

COVER SHEET

Title: Final Supplement II (SEIS II) to the Final Environmental Impact Statement, Mississippi River and Tributaries (MR&T) Project, Mississippi River Mainline Levees and Channel Improvement of 1976 (1976 EIS), as updated and supplemented by Supplement No. 1, Mississippi River and Tributaries Project, Mississippi River Mainline Levee Enlargement and Seepage Control of 1998 (1998 SEIS)

Abstract: The responsible lead agency is the U.S. Army Corps of Engineers (USACE). The SEIS II is a joint effort of the USACE Memphis, Vicksburg, and New Orleans Districts. Cooperating agencies include the U.S. Fish and Wildlife Service, the U.S. Environmental Protection Agency, and the Osage Nation.

The MR&T Project, authorized by the Flood Control Act of 1928, as amended, is designed to reduce flood risk in the Mississippi River alluvial valley between Cape Girardeau, Missouri and the Head of Passes, Louisiana. The scope of this SEIS2 is limited to updating the environmental analysis of the remaining authorized work on the MRL feature of the MR&T project. Through evaluation of information and data obtained from levee inspections, seepage analyses, research, studies, and engineering assessments, the USACE Districts have collectively identified a total of 143 additional Work Items along various reaches of the MRL feature of the MR&T project that are in need of remedial measures necessary to control seepage and/or raise and stabilize deficient sections of the existing levees and floodwalls to protect the structural integrity and stability of the MRL system. The 143 Work Items constitute the proposed action for this SEIS II and are located across portions of seven states: Illinois, Missouri, Kentucky, Tennessee, Arkansas, Mississippi, and Louisiana. This document is intended to supplement and, as necessary, augment the 1976 EIS and 1998 SEIS using the primary MR&T goals of: (1) providing flood protection from the project design flood (PDF); and (2) developing an environmentally sustainable project.

If you would like further information on this statement, please refer to the Project website at: <http://www.mvk.usace.army.mil/MRLSEIS/>, or contact:

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MISSISSIPPI RIVER AND TRIBUTARIES PROJECT
MISSISSIPPI RIVER MAINLINE LEVEES

FINAL SUPPLEMENT II TO THE FINAL
ENVIRONMENTAL IMPACT STATEMENT

November 2020

MEMPHIS DISTRICT
MEMPHIS, TENNESSEE

VICKSBURG DISTRICT
VICKSBURG, MISSISSIPPI

NEW ORLEANS DISTRICT
NEW ORLEANS, LOUISIANA

SUMMARY

S1. Introduction

This final Supplement II (SEIS II) to the Final Environmental Impact Statement, Mississippi River and Tributaries (MR&T) Project, Mississippi River Mainline Levees and Channel Improvement of 1976 (1976 EIS), as updated and supplemented by Supplement No. 1, Mississippi River and Tributaries Project, Mississippi River Mainline Levee Enlargement and Seepage Control of 1998 (1998 SEIS), was prepared to address construction of remaining authorized work on the Mississippi River mainline levees (MRL) feature. The final SEIS II is a joint effort of the USACE Memphis, Vicksburg, and New Orleans Districts.

The Mississippi River and Tributaries (MR&T) Project, authorized by the Flood Control Act of 1928, as amended, is designed to reduce flood risk in the Mississippi River alluvial valley (MAV) between Cape Girardeau, Missouri and the Head of Passes, Louisiana from the project design flood (PDF), which is defined as the greatest flood having a reasonable probability of occurrence. The goal of the MR&T Project is to provide an environmentally sustainable project for comprehensive flood damage control, protection, and risk reduction from the PDF, in the alluvial valley beginning at Cape Girardeau, Missouri to the Head of Passes, Louisiana, by means of levees, floodwalls, floodways, reservoirs, banks stabilization and channel improvements in and along the Mississippi River and its tributaries. The MR&T Project includes an extensive levee system; floodways to divert excess flows past critical reaches; channel improvement and stabilization features to protect the integrity of flood risk management measures and to ensure proper alignment and depth of the navigation channel; and a system of reservoirs to regulate flows and backwater areas to provide storage during extreme events. The purpose and need of this project is to address specific areas of the MRL feature (levees and floodwalls) of the MR&T project that are deficient to ensure that the MRL system provides protection up to the congressionally-authorized level of the PDF in order to ensure reliability and resiliency of the system. The Refined 1973 MR&T Project Flood Flowline is the basis for the design of the levee system under construction. Through evaluation of information and data obtained from levee inspections, seepage analyses, research, studies, data collected from recent high water events, and other engineering assessments conducted since the 1998 SEIS, the USACE Districts have collectively identified a total of 143 additional Work Items along the MRL system that were not identified in the 1998 SEIS and require the construction of remedial measures necessary to control seepage and/or raise and stabilize deficient sections of the existing levees and floodwalls. The MRL feature of the MR&T Project has been an ongoing Civil Works project since its authorization in the Flood Control Act of 1928. SEIS II is not being prepared in conjunction with a feasibility study since the Work Items have already been authorized as an integral part of the MR&T Project, nor does it reexamine other areas, features, or major structures, components, spillways, or floodways of the MR&T Project, including the overall system design or authorized level of protection. Future examinations or alterations of other components of the MR&T Project would not be precluded by the proposed action.

The proposed 143 Work Items are summarized into the following categories: levee enlargements, floodwall deficiencies, slope flattenings, seepage berms, and relief wells. Some Work Items contain multiple deficiencies (e.g., grade deficiency and seepage issues) in need of being addressed.

- Levee enlargements are conducted in locations where the existing levee is not at the authorized grade. Depending on the location of the project, these raises may occur on the landside, riverside, or straddle the existing levee section. There are 101 Work Items containing grade deficiencies averaging approximately 2 feet in height.
- Floodwalls, typically located in urban settings, have stability concerns or height deficiencies that need to be addressed. There are 22 Work Items addressing floodwalls with grade deficiencies or in need of stabilization.
- Flattening the slopes of the levee can reduce the chances of levee slides along those reaches of the MRL that are experiencing recurring slides and in need of repairs beyond ordinary operation and maintenance. There are 7 Work Items in need of slope flattening.
- Seepage berms are constructed on the landside of the levee using impervious soils to reinforce existing top stratum and to reduce underseepage pressure near the toe of the levee. Upon construction, berms are turfed and mowed to prevent erosion or encroachment of undesired vegetation. There are 14 Work Items in need of seepage berms.
- Relief wells are vertically installed wells consisting of a well screen surrounded by a filter material designed to prevent in-wash of foundation materials into the well. Relief wells intercept underseepage and provide a controlled outlet for the water while minimizing material transport underneath the levee. There are 12 Work Items that are in need of relief wells.

S2. Major Conclusions and Findings

Several alternatives were suggested during scoping and considered for SEIS II to address the deficiencies, with suggestions ranging from using similar procedures outlined in the 1998 SEIS to most expeditiously make the required repairs to setting back the levees. A majority of the Work Items require the use of earthen borrow material for construction. Location of these proposed borrow areas was a common theme identified during scoping. Thus, the SEIS II also evaluates alternative methods of selecting borrow sources. Several alternatives regarding location of borrow areas were suggested during scoping, ranging from prioritizing batture lands riverside of the levee to complete avoidance of all wetlands. Some alternatives were eliminated from further analysis while others were carried forward. Reasons for non-selection include an inability to meet the purpose and need, technical and economic factors, and other factors as described. Ultimately, three alternatives were carried forward for detailed analysis, including the required no action alternative. These are:

Alternative 1: No Action

Alternative 2: Traditional Construction

This alternative would implement the proposed improvements and modifications using the most cost efficient means available. The 143 Work Items would be constructed to the design grade as determined by the Refined 1973 Project Design Flowline. Reaches of the MRL with seepage concerns would be addressed with berms or relief wells to lower risks of levee failure. Reaches of levee with stability concerns due to persistent levee slides would be addressed by flattening of the side slopes of the levee. Reaches of floodwalls with stability concerns would be replaced or repaired to lower risks of failure. Most often, borrow areas for levee repairs would be located

along the riverside toe of the levee adjacent to the proposed construction locations. Impacts to wetlands and wildlife habitat would be greatest under this alternative, as this plan emphasizes engineering feasibility. Traditional mitigation measures to compensate for losses would be included as required by law and policy. No provisions would be made for drainage, reforestation, or other environmental enhancement features for the borrow areas.

Alternative 3: Avoid and Minimize

The primary difference between Alternative 2 and Alternative 3 is the method of selecting the borrow source for each Work Item and whether the selection of borrow sites is made with an intent to avoid and minimize adverse environmental impacts. Unlike Alternative 2, this alternative establishes a method for identifying and ranking potential borrow sources in terms of land use and locations that best avoid and minimize adverse environmental effects from the excavation and placement of borrow material, based off of the comments received during scoping. Environmentally sensitive areas, forested areas of bottomland hardwoods (BLH), and wetlands are critical areas to be avoided whenever practicable and possible. A prioritization criteria for those lands traditionally used as borrow sources for the MRL were ranked in order from most preferable to least preferable, in terms of borrow source locations that have the greatest ability to avoid and minimize environmental impacts. Another common theme identified during scoping was the importance of allowing local landowners who provide their land for construction to have input into the design of borrow areas. Additional environmental features (e.g., irregular shorelines, islands, variable depths, reforestation, etc.) that could be incorporated into borrow area designs to increase habitat and property value would be explored with willing landowners and non-Federal sponsors during project design. These opportunities would be explored during future phases of project design; however, it was not assumed that these features would be incorporated into all borrow areas. Furthermore, there would be no site protection instrument to ensure the long-term protection or management of these features. As such, these environmental benefits were not assumed to offset any impacts in calculations of compensatory mitigation, but they would provide noteworthy ecological benefits when implemented.

Compensatory mitigation is proposed for unavoidable project-induced adverse impacts. Mitigation requirements were calculated using the same ecological models that were used to quantify project impacts. Ecological models were selected to address the significant environmental resources determined through scoping and interagency coordination, specifically, waterfowl, wetlands, terrestrial habitat/wildlife, and aquatics. These ecological models were all certified or approved by the USACE National Ecosystem Restoration Planning Center of Expertise and used within their applicable ranges, in accordance with Engineer Circular EC 1105-2-412. Application of the models was also reviewed by the interagency team throughout the development of the SEIS. The proposed compensatory mitigation plan includes active reforestation within three hydrologic zones: Mitigation Zone 1) in the batture area (i.e., lands between the river and the levee); Mitigation Zone 2) frequently flooded areas, or those with a hydrologic connection to the Mississippi River landside of the MRL; and Mitigation Zone 3) low lying flooded areas landside of the MRL whose hydrologic conditions are dictated by precipitation and landscape position. Restoring wetland vegetation within these three zones would mitigate 100 percent of the wetland losses and greater than 100 percent of the waterfowl and terrestrial habitat/wildlife losses. The project results in benefits to aquatic resources; thus, compensatory mitigation was not required.

Alternative Evaluation

With Alternative 1 (No Action), the threat of catastrophic flooding and associated economic damages and impacts to the human environment from the PDF would remain. By relocating borrow areas to less environmentally sensitive areas, Alternative 3 would reduce impacts to BLH wetlands, waterfowl, and wildlife, resulting in 329 fewer mitigation acres compared to Alternative 2 (Table S-1). However, avoiding and minimizing impacts to BLH and wetlands would result in a tradeoff of increased lost acreage of agricultural lands (including approximately 223 more acres of prime farmland) when compared to Alternative 2. Alternative 3 (avoid and minimize) was determined to be the preferred alternative. The preferred alternative has a first cost of \$2.08 billion.

Table S-1. Summary of significant impacts and required compensatory mitigation from quantitative assessments of Alternatives 2 and 3 by USACE District.

