of aquatic and floodplain plants and animals on the island and throughout the river valley. The measure would also eliminate sediment and nutrient runoff from the agricultural fields. The adjacent 2,500+ acres of meander scarps and main channel would also benefit from the reduced sediment and nutrient influx.

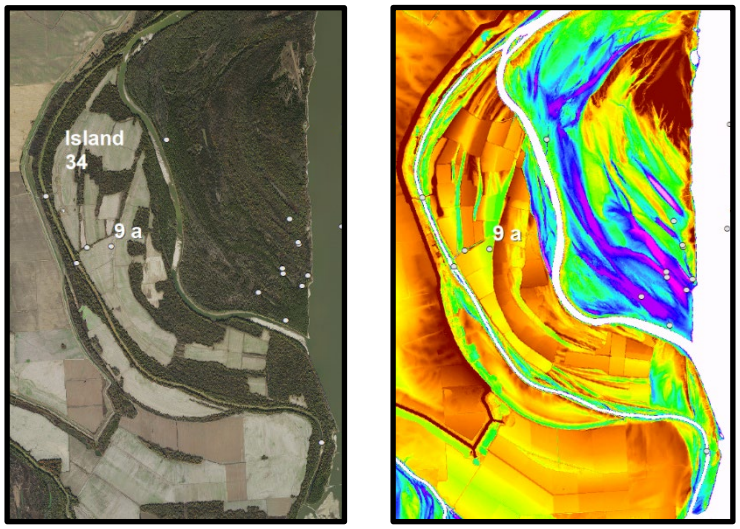


Figure 12-10. S-9

Table 12-9: S_9 Description

S_9 Description of Features			
Measure Description	Reforestation – BLH		
Construction Activity	Floodplain Vegetative		
Model	HGM		
Restoration Activity	Enhance and Restore Natural Vegetation		
Habitat	BLH (floodplain)		
S_9 Items			
Item - Feature	**Meets Objective**	**Notes**	**Screened**
S_9a	1	Purchase 2,489 acres of mixed agricultural land and woodlands; plan to reforesting/restore 1,167 acres, restore dendritic flow paths and reforest agricultural land to meander scrolls (include LMVJV high priority).	Yes – CEICA Round 1

		Screening criteria: This measure did not perform well during first iteration of CE ICA due to significant construction and real estate costs.	
S_9 Construction Assumptions			
S_9a	HGM costs provided by ERDC.		
S_9 Real Estate Assumptions			
S_9a	Assume purchase of 2,489 floodplain acres of agricultural land and woodlands.		
S_9 OMRR&R Assumptions			
S_9a	None		
S_9 Adaptive Management & Monitoring Assumptions			
S_9a	HGM AMM costs provided by ERDC.		

12.9 SUNRISE ISLAND (S_10)

This measure cannot be combined with the larger scale S_9 measure. Currently nearly half of Island 34 is farmed. Drainage ways have been created to move water from these fields through a central channel and into Island 34 Chute. Just downstream of this confluence is one of the highest elevation areas of sediment deposition within Island 34 chute. This measure proposes to increase the forested buffer along the agricultural drainage channel to reduce sediment and nutrient runoff. The project area acreage is the reforestation footprint while the supplemental acreage is the adjacent forest. The 178-acre Island 34 Chute would also benefit from the decrease in sedimentation and nutrient input though these benefits were not evaluated.

S_10 proposes to increase the forested buffer along the agricultural drainage channel on Island 34 to reduce sediment and nutrient runoff. The 178-acre Island 34 Chute would also benefit from the decrease in sedimentation and nutrient input.