District	Impacts with Alternative 2 (Traditional Construction)					Impacts with Alternative 3 (Avoid and Minimize)				
	Wtlnl FCU/ HSU ¹	Wtrfwl DUD ²	Terrest. Wildlife AAHU ³	Aquatic HU ⁴	Req. Comp. Mit. (acres)	Wtlnl FCU/ HSU ¹	Wtrfwl (DUD) ²	Terrest. Wildlife AAHU ³	Aquatic HU ⁴	Req. Comp. Mit. (acres)
MVM	-37,338	-141,330	-1643	295	795	-23,924	-99,029	-540.3	379	673
MVK	-24,141	-550,069	-1108	367	724	-20,386	-545,676	-867.9	347	614
MVN	-8,055	-92,411	-325	174	257	-4,983	-18,246	-197.8	140	160
TOTAL	-69,534	-783,810	-3,076	835	1,776	-49,293	-662,951	-1,606	866	1,447
Acres ⁷ lost (-) or gained	Forested/ Marsh ⁵ -1343	-639	-1,426	1403	1,776	Forested/ Marsh ⁵ -1013	-523	-789	1,403	1,447
	Farmed ⁶ -1949					Farmed ⁶ -1646				

¹ Functional Capacity Units calculated from Hydrogeomorphic Manual (HGM) and Habitat Suitability Units from Wetland Value Assessment (WVA) analyses.

² Duck-Use-Days (DUD) calculated from waterfowl analyses. DUD is not comparable to other units of measure (FCU, HU, etc.).

³ Average Annual Habitat Units calculated using Habitat Evaluation Procedures (HEP) analyses on wildlife.

⁴ Habitat Units calculated from Borrow Area Habitat Suitability Index Fish Diversity Model (aquatic HUs were gains due to addition of open water associated with borrow areas).

⁵ Forested wetland impacts include areas mapped as forested, tree plantations, scrub/shrub wetlands, sandbars, and non-forested wetlands assuming that they could convert into forest over time. All of these lands were assumed to be wetlands for the wetland assessment. Because forested wetlands receive the highest scores within the assessment approach, this represents the most conservative possible tactic for evaluating impacts to wetland resources. This also includes 5 acres of brackish marsh impacted by Alternative 3.

⁶ All agricultural cropland, pasture, and bare soil cover types were assumed to be farmed wetlands for the wetland assessment; however, these areas provide limited wetland functions or habitat suitability.

⁷ Acres are shown as a point of reference. Compensatory mitigation is calculated based off of the functional resource assessments. Each resource assessment and their corresponding Appendix should be referred to for details on the methods and associated assumptions used for calculating impacts and acreages relevant to that particular resource.

S3. Areas of Unresolved Controversy

Some controversy exists over the scope of the SEIS and whether additional MR&T features or components should be analyzed, such as, re-assessing the congressionally mandated distribution of flows between the Mississippi and Atchafalaya Rivers at the Old River Control Complex, the potential to remove or modify channel improvements along the Mississippi River as it relates to the MRL integrity, and the potential for new floodways, levee removals, and/or other passive, non-structural, or nature-based measures. The SEIS II was initiated to address deficiencies specific to the MRL that were not evaluated in the 1976 EIS or the 1998 SEIS. Currently, environmental documentation is developed separately for each component of the MR&T Project. SEIS II is not being prepared in conjunction with a feasibility study since the Work Items have already been authorized as an integral part of the MR&T Project. While the SEIS II does not reexamine other areas of the MR&T Project, including the overall system design or authorized level of protection, future examinations or alterations of other components of the MR&T Project would not be precluded by the proposed action for SEIS II. Additionally, while some non-structural and nature-based alternatives were considered during development of the SEIS II, they were screened out due to factors such as excessive costs, not accomplishing the congressionally mandated project purpose to provide a prescribed level of flood protection, and not meeting the purpose and need identified in the SEIS II.

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1.0 PURPOSE AND NEED FOR PROPOSED ACTION

The Mississippi River and Tributaries (MR&T) Project, authorized by the Flood Control Act of 1928, as amended, is designed to reduce flood risk in the Mississippi River alluvial valley (MAV) between Cape Girardeau, Missouri and the Head of Passes, Louisiana from the project design flood (PDF), which is defined as the greatest flood having a reasonable probability of occurrence. The goal of the MR&T Project is to provide an environmentally sustainable project for comprehensive flood damage control, protection, and risk reduction from the PDF, in the alluvial valley beginning at Cape Girardeau, Missouri to the Head of Passes, Louisiana, by means of levees, floodwalls, floodways, reservoirs, banks stabilization and channel improvements in and along the Mississippi River and its tributaries. The MR&T Project includes an extensive levee system; floodways to divert excess flows past critical reaches; channel improvement and stabilization features to protect the integrity of flood risk management measures and to ensure proper alignment and depth of the navigation channel; and a system of reservoirs to regulate flows and backwater areas to provide storage during extreme events. The integrity of the levee system is also bolstered by control measures, such as landside berms, drainage trenches, drainage blankets, relief wells, and tributary basin improvements including levees, headwater reservoirs, and pumping stations that expand flood risk management coverage and improve drainage into adjacent areas within the MAV. The Mississippi River Levee (MRL) feature (levees and floodwalls) extends for nearly 1,610 miles along the Mississippi River beginning at the head of the alluvial valley near Cape Girardeau, Missouri and continues to approximately 10 miles above Head of Passes near the Gulf of Mexico and is considered the backbone of the MR&T flood risk management system. It assists in protecting the 36,000 square-mile MAV from periodic overflows of the Mississippi River. This alluvial valley ranges in width from approximately 40 to 110 miles and extends through parts of seven states: Missouri, Illinois, Kentucky, Tennessee, Arkansas, Mississippi, and Louisiana.

There is a need to design, build, maintain, operate, and repair the mainline MRL to ensure that the MRL system provides protection up to the congressionally-authorized level of the PDF. A catastrophic failure of the MRL, at any point, would likely cause grievous loss of life and personal injury, extensive damage to property and natural resources, serious harm to river navigation, and significant and long-lasting economic and social upheaval. One of the greatest threats to a levee or floodwall is overtopping during high water events. Once a levee or floodwall overtops, the flow of water over the top would erode the protected side of the structure, often creating a full breach. Every section of levee or floodwall raised to the congressionally authorized height along the entire Mississippi River helps strengthen the system and reduce the areas subject to overtopping that would need supplemental flood fighting measures during floods (typically done by using sand bags or other temporary water retarding methods).

Seepage problems in a levee can lead to piping, which occurs when sediment from under the levee is carried away through sand boils, resulting in internal erosion. When enough sediment is transported from under the base of the levee, the levee would collapse. A breach of the levee could inundate hundreds of thousands of acres of land, thousands of structures, and displace or result in catastrophic consequences to humans and a variety of flora and fauna. Earthen berms are vital to strengthening the integrity of the levee system because they apply counter pressure to

areas that are experiencing seepage problems or areas likely to exhibit seepage problems during the PDF, and they are designed to minimize the risk of levee failure by reducing or stopping the movement of sediment from underneath the levee. Similarly, relief wells control seepage, but do so by intercepting seep water and providing a controlled outlet while minimizing material transported underneath the levee.

Additionally, another threat to levees are slope stability problems. Soil saturation of levees during prolonged periods of high water can result in slope failures, or levee slides, when flood waters recede. Reaches of levee with persistent levee slides require measures beyond ordinary maintenance repairs. In these locations, flattening the slope of the levee can achieve the necessary factor of safety against sliding, reducing recurring maintenance needs.

1.1 Proposed Action

On July 13, 2018, USACE published its Notice of Intent to prepare Supplement II to the Final Environmental Impact Statement, Mississippi River and Tributaries (MR&T) Project, Mississippi River Mainline Levees and Channel Improvement of 1976 (1976 EIS), as updated and supplemented by Supplement I, Mississippi River and Tributaries Project, Mississippi River Mainline Levee Enlargement and Seepage Control of 1998 (1998 SEIS) to the 1976 EIS. The 1998 SEIS focused on the MRL reaches that were the most deficient in height and on seepage control measures for levee reaches with observable signs of seepage.

Over the past twenty years since the finalization of the 1998 SEIS, USACE has determined that various sections (reaches) of the mainline levee system are deficient in varying amounts, and that certain remedial measures need to be undertaken at these locations to control seepage and to raise and stabilize the levee to protect the MAV against the PDF and maintain the structural integrity of the MRL system. The 2011 flood, which was larger than the 1973 flood, and the subsequent flood events in 2016, 2018 and 2019, indicated several vulnerabilities in the MRL system.

Through evaluation of information and data obtained from levee inspections, seepage analyses, research, studies, and engineering assessments, USACE has concluded that certain levee reaches do not meet the federally-authorized design grade due to effects from various changed conditions, including, but not limited to consolidation of levee materials, subsidence, and changes in river conditions and survey datums over time. Additionally, advances in geotechnical mapping, data collected from recent high water events, and subsequent seepage analyses that have taken place since the finalization of the 1998 SEIS, have revealed the need for additional seepage control measures and the construction of other authorized project features to protect the structural integrity and stability of the MRL system.

Over the past 10 years, the USACE Levee Safety Program has completed risk assessments for all of the MRL levee systems. Risk assessments evaluate the likelihood and consequences of uncertain future events. In this case the "future uncertain event" is a levee breach resulting from an overtopping or performance issue on the MRL. The likelihood of the breach was estimated based upon past performance and available engineering analyses. The consequences of a breach were estimated based on data from the HAZUS database. The results of the risk assessment

include identifying those things that are driving risk and information to help us prioritize action to reduce risk. Generally risk drivers for the MRL include floodwall stability concerns, seepage issues, and overtopping of below grade sections of the MRL.

In 2017, USACE developed and prioritized a comprehensive list of all known deficiencies of the MRL, including both unconstructed Work Items assessed in the 1998 SEIS and remaining deficiencies that had been identified since the 1998 SEIS was published. This effort was based on findings and data from USACE Levee Safety Program risk assessments.

Based on the results of the Levee Safety Program risk assessments and the MRL prioritization effort, USACE has determined that this SEIS II is necessary to formulate alternatives, identify significant resources, assess the direct, indirect, and cumulative impacts to the significant resources, develop mitigation measures, and evaluate and select a preferred alternative to construct these levee segments to the federally-authorized design grade.

The districts have collectively identified a total of 143 additional Work Items located in numerous reaches of the MRL project that were not identified in the 1998 SEIS and require the construction of remedial measures necessary to control seepage and/or raise and stabilize deficient sections of the existing levees and floodwalls. An overview map is shown in Figure 1-1. The 143 Work Items constitute the proposed action for this SEIS II. Maps and descriptions of each Work Item are shown in Appendix 1. Project features, such as levee enlargements; floodwall stabilizations; slope flattenings; berms to control underseepage; and relief wells to control underseepage, would improve sections of deficient MRL and floodwalls to provide the required PDF protection.

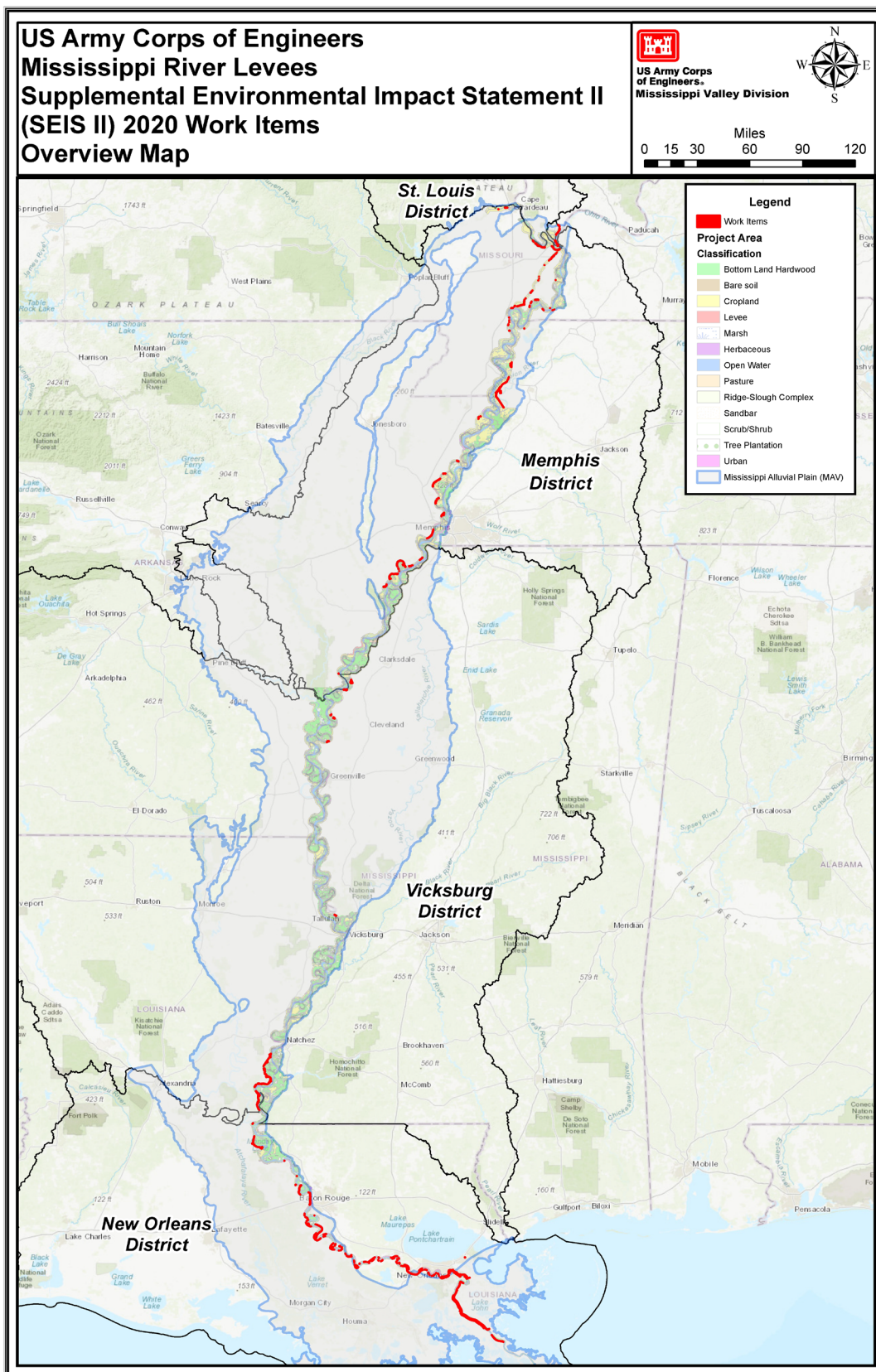


Figure 1-1. Overview Map of the MRL-SEIS-II Project Area.

Levee Enlargements

Levee enlargements are conducted in locations where the existing levee is not at the authorized grade. Depending on the location of the project, these raises may occur on the landside, riverside, or straddle the existing levee section. There are 101 Work Items containing grade deficiencies averaging approximately 2 feet in height. Figure 1-2 shows a typical levee enlargement to address a grade deficiency.

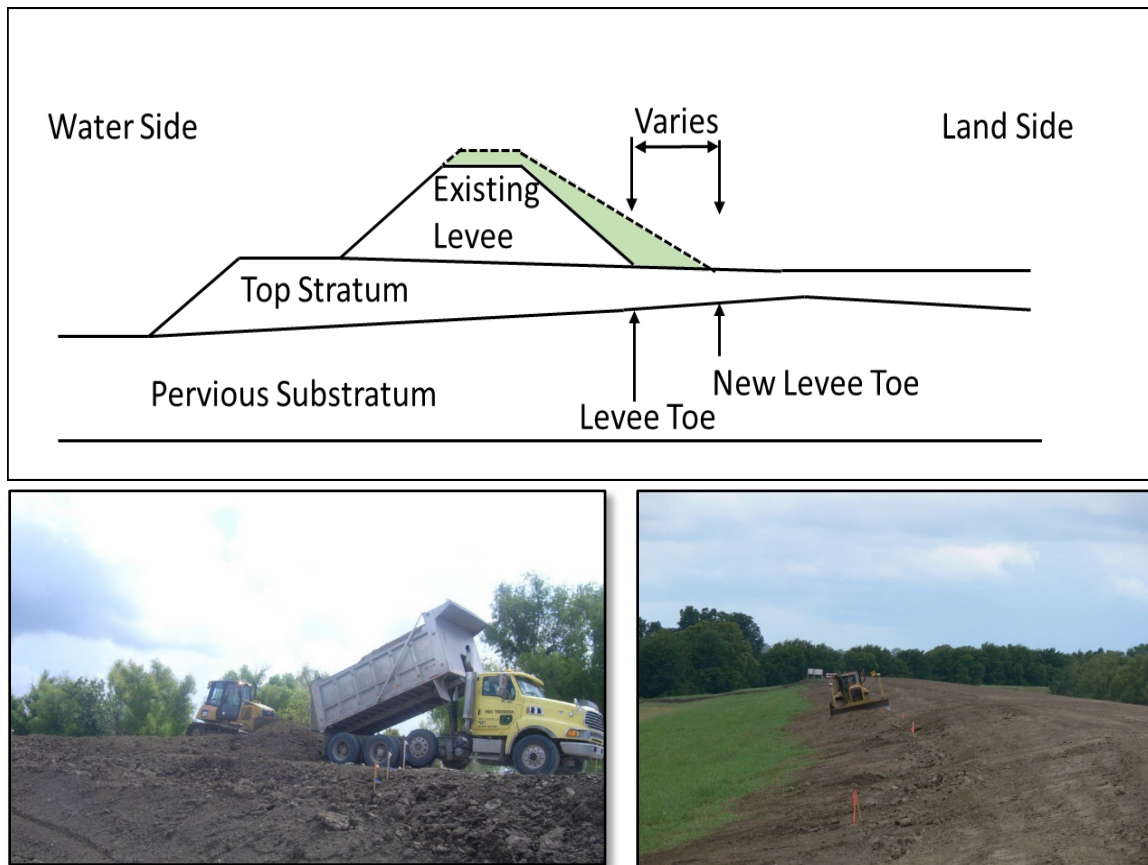


Figure 1-2. Profile and photographs showing levee enlargements along a deficient levee reach.

Floodwall Deficiencies

Due to space constraints, urban areas often require floodwalls rather than levees to reduce impacts to residences and businesses. These floodwalls can have stability concerns or height deficiencies that need to be addressed. There are 22 Work Items requiring floodwalls with grade deficiencies or in need of stabilization. Figure 1-3 shows a typical floodwall and profile addressing deficiencies.

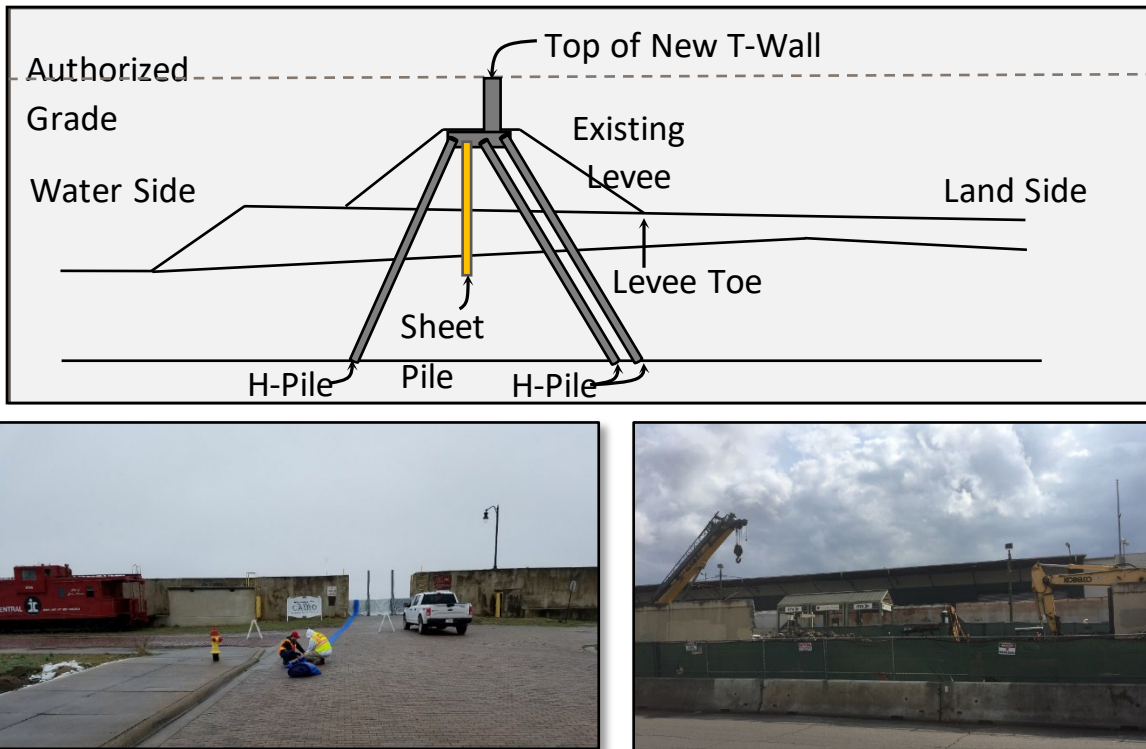


Figure 1-3. Profile and photographs showing a floodwall along a deficient reach of the MRL.

Slope Flattening

Areas with recurring levee slides require measures beyond ordinary operation and maintenance repairs. In these locations, the slopes of the levee would be flattened to reduce the chances of slide recurrence. There are 7 Work Items in need of slope flattening. Figure 1-4 shows levee slides and a levee profile to address by slope flattening.

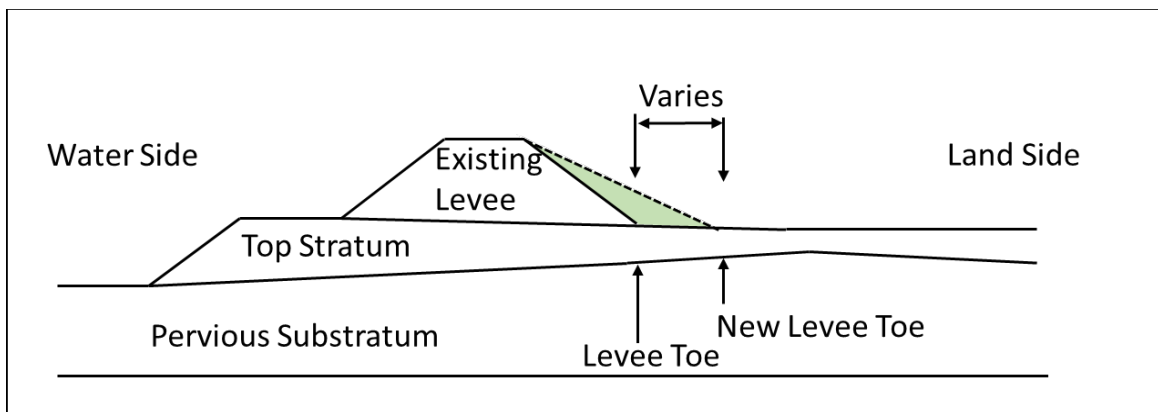




Figure 1-4. Profile and photographs showing levee slides in need of slope flattening.

Seepage Berms

Seepage berms are constructed on the landside of the levee using impervious soils to reinforce existing top stratum and to reduce underseepage gradients near the toe of the levee. Upon construction, berms are turfed and mowed to prevent erosion or encroachment of undesired vegetation. There are 14 Work Items in need of seepage berms. Figure 1-5 shows a typical seepage berm.