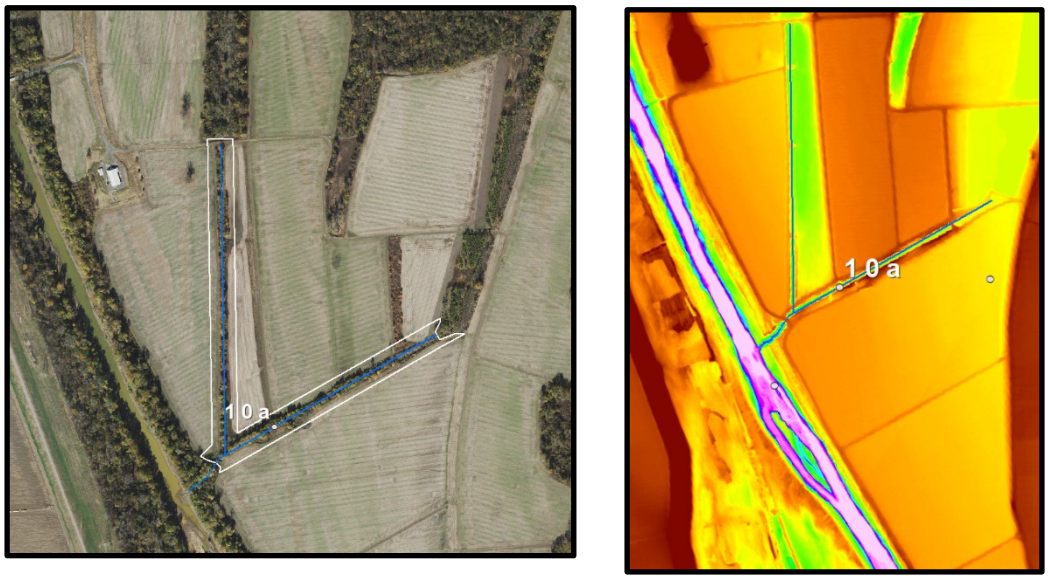


Figure 12-11. S-10

Table 12-10: S_10 Description

S_10 Description of Features			
Measure Description	Reforestation – BLH		
Construction Activity	Floodplain Vegetative		
Model	HGM		
Restoration Activity	Enhance and Restore Natural Vegetation		
Habitat	BLH (floodplain)		
S_10 Items			
Item – Feature	**Meets Objective**	**Notes**	**Screened**
S_10a	1 and 3	Create a 100-ft. width buffer (21 acres=4,500ft length x 210-ft width) along both sides of agriculture ditch to reduce sedimentation into meander scarp.	No
S_10 Construction Assumptions			

S_10a	HGM costs provided by ERDC.
S_10 Real Estate Assumptions	
S_10a	Assume purchase of 21 floodplain acres of agricultural lands (including floodplain waterbodies (i.e., borrow areas, lakes, etc.).
S_10 OMRR&R Assumptions	
S_10a	None
S_10 Adaptive Management & Monitoring Assumptions	
S_10a	HGM AMM costs provided by ERDC.

Table 13-1: Significant Resources

Measure-Item	Screened	ESA Federal	SWAP TN/AR	RAGR	TDEC Exc H20	AG HSI	LMVJV Bird	LMR ACCSF	RVRCNE	DU	LMR EcnPro	Rvrgator	Wolf rvr conserv
Br_1	In	PS, FPB	X	AR11		X		X					
Br_10	Out		X	AR11			X			X			
Br_11	In		X	AR11			X						
Br_12	In	PS, FPB	X	AR11		X		X					
Br_13	In	PS, FPB	X	AR11		X		X					
Br_14	Out		X		X								
Br_15	Out		X	AR11	X	X	X		X				
Br_16	Out		X		X		X						
Br_2	In	PS, FPB	X	AR11		X		X					
Br_3	Out	PS, FPB	X	AR11		X		X					
Br_4	In	PS, FPB	X	AR11		X		X					
Br_5	In	PS, FPB	X	AR11		X	X	X					
Br_6	In		X	AR11			X		X				
Br_7	In		X	AR11			X		X				
Br_8	In		X		X		X			x			
Br_9	Out		X	AR11			X						
D_1	In	PS, FPB, ILT	X	TN20, TN21	X	X							
D_2	In	PS, FPB, ILT	X	TN20, TN21	X	X							
D_3	In	PS, FPB, ILT	X	TN20, TN21	X	X							
HB_1	In		X			X*	X	X	X		X	X	
HB_10	In		X							X	X		
HB_2ab	In	PS, FPB	X	TN32 AR14?	X	X	X	X		X	X	X	
HB_2c	In	PS, FPB	X	TN32 AR14?		X*		X			X	X	
HB_3	In		X				X		X	X	X	X	
HB_4	In		X				X		X	X	X	X	
HB_5	In		X				X		X	X	x	X	
HB_6	In		X				X		X	X	X	X	
HB_7	In		X				X		X	X	X	X	
HB_8	In		X							X	X	X	
HB_9	In		X				X		X	X	X	X	
HT_1	In		X	TN17, TN18	X	X		X					

HT_10	Out	PS, FPB	X	TN17, TN18	X	X		X					
HT_2	In	PS, FPB	X	TN17, TN18	X	X		X	X				
HT_3	Out	PS, FPB	X	TN19	X			X					
HT_4	In	PS, FPB	X	TN17, TN18	X	X		X			X	X	
HT_5	Out		X	TN17, TN18	X			X					
HT_6	In		X	TN17, TN18	X		X?						
HT_7	Out		X	TN17, TN18	X	X		X					
HT_8	Out		X		X								
HT_9	Out		X		X		X?		X				
I35_10a	Out		x		x	x		x					
I35_11	Out	PS, FPB	X		X	X		X					
I35_12a	In		X				X						
I35_12b	In		X				X		X?				
I35_12c	Out	PS, FPB	X		X	X		X					
I35_1a	Out		X		X	X		X					
I35_1b	Out		X		X	X		X					
I35_2a	In		X				X						
I35_2b	In		X				X						
I35_3	In	PS, FPB	X		X	X		X					
I35_4a	Out		X										
I35_4b	In		X										
I35_5a	Out		X										
I35_5b	Out		X				X						
I35_5c	In		X		X								
I35_6a	Out		X										
I35_6b	In		X				X						
I35_6c	Out	PS, FPB	X	TN16	X	X		X					
I35_7a	In	PS, FPB, ILT	X		X			X					
I35_7f	Out	PS, FPB, ILT	X		X	X		X					
I35_7g	In		X				X						
I35_7h	In		X				X						
I35_8_a	Out												
I35_8_a	Out		X			X							
I35_8_d1	Out		X				X						