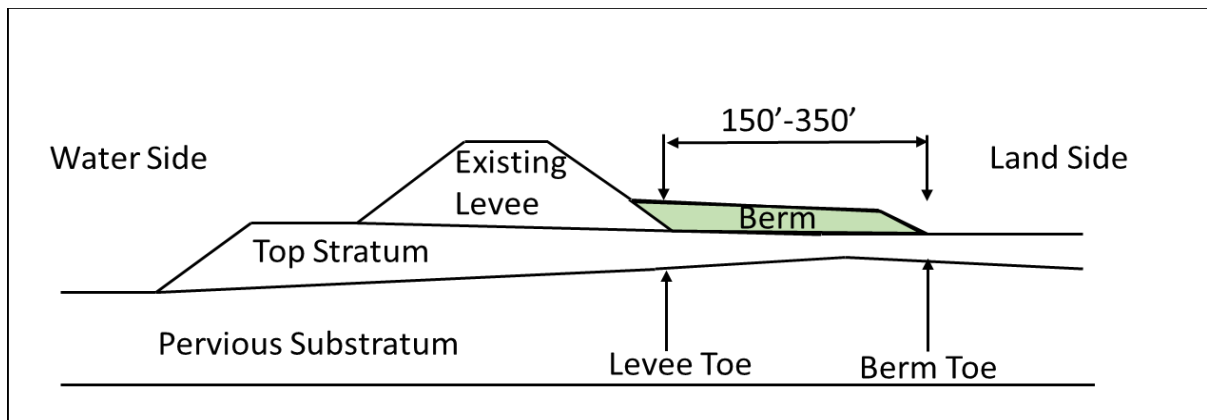


Figure 1-5. Profile and photographs of a typical seepage berm along the MRL.

Relief Wells

Relief wells are vertically installed wells consisting of a well screen surrounded by a filter material designed to prevent in-wash of foundation materials into the well. Relief wells intercept underseepage and provide a controlled outlet for the water while minimizing material transport underneath the levee. There are 12 Work Items that are in need of relief wells. Figure 1-6 shows relief wells along a typical reach of the MRL.

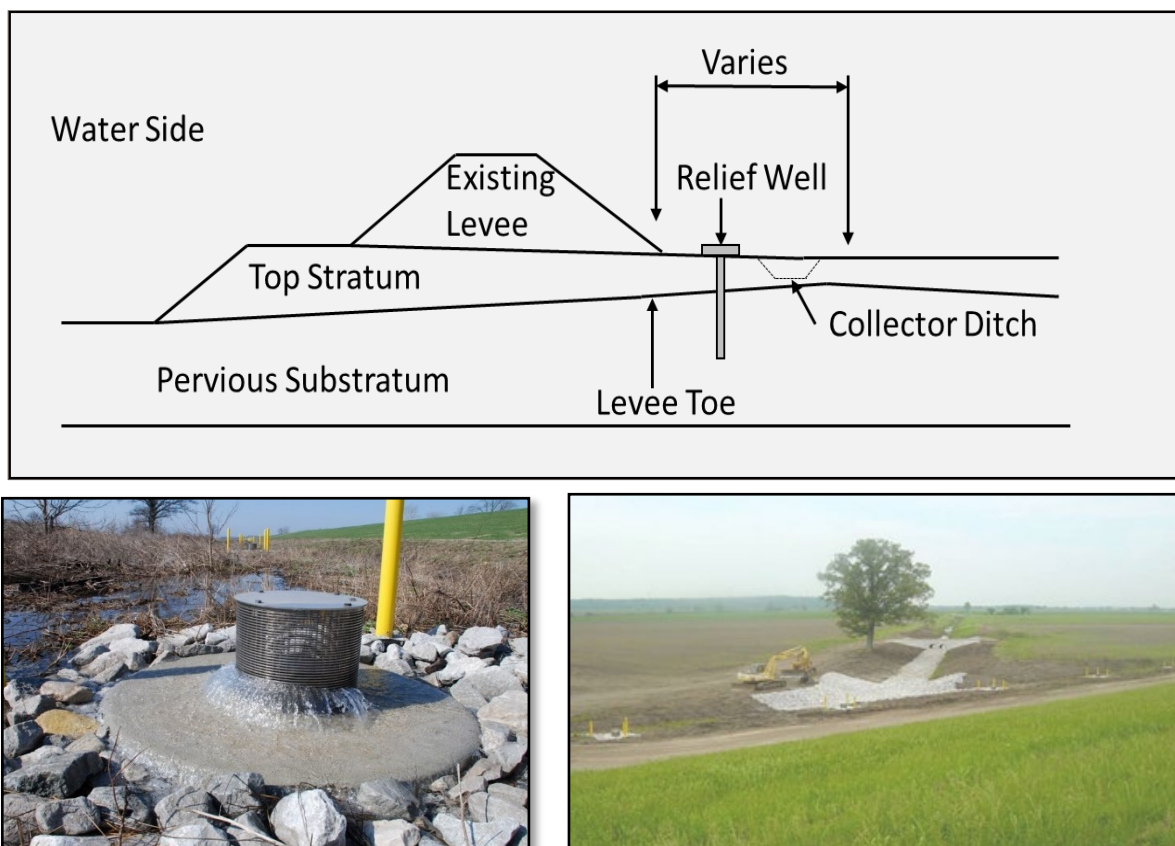


Figure 1-6. Profile and photographs of a typical levee reach containing relief wells and associated drainage ditch collecting the seep water.

Some Work Items contain multiple deficiencies (e.g., grade deficiency and seepage issues) in need of being addressed. Detailed maps and descriptions of each Work Item are shown in Appendix 1.

SEIS II is not being prepared in conjunction with a feasibility study or other kind of project decision document since the Work Items have already been authorized as an integral part of the MR&T Project, nor does it reexamine other areas, features, or major structures, components, spillways, or floodways of the MR&T Project, including the overall system design or authorized level of protection. Additional information on the overall MR&T Project and other features can be found at: <https://www.mvd.usace.army.mil/About/Mississippi-River-Commission-MRC/Mississippi-River-Tributaries-Project-MR-T/>. Future examinations or alterations of other features of the MR&T Project would not be precluded by the proposed action for SEIS II.

Because a majority of the Work Items require the use of earthen borrow material for construction, SEIS II evaluates the No Action Alternative as well as alternative methods of selecting borrow sources, and recommends a selected alternative. Operation of the remaining features and structures of the MR&T Project features remain unchanged, and will therefore not be evaluated in this document.

SEIS II will evaluate the environmental impacts of the construction of the 143 Work Items. The evaluation will include, but is not limited to, the evaluation of a No Action Alternative and alternatives for the selection of borrow sites necessary for the construction of the proposed action. SEIS II will identify significant resources and assess the direct, indirect, and cumulative impacts to those resources; develop mitigation measures, and evaluate and select a preferred methods to implement the Work. The Proposed Action for this SEIS II is to supplement and, as necessary, augment the 1976 EIS and 1998 SEIS using the primary MR&T goals of: (1) providing flood protection from the PDF; and (2) developing an environmentally sustainable project.

As the Nation's principal public engineering enterprise, USACE must accomplish its flood protection and risk reduction mission as resources are authorized and appropriated by Congress. The MRL feature is federally-authorized and has continued to successfully pass major floods, including the floods in 1973, 1997, 2011, 2016, 2018, and 2019. These floods, while significant, do not represent the PDF for most of the MRL system. Currently, it is estimated that 83 percent of the MRL system is constructed to a grade that would withstand the PDF, which is the congressionally authorized design standard for the MRL system. The remaining reaches of the MRL are currently in place, but the existing levee cross section and/or seepage remediation features do not provide the factor of safety required to pass the PDF. Satisfactory performance of these reaches during past flood events does not guarantee that a specific levee reach will perform similarly when loaded to PDF levels. The 143 Work Items represent modifications to the existing levee that would benefit the MR&T Project by bolstering the integrity of the mainline levee system and reducing the chance of levee failure, thus meeting the USACE mission for flood risk reduction on the Mississippi River.

Each of the 143 Work Items described herein is a separate item of work and would be designed and constructed incrementally, subject to funding availability and priority. Upon receipt of Congressional funding, detailed plans and specifications would be prepared for each Work Item. Development of plans and specifications would include the preparation of detailed rights-of-way (ROW) maps, along with identification of the relocations necessary for construction of each item of work. Based on traditional funding allocations, these Work Items would likely begin in 2020 or 2021 and extend for more than 50 years. Since detailed designs are not yet available and the Work Items extend over many years, full environmental compliance for all Work Items is not anticipated with this SEIS II; however, the framework for achieving environmental compliance is outlined.

1.2 MR&T Project Area

The MR&T Project begins at the head of the alluvial valley at Cape Girardeau, MO, and continues to Venice, LA, near the Gulf of Mexico on the right descending bank and to Bohemia, LA on the left descending bank, approximately 10 miles above the Head of Passes near the Gulf of Mexico. The MR&T Project includes 3,787 miles of authorized embankments and floodwalls. Of this number, nearly 2,216 miles are along the main stem Mississippi River. The remaining levees are backwater, tributary and floodway levees. The areas to be examined in SEIS II are work item sites spread throughout the length of the system. The project area includes all lands and waters lying between the mainline MRL (and floodwalls), or bluffs where levees are absent, plus a zone extending 3,000 feet landside of the levees.

The Mississippi River has the third largest drainage basin in the world, exceeded in size only by the watersheds of the Amazon and Congo Rivers. It drains 41 percent of the 48 contiguous states of the United States. The MAV is subject to frequent and severe floods. Major floods on the lower Mississippi River (LMR) may result from flooding on the upper Mississippi River, or the Ohio River, or both, augmented by contributions from other major tributaries of the LMR. The flood season on the Mississippi River occurs on average from the middle of December through July. Major floods on the Ohio River generally occur between the middle of January and the middle of April. Major floods from the upper Mississippi and Missouri Rivers usually occur between the middle of April and the last of July; and, from the Arkansas and White Rivers between the first of April and the end of June.

Since its inception, the MR&T Project has become one of our nation's most comprehensive and successful civil works projects with a 96 to 1 return on investment. The MR&T Project provides flood risk reduction for residential, commercial, and industrial structures with a value totaling in excess of \$458 billion and protects a population of 7.2 million. It also provides safe and efficient navigation to the nation by supporting the transport of 681 million tons of cargo; saving \$5.7 billion in domestic transportation savings. To date, the MR&T Project has saved countless lives and prevented \$1.54 trillion in damages to homes, businesses, and public infrastructure from Illinois to Louisiana.

The levees are the backbone of the MR&T flood control plan. The levee system, constructed of compacted soil and clay, rivals in length the Great Wall of China. The levee system design incorporates technological breakthroughs from the science of soil mechanics that take into account the type, condition and moisture content of material used in construction. The integrity of the system is enhanced by advancements in design, construction, installation and maintenance of seepage control measures, to include landside berms, drainage trenches, and relief wells. To this date, no project levee built to standards has ever failed.

1.3 MR&T Project Authority

Individual levee construction to reduce risks of riverine flooding in the MAV began along the Mississippi River in the 1700's and as settlements developed along the river, more local levees were built. Numerous flood events occurred in 1849, 1850, 1882, 1912, 1913 and 1927, and

therefore, raising and strengthening of the levees continued into the 1920's. The flood of 1927 was the most disastrous in the history of the MAV. This flood resulted in the failure of existing levees and caused extensive flooding of populated and agricultural areas; levees were breached, cities, towns and farms were laid to waste, crops were destroyed and industries and transportation were paralyzed.

Following the devastating flood of the Mississippi River Basin in 1927, Congress authorized the MR&T Project in 1928, which featured a system of levees, floodways, spillways and bank stabilization measures that direct floodwaters through the Mississippi River Valley to the Gulf of Mexico. (See 1928 Flood Control Act, Pub. L. No. 70-391, 45 Stat. 534; 33 U.S.C. §702a.) The MR&T Project was set forth in the Chief of Engineers Report to Congress, House Document 90, 70th Congress, 1st Session (also known as the "Jadwin" report). The MRL feature was authorized by the Flood Control Act of 1928, 33 U.S.C. §§ 702c, as amended.

Mainline levees constitute a major portion of the MR&T Project, and are designed to protect the MAV against the project design flood by confining flow to the channel within the levee system, except where it enters the natural backwater areas or is diverted purposely into floodway areas. MRL, floodwalls, floodgates and other flood risk management measures have been constructed along the Mississippi River by the USACE. Routine operation and the minor maintenance and minor repair of the levees and associated project features is performed by a local non-Federal sponsor, except for USACE assistance provided when necessary during major floods. USACE is responsible for major maintenance and/or repairs and replacement and rehabilitation of project features. Periodic inspections are made by personnel from USACE and the non-Federal sponsors to ensure that the levees and other project features are maintained in good condition to ensure the safe and effective functioning of the project in accordance with the project authorization.

1.4 Project Design Flood

The MR&T Project is congressionally-Authorized to provide comprehensive flood risk reduction from the PDF in the MAV. The Mississippi River mainline levees protect the MAV against the PDF by confining flow to the leveed channel, except where it enters backwater areas, overflows several levees designed to overtop and fill tributary basins, or is intentionally diverted into floodway areas.

The hypothetical PDF establishes the design criteria for the MRL system. The PDF is defined as the greatest flood having a reasonable probability of occurrence. The original PDF was developed by analyzing several combinations of storm patterns over the Mississippi River drainage to determine the design flood to be used in designing the MR&T Project in the LMR Basin. A 1956 PDF was developed between 1954 and 1955, by incorporating previously unavailable data regarding the sequence, severity, and distribution of past major storms and investigated 35 different hypothetical combinations of actual storms that produced significant amounts of precipitation and runoff. The 1956 project design flowline used the flows from the 58A-EN-PDF and the Mississippi River channel and overbank hydraulic data based on the 1945 and 1950 flood conditions. The historical storms were arranged sequentially to mimic frontal movements and atmospheric situations consistent with those occurring naturally to determine the most feasible pattern capable of producing the greatest amount of runoff on the LMR. This included

the consideration of storm transpositions, storm intensity adjustments, seasonal variations, and storm mechanics. In simpler terms, the project design storm series was developed from various combinations of actual storms and resultant floods (hypo-floods) that had a reasonable probability of occurring from a meteorological standpoint. Details on the establishment of the 1956 flowline are contained in Appendix 6 of the 1998 SEIS (USACE 1998).

The major flood event of 1973 resulted in reevaluation of the flowline elevations. Following the flood event, a study was undertaken to adjust the 1956 flowline using hydrologic data collected during the flood to account for higher stages for given discharges. The resulting adjusted 1973 Project Design Flowline was then used to raise the most deficient problem areas. Subsequently, detailed hydrographic and overbank surveys were made to accurately define the geometric properties of the leveed channel and overbank area. The 1974 high water and 1975 flood produced additional hydrologic data of value in the analyses. Further study, using the design flows determined in 1956 that were ascertained to be applicable to current river conditions, included the use of a numerical model, a physical model and other related studies. The water surface data obtained from the numerical model was supplemented with data from the physical model. The other studies included a detailed analysis of the magnitude of the “loop” effect that could be expected for flows of the magnitude of the project flood and an analysis of the magnitude of the additional loss of channel efficiency (future deterioration) that could be expected due to sedimentation. A “loop” effect is where there are several different stages for a given discharge during a flood. The lower stage value is associated with the rising limb of the discharge hydrograph and the higher value occurs after the initial rise in discharge. The “loop” effect and future deterioration were added to water surface elevations obtained from the numerical and physical models. The resulting flowline is the Refined 1973 MR&T Project Flood Flowline. This flowline is the basis for the design of the levee system under construction. The Vicksburg District (MVK) Refined 1973 Project Design Flood Flowline and existing levee grades are shown in Appendix 4 of the 1998 SEIS (USACE 1998).

The 1993 and 1995 floods revealed significant upward changes in stage-discharge relationships on the upper Mississippi River. The higher than expected water surface elevations experienced during the flood of 1995 on the reach of the Mississippi River above Cairo, Illinois, indicated that significant changes in the floodplain have occurred from the conditions used to develop the 1956 PDF. Therefore, the MR&T Project design flowline from Cairo to Cape Girardeau was revised in 1996. The 1973 refined flowline referenced throughout this document incorporates this revision. The revision was based on available data and analyses of river hydraulic and hydrologic parameters. Two private levees (Powers Island levee and the Miller City levee) located in the Upper Mississippi River Commerce to Birds-Point reach are factors in the changed floodplain conditions. Earlier, these private levees tended to fail during floods, permitting partial conveyance of flow through the floodplain. In later years these levees demonstrated greater resistance to failure, resulting in higher than expected stages against the project levee. Table 1.1 presents PDF flowline elevations for selected locations along the Mississippi River through time.

Table 1-1. PDF flowlines through time for select locations.

Location	1956 Flowline Elevations Ft (NGVD)	1973 Refined Flowline Elevations Ft (NGVD)	1996 Flowline Elevation Ft (NGVD)
Commerce	344.6	--	345.3
Cairo	333.2	333.0	333.0
New Madrid	307.2	307.9	--
Memphis	236.5	237.8	--
Helena	204.3	204.2	--
Arkansas City (Old Location)	154.1	157.7	--
Vicksburg (Bridge)	104.4	109.2	--
Natchez	80.0	85.3	--
Red River Landing	61.0	64.8	--
Baton Rouge	45.3	46.1	--
Carrolton Gage	19.8	19.8	--
Fort Jackson	7.5	9.2	--

With the revision in flowline elevations, there have been concurrent revisions to the project design levee grades. The project levee grade is the top elevation of the levee, which is higher than the project flowline due to freeboard. Design freeboard is the vertical [design] height of a levee above the estimated flowline of the PDF. The actual height of an existing levee above the maximum flowline of the PDF is the available freeboard. Table 1-2 presents changes in design levee grades over time for selected locations along the Mississippi River.

Table 1-2. Design levee grades through time.

LOCATION	Elevation (Feet, NGVD)							
	1861	1899	1914	1928	1941	1956	1973	1996
Commerce	--	--	--	--	--	347.6	--	348.3
Cairo	--	--	--	--	--	335.2	335.0	335.0
New Madrid	--	--	--	--	--	310.2	310.9	--
Memphis	--	--	--	--	--	239.5	240.8	--
Helena	--	--	--	--	--	207.3		--
Arkansas City (Old Location)	--	155.0	157.2	160.2	159.6	158.8	162.5	--
Vicksburg (Bridge)	--	--	--	--	107.0	107.4	112.2	--
Natchez	--	--	--	--	84.1	83.0	88.3	--
Red River Landing	54.3	57.1	61.1	64.1	64.1	64.0	68.8	--
Baton Rouge	--	--	--	--	--	48.3	49.1	--
Carrolton Gage	--	--	--	--	--	25.5	25.4	--

Fort Jackson	--	--	--	--	11.5	13.2	--	--
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As a result of the 2011 Greater Mississippi River Basin Flood, the 2011 MR&T Post Flood Report (USACE 2012a) highlighted the need to conduct a flowline assessment for the MR&T system. This assessment was to include data from the 2011 flood event and any physical, hydrologic, or hydraulic changes that had occurred in the river system to determine if a change in flowline or water control plans was warranted. The USACE, Mississippi Valley Division (MVD) Commander at that time, MG John Peabody, also emphasized the need for an objective re-assessment of the flowline and meteorological conditions associated with the 1955 “hypo flood.” The “hypo flood” was one of the different hypothetical combinations of actual storms that produced significant amounts of precipitation and runoff conducted by the Mississippi River Commission and the Weather Bureau. Based upon this guidance, the flowline assessment (USACE 2018a,b,c,d,e) was initiated in 2014 to address the issues outlined in the Post Flood Report along the main stem and to assess the refined 1973 flowline.

Several key findings from the assessment (USACE 2018a) are relevant to this report. One key finding is that the meteorological conditions associated with the 1955 hypo flood still characterize the storm event that generates and defines the PDF. Furthermore, any potential changes in the future to the flowline do not change the risk-informed schedule for remaining work required for project completion. Therefore, a key conclusion from the assessment is that the activities to complete the authorized remaining work should continue as presently scheduled and as expeditiously as project funding allows.

The assessment (USACE 2018a) also evaluated climate change and sea level rise (SLR). In terms of climate change, after conducting a regional literature review and evaluating the currently available data for the Mississippi River basin, the assessment found that “the meteorological and hydrological underpinnings of the MR&T PDF are found to be adequate” (USACE 2018a). The assessment evaluated the sensitivity to SLR through the simulation of the “high” SLR scenario following the guidance of ER 1100-2-8162. The assessment demonstrated that the maximum expected influence of SLR under the “high” scenario would range from 0.1 feet at Baton Rouge to 1.1 feet at Venice. Additional information associated with SLR can be found in the results of the assessment (USACE 2018a).

1.5 Public Concerns and Scoping

The scoping process consisted of publishing the NOI in the Federal Register, conducting public scoping meetings, and numerous interagency communications throughout the development of the EIS.

A NOI to prepare an EIS was published in the Federal Register on July 13, 2018, (Federal Register Volume 83, Number 135, pages 32642 – 32644) inviting full public participation in the scoping phase. An additional NOI was published in the Federal Register on August 29, 2018, (Federal Register Volume 83, Number 168, page 44035) announcing the meeting dates, times, and locations of four public scoping meetings and extending the public scoping comment period. A copy of the NOIs can be found in Appendix 21.

In addition to the NOI in the Federal Register, notification of the public scoping meetings was distributed through news releases, email and hard copy mailing lists, and the project website. Four public scoping meetings were held from September 10-13, 2018, at the following locations:

- September 10, 2018, 7:00 – 9:00 pm: Holiday Inn Blytheville, 1121 East Main Street, Blytheville, Arkansas 72315
- September 11, 2018, 7:00 – 9:00 pm: Vicksburg Convention Center, 1600 Mulberry Street, Vicksburg, Mississippi 39180
- September 12, 2018, 7:00 – 9:00 pm: Louisiana Department of Environmental Quality, Room C111, 602 North 5th Street, Baton Rouge, Louisiana 70802
- September 13, 2018, 7:00 – 9:00 pm: United States Army Corps of Engineers, New Orleans District Headquarters District Assembly Room, 7400 Leake Avenue, New Orleans, Louisiana 70118

At each meeting, the public received an overview of the proposed project, the purpose of NEPA and scoping, and were invited to provide verbal or written comments. Information on the scoping process, including presentations/handouts from the meetings, comments received, and other relevant information can be found in Appendix 21.

In addition to formal scoping meetings, USACE created a project website to provide updated information on the EIS process: <http://www.mvk.usace.army.mil/MRLSEIS/>. Information regarding the project background, a description of the MR&T Project, and information on public involvement is contained on the website. In addition, the website allows visitors to submit comments on the SEIS II.

1.6 Relevant Issues and Resources

Relevant issues and resources identified through public scoping and interagency coordination for impact analyses were of seven major categories: ecological, societal, cultural, project measures, agricultural, future coordination/framework, and hydraulics and hydrology. Table 1-3 lists these and identifies the sections where they are addressed.

Table 1-3. List of relevant issues identified during public scoping for the SEIS II.