I35_8_d2	Out		X				X					
I35_8_d3	Out		X				X					
I35_9a	Out		X						XX?			
I35_9b	In		X				X		X?			
I40_1a	In		X	X			X					
I40_1b	In	PS, FPB	X	TN24	X	X		X			X	
I40_2a	Out	PS, FPB	X	X	X	X		X			X	X
I40_2b	Out	PS, FPB	X	TN24	X	X		X			X	X
I40_3	In		X				X					
I40_4	In	PS, FPB	X		X	X		X			X	X
I40_5	In	PS, FPB	X		X	X		X			X	X
I40_6	In		X				X					
I40_7	In		X				X					
I40_7b	In		X				X		X			
LW_1	In		X		X						X		X
M_1	In		X		X		X				X	
M_10	Out											
M_11	In		X	TN22	X					X		
M_12	Out											
M_13	Out		X	TN22	X		X			X		
M_14	In	PS, FPB	X	TN23	X	X		X				
M_15	Out											
M_2	In										X	
M_3	Out	PS, FPB, ILT	X	TN21?	X							
M_4	Out											
M_5	In		X		X	X	X			X		
M_6	In		X		X	X	X			X		
M_7	Out		X		X		X			X		
M_8	Out											
RCP_1	In		X		X		X					
RCP_2	In	PS, FPB	X	TN19?	X	X	X	X	X	X	X	X
RCP_3	Out		X		X		X					
RCP_4	In		X		X		X					
RL_1	Out	PS, FPB	X	TN24, AR 12		X		X			X	X
RL_2	Out	PS, FPB	X	TN24		X		X			X	X
RL_3	In	PS, FPB	X	TN24		X		X			X	X
RL_4	In		X		X		X					
RL_5	Out	PS, FPB	X		X	X		X			X	X
RL_6	In	PS, FPB	X		X	X		X			X	X

RL_7	In	**PS, FPB**	**X**		**X**	**X**		**X**		
S_1	In	**PS, FPB**	**X**	**TN16**	**X**	**X**		**X**		
S_2	Out	**PS, FPB**	**X**	**TN16**	**X**	**X**		**X**		
S_3	Out	**PS, FPB**	**X**	**TN1**	**X**	**X**		**X**		
S_4	In	**PS, FPB**	**X**	**TN16**	**X**	**X**		**X**		
S_6	In	**PS, FPB**	**X**	**TN1**	**X**	**X**		**X**		
S_7	In	**PS, FPB**	**X**	**TN1**	**X**	**X**		**X**		
S_8	In		**X**		**X**		**X**			**X**
S_9	Out		**X**		**X**		**X**			**X**
ESA Federal	**SWAP TN/AR**	**RAGR**	**TDEC Exc H20**	**AG HSI**	**LMVJV Bird**	**LMR ACCSF**	**RVRCNE**	**DU**	**LMR EcnPro**	**Rvrga**

ESA Federal = Supports recommendations in the ESA Section 7a1 Conservation Plan for the LMR for interior least tern (ILT), pallid mussel (FPM)

SWAP TN/AR = Promotes species of conservation concern in TN and/or AR State Wildlife Action Plans

RAGR = Supports activities recommended in the Lower Mississippi River Conservation Committee's (LMRCC) Restoring America's

TDEC Exc H2O = Restoration measures benefitting waters in the Tennessee Department of Environment and Conservation's (TDE

AG HSI = Promotes potential spawning areas for Alligator Gar, a species of conservation concern and identified native predator for

LMVJV Bird = Promotes lands identified in Lower Mississippi Valley Joint Venture's (LMVJV) Forest Breeding Bird Priority areas

LMR ACCSF = Promotes strategies identified in the LMR Invasive Carp Control Strategy Framework (Rodgers 2019).

RVRCNE = Promotes restoration of native river cane communities, a goal shared by Native American communities and other conse

DU = Promotes restoration in lands identified in Ducks Unlimited's (DU) Land Protection Model for waterfowl.

LMR EcnPro = Further secures valuable economic sectors connected with healthy ecological conditions in the LMR, like Outrdoor r harvesting, tourism, and water supply.

Rvrgator = Promotes more opportunity to interact with flora and fauna of the river floodplain, as identified by Rivergator, an organiza kayakers and others ventures in the LMR.

Wolf rvr conserv = Promotes restoration and education goals of the Wolf River Conservancy, a conservation NGO active in the stu

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