CATEGORY	ISSUE	SECTION
Ecological	Wetlands	3.2.6, 4.2.6, 5.0, Appendix 10
	Wildlife	3.2.2, 4.2.2, 5.0, Appendix 6
	Threatened, Endangered, and At-Risk Species	3.2.5, 4.2.5, 5.0, Appendix 9
	Waterfowl	3.2.1, 4.2.1, 5.0, Appendix 5
	Migratory Birds	3.2.4, 4.2.4, Appendix 8
	Mitigation	5.0

Societal	Water Quality	3.2.8, 4.2.8, Appendix 12
	Aquatics and Fisheries	3.2.7, 4.2.7
	Life and property	1.0, 3.2.11, 4.2.11, Appendix 15
	Economics	1.0, 3.2.11, 4.2.11, Appendix 15
	Roads and Infrastructure	1.0, 3.2.11, 4.2.11, Appendix 15
	Environmental Justice	3.2.9, 3.2.11, 3.2.12, 3.2.17, 4.2.9, 4.2.11, 4.2.12, 4.2.17, Appendix 16
Cultural Resources	Climate change	1.4, 2.0, 4.3, Appendix 4
	Historic properties	3.2.10, 4.2.10, 7.0, Appendix 14
	Inadvertent discoveries	3.2.10, 4.2.10, 7.0, Appendix 14
Measures	Non-structural	2.2
	Borrow Area Considerations	2.3, 2.4, 4.2
Agricultural	Agriculture	3.2.11, 3.2.13, 4.2.11, 4.2.13
Coordination/Framework	Landowner input	2.3, 2.4.1, 4.2.7
	Agency/Tribal coordination	2.4.1, 4.2.5, 7.0, 7.10, 7.17
Hydraulics and Hydrology	Flowline	1.4, Appendix 4
	Old River Control Complex	S3
	Sea level rise, subsidence, climate change	1.1, 1.4, 2.0, 4.3, Appendix 4

A full list of public scoping comments are available in Appendix 21. The most common public concerns identified during scoping by local levee boards and citizens near the MRL was a need for expeditious design and completion of the remaining deficient MRL reaches using design criteria, and avoid and minimize environmental considerations from the 1998 SEIS, and a need for local land owners that provide land for the project to be allowed input into the design process and location of borrow areas. The most common concerns voiced by environmental organizations identified during scoping was a need for borrow areas to be located outside of wetlands (including bottomland hardwood forest), a need for successful mitigation, and a need for nonstructural (e.g., levee removals or setbacks) and nature-based alternatives to be analyzed. Alternatives were formulated around these scoping comments.

2.0 ALTERNATIVES

2.1 General

The MR&T Project MRL feature has been an ongoing Civil Works project since its authorization in the Flood Control Act of 1928. SEIS II is not being prepared in conjunction with a feasibility

study or other kind of project decision document since the Work Items have already been authorized as an integral part of the MR&T Project. SEIS II does not reexamine other areas of the MR&T Project, including the overall system design or authorized level of protection.

2.2 Alternatives Considered

Several alternatives were suggested during scoping and considered for SEIS II. This section describes both those alternatives eliminated from further analysis and those carried forward. Reasons for non-selection include an inability to meet the purpose and need, technical and economic factors, and other factors as described. Because a majority of the Work Items require earthen borrow material for construction, this SEIS II evaluates the No Action Alternative as well as other Alternatives for selecting borrow sources for the construction of the Work Items and recommends a preferred alternative.

Alternative 1 - No Action Alternative

The no action scenario is what would occur if no Federal action is taken. Current concerns in the project area would persist into the future. Neither the proposed action nor any of the other alternatives would be implemented. This alternative is required to be considered under NEPA.

Alternative 2 - Borrow Sources Selected Based on Most Cost Efficient Means (Traditional Construction Alternative)

This alternative would consider the most cost effective and cost efficient means of constructing the proposed Work Items. This would include obtaining borrow from the closest site with suitable material and using the shortest possible access routes (i.e., shortest haul distance). Traditional mitigation measures to compensate for losses would be included as required by law and policy. Borrow areas would only be designed as deep rectangular pits to maximize efficiency, and no special deference would be given to landowner requests to incorporate environmental features. This alternative will be carried forward for detailed analysis.

Alternative 3 - Borrow Sources Selected based on Avoid and Minimize Site Ranking Process (Avoid and Minimize Alternative)

This alternative would address public concerns about the locations of borrow areas, access routes and other ground disturbances. This alternative establishes a method for identifying and ranking potential borrow sources in terms of land use and locations that best avoid and minimize adverse environmental effects from the excavation and placement of borrow material. This alternative would use an “avoid and minimize” approach to reduce impacts to bottomland hardwood (BLH) forests to the extent practicable and would allow USACE to work with landowners and local sponsors to reduce impacts to them. This alternative will be carried forward for detailed analysis.

An alternative in which borrow areas would be selected in locations that resulted in no impacts to wetlands was considered in SEIS I as Alternative 2, Landside Borrow. A borrow area that results in no wetland impacts would be required to be located on the protected side of the levee for most Work Items. To avoid impacts to landside terrestrial wetland areas, these borrow areas would be located on agricultural property. The findings from the alternative analysis conducted on Alternative 2 in the 1998 SEIS I remain valid, thus an alternative where borrow area

placement would result in no wetland impacts was eliminated from further consideration. Justification for this decision includes cost effectiveness of implementation and the likelihood of condemnation being required to attain required project lands.

Alternative 4 - Nonstructural Alternative

This alternative would address the public comments regarding the need to examine nonstructural flood control. Section 73 of the Water Resources Development Act (WRDA) of 1974 directed Federal agencies to consider nonstructural flood control methods to prevent damages to structures. The MR&T Project authorization predates WRDA 1974 and this SEIS is not a planning study that is considering methods to provide flood control, optimize protection, or maximize economic benefits. The flood risk reduction system is already in place and provides the level of protection for which it is authorized in some areas. The purpose and need of this project is to ensure reliability and resiliency of the system in the specific areas that are deficient. As described in the NOI (Appendix 21), this is not a reformulation of the overall MRL feature of the MR&T Project. Further, nonstructural flood control focuses on reducing damages to structures and the majority of the 20 million acres the MR&T protects are agricultural lands on which nonstructural methods are not effective. The 1998 SEIS considered acquisition of flowage easements in lieu of providing protection of the PDF through levee raising; however, it was not implementable due to factors such as not accomplishing the congressionally mandated project purpose to provide a prescribed level of flood protection and the magnitude of these easements. Nonstructural flood protection can include temporary features like sand bags, geotubes and deployable floodwalls, which are all used during flood fighting to supplement the structural system. The action of flood fighting is assumed to be part of every alternative, but a separate nonstructural alternative would not meet the purpose and need and will not be considered further.

Alternative 5 - Nature-Based Alternative

This alternative would consider nature based features in lieu of the traditional levee raises, seepage control or other actions. Section 1134 WRDA 2016 requires USACE to consider nature-based alternatives during plan formulation of feasibility studies. Much like nonstructural, the MR&T predates this requirement and this is not a planning study. Healthy wetland ecosystems within the batture can locally attenuate small rises in the river, but provide no protection against the PDF. Thus, a separate nature-based alternative would not meet the purpose and need and will not be considered further. Although a separate nature-based alternative will not be considered further, there is an alternative that will design borrow areas, to the extent practicable, to mimic natural features, and minimize environmental impacts.

Alternative 6 - Levee Setback Alternative

This alternative would consider relocating levees that are unstable or are prone to seepage if other means were not available to address these issues. Engineering analysis determined proposed solutions to the deficiencies noted at each location. It is anticipated that all can be addressed at a much lower cost than levee relocations would incur. Moving levees would create extensive ground disturbances and environmental impacts at the site of both the new levee and the existing levee if it were to be degraded. In addition, this would require extensive borrow areas and associated environmental impacts. The new setback levee section would have to be constructed to authorized grade prior to degrading the existing levee section so as to not have a significant lapse in flood protection during construction. Additionally, residences, infrastructure,

and large tracts of privately owned property would almost certainly be required to accommodate drastic shifts in the mainline levee alignment, and would almost certainly require condemnation of private property. Thus, while levee setbacks could meet the purpose and need, this alternative was not given additional consideration in this SEIS. If an area of the MRL were found to have problems that could not be managed with relief wells, berms, or other means and a relocation of the levee was deemed necessary it would be considered separately.

2.3 Alternatives Considered in Detail

Alternative 1 - No Action

Under the No Action Alternative, no new construction would be undertaken to address the known deficiencies for the proposed 143 items of work. The overall system, including the areas with the identified deficiencies discussed herein, would continue to be operated and maintained at current levels. This would include mowing and brush management, maintaining the gravel road surface and access ramps, operation of pump stations, relief well maintenance, repair of levee slides or other damages (animal burrows, tire ruts, etc.) and routine inspections. When the river reaches flood stage, USACE will initiate flood-fight activities, which include monitoring performance of features, surveying for new seepage, installing poly sheeting, and ringing sand boils. It could also include temporary levee and floodwall raises using mudboxes, sandbags or other materials. These emergency measures are not as robust and reliable as the proposed relief wells, berms, and permanent levee/floodwall raises at these locations and flood-fighting teams have limited time to get them in place during a flood event.

The probability of a failure in the system would likely be highest at the areas identified as deficient. It is not likely that all of the areas would fail during a flood, but a single failure at any point would result in catastrophic damages. These damages would not only consist of economic harm, but environmental degradation and possibly loss of human lives, as described in Section 1.2.

Alternative 2 - Traditional Construction

This alternative would implement the proposed improvements and modifications using the most cost efficient means available. The 143 Work Items would be constructed to the design grade as determined by the Refined 1973 Project Design Flowline. Reaches of the MRL with seepage concerns would be addressed with berms or relief wells to lower risks of levee failure. Reaches of levee with stability concerns due to persistent levee slides would be addressed by flattening the side slopes of the levee. Reaches of floodwalls with stability concerns would be replaced or repaired to lower risks of failure. Most often, borrow areas for levee repairs would be located along the riverside toe of the levee adjacent to the proposed construction locations. Impacts to wetlands or wildlife habitat would not be avoided or minimized under this alternative, as this plan would require no special configuration or location of borrow areas other than for engineering purposes. Traditional mitigation measures to compensate for losses would be

included as required by law and policy. No provisions would be made for drainage, reforestation, or other environmental enhancement features for the borrow areas.

As with No Action Alternative, flood fighting activities would continue along the MRL during times of high water, but would be less intense in these areas if the problems were addressed as proposed.

Alternative 3 - Avoid and Minimize

The primary difference between Alternative 2 and Alternative 3 is the method of selecting the borrow source for each Work Item and whether the selection of borrow areas is made with an intent to avoid and minimize adverse environmental impacts. The MRL would be constructed to the design grade as determined by the refined 1973 PDF. Reaches of the MRL with seepage concerns would be addressed with berms or relief wells to lower risks of levee failure. Reaches of levee with stability concerns due to persistent levee slides would be addressed with flattening levee slopes. Reaches of floodwalls with stability concerns would be replaced or repaired to lower risks of failure. Unlike Alternative 2, this alternative establishes a method for identifying and ranking potential borrow sources in terms of land use and locations that best avoid and minimize adverse environmental effects from the excavation and placement of borrow material, based off of the comments received during scoping. Environmentally sensitive areas, forested areas of BLH, and wetlands are critical areas to be avoided whenever practicable and possible. The following is a list of eight different types of land uses that are traditionally used as borrow sources for the MR&T Project. These land uses are ranked in order from most preferable to least preferable, in terms of borrow source locations that have the greatest ability to avoid and minimize environmental impacts:

- | | |
|-------------------|---|
| MOST PREFERABLE: | 1) Riverside prior-converted cropland |
| | 2) Landside cropland from willing sellers |
| | 3) Riverside farmed wetlands (cropland) |
| | 4) Riverside farmed wetlands (pasture) |
| | 5) Riverside herbaceous wetlands not in federal conservation programs |
| | 6) Riverside forested non-wetlands not in federal conservation programs |
| | 7) Riverside forested wetland not in federal conservation programs |
| LEAST PREFERABLE: | 8) Landside/Riverside cropland condemnation |

Additional environmental features (e.g., irregular shorelines, islands, variable depths, reforestation, etc.) that could be incorporated into borrow area designs to increase habitat value would be explored with willing landowners and non-Federal sponsors during project design. A brochure detailing these recommendations and outlining this framework is included in Appendix 21. These opportunities would be explored during future phases of project design; however, it is not likely, nor assumed, that these features would be incorporated into all borrow areas. Furthermore, there would be no site protection instrument to ensure the long-term protection of these areas. As such, these environmental benefits were not assumed to offset any impacts in

calculations of compensatory mitigation, but they would provide noteworthy ecological benefits when implemented.

As with other alternatives, when the river reaches flood stage, USACE would initiate flood fight activities, which include monitoring performance of features, surveying for new seepage, installing poly sheeting, and ringing sand boils. Flood fighting activities would continue along the MRL during times of high water, but would be less intense in these areas if the problems were addressed as proposed.

Construction Scenario

Construction methods would be similar under each alternative. The basis of design and assumptions used for estimating the rights-of-way requirements for the Work Items in this SEIS II are included in Appendix 4. Upon receipt of congressional funding, detailed plans and specifications would be prepared for each Work Item. Development of plans and specifications would include the preparation of detailed rights-of-way maps, along with identification of the relocations necessary for construction of each item of work. Disturbance from construction would include the footprint of the Work Items, associated borrow areas, staging areas, haul roads, and drainage ditches. These features were either identified separately or included in the overall construction footprint, as shown in the maps of each Work Item in Appendix 1 and described in Appendix 4. Existing roads would be used, and staging areas would be located in previously disturbed areas to the extent practical. The same construction equipment would be needed for either construction alternative. While this is not an all-inclusive list, the typical construction equipment expected to be used is included below.

- excavators, dump trucks, dozers, graders, backhoes, and rollers
- water trucks, highway trucks, mulchers, and agricultural tractors
- cranes, drill rigs, trenchers
- air compressors, welding machines

Installation of signage, construction fencing and gates, and best management practices (BMPs) for erosion control would be implemented at each Work Item construction site. A stormwater pollution prevention plan (SWPPP) would be prepared in accordance with EPA and associated state regulations. The SWPPP would outline temporary erosion control measures, such as silt fences, retention ponds, and dikes. The construction contract would include permanent erosion control measures, such as turfing and placement of riprap and filter material. Additionally, interim flood reduction measures would be included with any alternative during ongoing construction at any of the Work Item locations, as needed. Funding for detailed design and implementation of the 143 Work Items would be received through annual congressional appropriations. Based on traditional funding allocations, these Work Items would likely begin in 2020 or 2021 and extend beyond 50 years. Since detailed designs are not yet available and the Work Items extend over many years, Work Items would continue to be evaluated and addressed to ensure environmental compliance prior to construction.

Construction Assumptions

For each of the proposed 143 Work Items, USACE created preliminary designs for each feature of work using existing data and various assumptions. Appendix 4 provides detailed information for how estimated construction footprints and required quantities of construction materials were calculated for each Work Item. These calculations were then used to estimate construction impacts and construction costs of each work item. Each of the three USACE Districts designed Work Items in their District in accordance with their specific local conditions (e.g. commonly encountered soils, typical depth of suitable borrow materials, etc.), and utilized these assumptions for the purposes of this SEIS. Detailed plans and specifications for each work items would be prepared upon the receipt of funding and would be compared to the assumptions described in SEIS II prior to the onset of construction activities. The following briefly describes the major features of work. Assumptions for other minor features of work (e.g. cattle guards, stone paving, access ramps and silt fencing requirements) can be found in Appendix 4.

The proposed construction techniques required to implement the required improvements and modifications to the MRL were based upon construction methods and equipment typically used in similar construction projects. It is possible that future improvements to these types of construction activities would be available at the time some of these Work Items are to be constructed. Similarly, new methods to address underseepage concerns might be available. If so, the PDT would evaluate the use of these new methods and determine if they could be applied to the Work Items proposed in SEIS II.

Levee Enlargements

Levee enlargements were recommended for Work Items with deficiencies greater than 1 foot. The raises are assumed to be one-sided and made on the riverside of the existing levee in Memphis and Vicksburg, but landside in New Orleans. To maintain a 5:1 levee slope, the levee crown would be widened 5 feet for every 1 foot of elevation raise and all newly raised levee sections would have a 6 inch gravel layer placed to facilitate travel and levee inspection. Generally, each levee raise assumed a 50-foot wide strip extending out from the levee toe would be disturbed. A standard overbuild of 0.7 feet was assumed for all enlargements.

Levee Slope Flattening

Each of the proposed slope flattening projects are in the Memphis District. Past experience has shown that if a 1V:5H slope failed, a 1V:7H would be required. Based on assumptions, the required footprint for a generic levee slope flattening project was estimated to be roughly a 100-foot wide strip along the levee toe for the entire length of the proposed Work Item (measured parallel to the levee centerline).

Seepage Berms

Seepage berms proposed within the Vicksburg District were assumed to be 300 feet wide, 6 feet thick at the levee toe, 3 feet thick at the berm crown, and have a 1:100 slope. These dimensions represent the most robust seepage berms used within the Vicksburg District. On the New Orleans District, the berms were assumed to be 200 feet wide and 3 feet high.

Relief Wells

The typical center-to-center spacing for relief wells ranges from 50 feet up to roughly 300 feet. Therefore, the total length of each seepage remediation project was divided by an estimated average well spacing of 150 - 200 feet to determine the approximate number of wells required for each project. Each well was assumed to be 100 feet in total depth. Relief well projects typically generate small quantities of spoil (from excavation of the collector ditch), so no borrow requirement was assumed for these projects.

Borrow Areas

For all three Districts' Work Items, once required earthwork quantities were established, the estimated earthen material requirement was converted into an acreage sufficient to provide the required amount of borrow material. Once size requirements were finalized, locations were selected by the PDT, utilizing input from engineering, planning, and regulatory PDT members. During future Work Item design, the size and location of these borrow areas would be adjusted to adequately facilitate project construction and to incorporate landowner input or data obtained on-the-ground.

Floodwalls

There is one floodwall proposed in the Memphis District, and the remaining floodwalls are in New Orleans District. There were no standard assumptions applied to the floodwalls. Each one has its own specific parameters for height, foundation type, setback distance and direction (toward or away from river). Appendix 4 provides these details.

2.4 Evaluation of Alternatives

With Alternative 1 (No Action), the threat of catastrophic flooding and associated economic damages, environmental degradation, displacement of wildlife, and impacts to the human environment from the PDF would remain. Local levee boards and USACE would continue to expend significant amounts of public funds to fight floods, including temporarily raising levee reaches and sandbagging sand boils. By relocating borrow areas to less environmentally sensitive areas, Alternative 3 would reduce impacts to BLH wetlands, waterfowl, and wildlife, resulting in 329 fewer mitigation acres compared to Alternative 2 (Table 2-1). Avoiding and minimizing impacts to BLH and wetlands would result in a tradeoff of increased lost acreage of agricultural lands (including approximately 223 more acres of prime farmland) when compared to Alternative 2. Construction of new borrow areas would result in positive gains of aquatic habitat for fish and other aquatic resources with either Alternative 2 or 3. The reduction of forested impacts with Alternative 3 ensures additional seasonal habitat for threatened and endangered species, including bats, and migratory birds. As previously discussed, additional environmental features (e.g., irregular shorelines, islands, variable depths, reforestation, etc.) that could be incorporated into borrow area designs to increase habitat value would be explored with willing landowners and non-Federal sponsors during project design. While these benefits are not assumed to occur, the aquatic assessment showed that incorporation of these features can increase aquatic habitat up to 40 percent more than standard dimensions (rectangular pit with 1:3

side slopes and 8-foot depth). Implementation of Alternative 3 is expected to increase overall construction cost of the proposed Work Items, as Alternative 2 would require shorter hauling distances and less ROW acquisition. However, these cost savings would be somewhat negated by the costs of additional compensatory mitigation requirements that would be required under Alternative 2. Alternative 3 (avoid and minimize) was determined to be the preferred alternative.

Table 2-1. Summary of significant impacts and required compensatory mitigation from quantitative assessments of Alternatives 2 and 3 by USACE District.

District	Impacts with Alternative 2 (Traditional Construction)					Impacts with Alternative 3 (Avoid and Minimize)				
	Wtld FCU/HSU ¹	Wtrfwd DUD ²	Terrest. Wildlife AAHU ³	Aquatic HU ⁴	Req. Comp. Mit. (acres)	Wtld FCU/HSU ¹	Wtrfwd (DUD) ²	Terrest. Wildlife AAHU ³	Aquatic HU ⁴	Req. Comp. Mit. (acres)
MVM	-37,338	-141,330	-1,643	295	795	-23,924	-99,029	-540	379	673
MVK	-24,141	-550,069	-1,108	367	724	-20,386	-545,676	-868	347	614
MVN	-8,055	-92,411	-325	174	257	-4,983	-18,246	-198	140	160
TOTAL	-69,534	-783,810	-3,076	835	1,776	-49,293	-662,951	-1,606	866	1,447

¹ Functional Capacity Units calculated from Hydrogeomorphic Manual (HGM) and Habitat Suitability Units from Wetland Value Assessment analyses.

² Duck-Use-Days (DUD) calculated from waterfowl analyses. DUD is not comparable to other units of measure (FCU, HU, etc.).

³ Average Annual Habitat Units calculated using Habitat Evaluation Procedures (HEP) analyses on wildlife.

⁴ Habitat Units calculated from Borrow Area Habitat Suitability Index Fish Diversity Model (aquatic HUs were gains due to addition of open water associated with borrow areas).

Detailed descriptions of each of the 143 Work Items from the preferred alternative and associated maps are in Appendix 1. Detailed descriptions of the impact/benefit analyses on significant resources expected to result from implementation of the proposed actions are discussed in the remainder of this SEIS and their corresponding appendices. Compensatory mitigation requirements for unavoidable project-induced adverse impacts were calculated using the same ecological models that were used to quantify project impacts. Ecological models were selected to address the significant environmental resources determined through scoping and interagency coordination, specifically, waterfowl, wetlands, terrestrial habitat/wildlife, and aquatics. These ecological models were all certified or approved by the USACE National Ecosystem Restoration Planning Center of Expertise and used within their applicable ranges, in accordance with Engineer Circular EC 1105-2-412. Application of the models was also reviewed by the interagency team throughout the development of the SEIS. The proposed compensatory mitigation plan includes active reforestation of agricultural lands within three hydrologic zones: Mitigation Zone 1) in the batture area (i.e., lands between the river and the levee); Mitigation Zone 2) frequently flooded areas, or those with a hydrologic connection to the Mississippi River landside of the MRL; and Mitigation Zone 3) low lying flooded areas landside of the MRL whose hydrologic conditions are dictated by precipitation and landscape position. Restoring wetland vegetation within these three zones would mitigate 100 percent of the wetland losses and

greater than 100 percent of the waterfowl and terrestrial habitat/wildlife losses. The project results in benefits to aquatic resources; thus, compensatory mitigation was not required. A comparison of compensatory mitigation requirements between Alternatives 2 and 3 is shown in Table 2-1. Additional details regarding compensatory mitigation is described in Section 5.

2.4.1 Other Features of Preferred Alternative

Funding for implementation of the 143 Work Items would be received through annual congressional appropriations. Based on traditional funding allocations, these phased Work Items would likely extend for decades and some programmatic frameworks are incorporated into this SEIS. USACE determined that the effects on historic properties could not be *fully* determined before congressional funding was received for each Work Item, and accordingly USACE initiated the development of a Programmatic Agreement in 2019 that would govern USACE's Section 106 review process for this series of undertakings. USACE notified the State Historic Preservation Officers (SHPO) for the States of Arkansas, Illinois, Kentucky, Louisiana, Mississippi, Missouri, and Tennessee, 34 federally-recognized Tribes having an interest in the seven states, the Advisory Council on Historic Preservation and the National Park Service (NPS). Similarly, while significant impacts to threatened and endangered species are not anticipated, USACE would consult with the local USFWS Ecological Services Field Office with each Work Item, pursuant to Section 7 of the Endangered Species Act (ESA), after Congressional appropriations are received and while detailed engineering and construction plans are being developed. Surveys for historic properties; site-specific surveys for threatened and endangered species; surveys and coordination on site-specific tracts of land for compensatory mitigation; state water quality certifications; Phase 1 assessments for hazardous, toxic, and radioactive waste (HTRW); farmland conversion impact ratings; surveys and coordination pursuant to the Migratory Bird Treaty Act; etc., would all be pursued or updated accordingly during the completion of detailed plans and specifications for each Work Item. If any of these updated assessments result in significant deviations from the impacts described in SEIS II, updated or tiered analyses under the NEPA, would be pursued. Coordination with Federally-recognized Tribes, and Federal and State regulatory agencies would occur for each Work Item as Congressional appropriations are received for detailed design and construction of the Work Items.

3.0 AFFECTED ENVIRONMENT

3.1 General Setting

The assessment area extends throughout the Mississippi Alluvial Valley from Cape Girardeau, Missouri near upper Mississippi River mile (RM) 50 downstream approximately 1,000 RM to the Gulf of Mexico and approximately 10 miles up the Ohio River. The assessment area is essentially the same as the 1998 SEIS, encompassing about 2.7 million acres within portions of seven states: Missouri, Illinois, Kentucky, Tennessee, Arkansas, Mississippi, and Louisiana. For the purposes of the impact analyses, it includes the lands and waters lying between the mainline MRL (and floodwalls), or bluffs where levees are absent, plus a zone extending approximately

3,000 feet landside of the levees. Land cover trends are similar to the 1998 SEIS, with the area dominated by BLH (38 percent), cropland (26 percent), and open water (21 percent) and no other category greater than 5 percent (Table 3-1).

Table 3-1. Current assessment area land cover compared to the 1998 SEIS.

Land Cover	2017 Acres	2017 percent composition	1997 Acres	1997 percent composition
BLH	1,028,685	38%	1,021,710	39%
Cropland	697,165	26%	769,260	29%
Open Water	577,460	21%	518,086	20%
Scrub/Shrub	108,446	4%	67,379	3%
Urban	99,725	4%	76,164	3%
Levee	75,039	3%	26,990	1%
Pasture	69,013	3%	42,390	2%
Tree Plantation	27,645	1%	50,471	2%
Non-forested wetland	24,603	1%	14,512	1%
Marsh	17,681	1%	5,925	0%
Sandbar	2,917	0%	49,390	2%
Ridge-Slough Complex	2,682	0%	-	0%
Bare Soil	1,851	0%	3,567	0%
TOTAL	2,732,913		2,645,844	

3.2 Significant Resources

Significant resources and relevant concerns within the assessment area were defined through agency and public scoping include: waterfowl; terrestrial wildlife; bats; migratory birds; threatened and endangered species; wetlands; aquatic resources; water quality; air quality; cultural resources; socioeconomics; environmental justice (EJ); agricultural lands; HTRW; recreation; aesthetics; and noise. Detailed descriptions of these resources and associated impact analyses are included in the

appendices accompanying this SEIS. Due to the large assessment area, these analyses focused on the 143 spatially defined proposed Work Items using assessment areas relevant to each resource; thus, the spatial extents of the analyses may have some slight variations. Summaries of the existing conditions of the significant resources and relevant concerns are described in the sections below.

3.2.1 Waterfowl Resources

Historically, the MAV was composed of mostly BLH, swamps, and bayous, including the largest forested wetland in North America (approximately 25 million acres) extending roughly from southeastern Missouri to southern Louisiana. Land use conversion to agricultural has resulted in over 80 percent of the forest in this region cleared. Additionally, most of the MAV was subject to periodic flooding by the Mississippi River and its tributaries; however, following the Flood Control Act of 1941, hydrologic relationships in the MAV were altered by federally funded water resource developments for flood control and agriculture (Reinecke et al. 1988). The loss and degradation of habitat have been identified as the major waterfowl management problems in North America (USFWS and Canadian Wildlife Service 1986). Despite these changes to the landscape and hydrology in the MAV, it remains a critical ecoregion for North American waterfowl and other wildlife (Kaminski 1999). Waterfowl have adapted to and have exploited foraging habitat created by farming. Although waste grain has been substantially reduced from advances in modern farming techniques, that which does remain provides valuable food sources for migrating waterfowl. Additionally, flooded agricultural fields provide invertebrate food resources for molting and pre-laying hens.

There are limited numbers of resident waterfowl present in the project area, mostly wood ducks and, to a lesser extent, mallards, hooded mergansers and blue-wing teal. However, approximately 40 percent of the Mississippi Flyway's waterfowl and 60 percent of all U.S. bird species either migrate through or winter in the MAV (LMVJV 2015). Furthermore, the MAV is considered the most important wintering location for mallard and wood duck populations, as well as wintering significant numbers of green-winged teal, northern shoveler, and gadwall (LMVJV 2015). Habitat requirements for wintering waterfowl include three components: availability, utilization, and suitability in meeting social behavioral requirements. Size of the migratory waterfowl population in the MAV is a direct function of these three components. The increased availability of wintering habitat also affects the distribution of wintering waterfowl in the MAV. Proportionately more waterfowl have been found to winter in the MAV during periods of above normal rainfall and cold winters (Nichols et al. 1983, Reinecke et al. 1987).

Unmanaged and flood susceptible habitats within the MAV, which are important to wintering waterfowl, have long been affected by human action that has altered historic flood events. Although, a large amount of waterfowl habitat is provided by artificial means, such as groundwater or surface water pumps, that are used to intentionally flood areas for waterfowl, primarily for hunting. Additionally, and although limited, the remaining BLH patches are important to wintering waterfowl because they provide nutritious food, secure roosting areas, cover during inclement weather, loafing sites, protection from predators, and isolation for pair formation. Because of the importance of wetlands to waterfowl, restoring wetlands, especially BLH, is a key objective of the Lower Mississippi Valley Joint Venture, a subset of the North

American Waterfowl Management Plan. A primary focus of the Joint Venture is reforestation of croplands into BLH; an extremely valuable wetland complex for waterfowl.

3.2.1.1 Duck-Use-Days (DUD) Assessment

To assess waterfowl resources across the project area, a landscape analysis that provides an index of how many waterfowl an area can support according to food resources that are present within a particular habitat was conducted. This index refers to the number of duck-use-days (DUD) or simply the number of days a single individual duck could be supported based on the food resources available in that area. DUD calculations for this project are based on data and formulas within “A Manual for Calculating Duck-Use-Days to Determine Habitat Resource Values and Waterfowl Population Energetic Requirements in the Mississippi Alluvial Valley”, hereafter referred to as DUD manual (Heitmeyer 2010). The DUD manual is certified by the USACE National Ecosystem Restoration Planning Center of Expertise for use in the project area. The spatial extent of the proposed 143 Work Items were used to define the waterfowl assessment area for quantitative analyses.

The information requirements to estimate DUD's are: (1) current land use, including crop type, (2) extent, duration, and depth of flooding, (3) amount of winter food present by land use, (4) energy of food items, (5) deterioration rates of food items, and (6) energy requirements of waterfowl. United States Department of Agriculture (USDA) Cropscape data, which provides classifications for crop production (e.g. corn, soybean, rice, cotton, etc.) was used to group the land classifications into the following habitat types applicable to the DUD model: 1) corn, 2) soybeans, 3) milo, 4) rice, 5) open water, 6) forested habitats, 7) seasonal herbaceous (SHM)-passively unmanaged, and 8) shrub/scrub (USDA National Agricultural Statistics Service Cropland Data Layer. 2018). Cotton is a common crop grown in the MAV but does not contribute toward the energetics of waterfowl. Several other crops (e.g. clover, sunflower) comprise a smaller portion of the overall land cover; therefore, were grouped together as “other crop.” Land cover types that do not provide significant available waterfowl food sources, such as developed lands (e.g., roads, residences, building sites, cities) and other agricultural lands (e.g., winter wheat or cotton) were not included in subsequent analyses. Additional details regarding the refinement of land cover classifications for the DUD analysis is included in Appendix 5.

Food and energy values for the eight applicable habitat types, by specified time period (month) were determined from the DUD manual (Heitmeyer 2010). These energy values were related to a daily existence energy (DEE) for a mallard (1 mallard DEE = 452.44 kcal/day) and divided by the number of hectares of each flooded habitat to determine the potential DUDs/hectare/specified time period. The amount of food available on a unit area was determined from tables within the DUD manual (Heitmeyer 2010). The methodology was further refined to include information on seed deterioration rates, seed availability/abundance, and invertebrate availability/abundance that was incorporated into energetic formulas as shown in Table 2 of Appendix 5 (Heitmeyer 2010). Although there are multiple species of waterfowl present in the project area, the mallard was selected to standardize all of the habitats found in the project area. Mallards are the most abundant duck species in the Mississippi Flyway during migration periods; they use a variety of

flooded forests and inundated agricultural fields, and a large amount of scientific research has been conducted on their habitat requirements and foraging ecology.

Waterfowl foraging habitat, regardless of food value, is only of use if available. Food availability is dependent on extent, duration, and depth of flooding. Ducks use relatively shallow water areas, 18 inches or less, for feeding. Using extensive hydrological data (Years 1969-2018), the area seasonally flooded 18 inches or less for the wintering season were estimated using ENVIRO-DUCK hydrological model developed by USACE.

Over 90 percent of the proposed Work Item footprints (6,762 of 7,283 acres of Alternative 3 construction footprints and 7,203 of 7,842 acres of Alternative 2 construction footprints, respectively) were not considered suitable habitat for foraging by waterfowl because they lacked flooded conditions or were flooded more than 18 inches in depth. A summary of the area of suitable foraging habitat (i.e. flooded 18 inches or less from November-February) and associated DUD overlapping the proposed Work Item footprints within each District is shown in Table 3-2 below.

Table 3-2. Summary of flooded habitats for wintering waterfowl and associated number of DUD within MRL-SEIS II Work Item footprints from November-February within each District.

		Alt. 3 Avoid/Minimize Work Item Footprints		Alt. 2 Traditional Construction Work Item Footprints	
District	Habitat Type	Total DUD (Nov-Feb)	Acres	Total DUD (Nov-Feb)	Acres Impacted
Vicksburg	Corn	139	0.1	139	0.1
	Floodplain Forest (5% canopy openings)	29,772	45.6	59,676	91.3
	Floodplain Forest (10% canopy openings)	10,260	13.1	31,367	40
	Floodplain Forest (20+% canopy openings)	139,276	133.4	106,457	101.9
	Open Water-Aquatic	4	0	8	0.1
	Rice	254	0.4	254	0.4
	SHM Passively Unmanaged	335,047	122.4	330,585	120.8
	Shrub/Scrub	12,873	11	12,564	10.8
	Soybeans	18,052	49.9	9,019	24.9
MVK Total		545,676	376	550,068	390.4
Memphis	Corn	2,905	2.6	2,097	1.9
	Floodplain Forest (5% canopy openings)	3,519	5.4	22,176	33.9
	Floodplain Forest (10% canopy openings)	3,250	4.1	10,486	13.4

	Floodplain Forest (20+% canopy openings)	56,826	54.4	85,101	81.5
	Open Water-Aquatic	0		19	0.2
	Rice	5	0	5	0
	SHM Passively Unmanaged	10,771	3.9	11,859	4.3
	Shrub/Scrub	2,642	2.3	2,642	2.3
	Soybeans	19,111	52.9	6,945	19.2
	MVM Total	99,029	125.6	141,330	156.7
New Orleans	Corn	87	0.1	122	0.1
	Floodplain Forest (5% canopy openings)	8,445	12.9	24,573	37.6
	Floodplain Forest (10% canopy openings)	3,169	4	15,415	19.7
	Floodplain Forest (20+% canopy openings)	1,498	1.4	25,623	24.5
	SHM Passively Unmanaged	4,395	1.6	26,498	9.7
	Shrub/Scrub	616	0.5	126	0.1
	Soybeans	36	0.1	54	0.1
MVN Total		18,246	20.7	92,411	91.9
Grand Total		662,951	522.3	783,809	639

Additional details of waterfowl resources can be found in Appendix 5.

3.2.2 Terrestrial Habitat

Terrestrial habitat types within the project area primarily include agricultural land, forest, and developed/residential areas. Agricultural lands and developed areas provide limited habitat for few species. BLH are the predominant terrestrial habitat within the project area. The two dominant BLH communities are riverfront BLH and mixed BLH. Dominant species of the riverfront BLH communities include cottonwood (*Populus deltoides*), sycamore (*Platanus occidentalis*), and black willow (*Salix nigra*) while dominant mixed BLH species include pecan (*Carya spp.*), green ash (*Fraxinus pennsylvanica*), sugarberry (*Celtis laevigata*), hackberry (*Celtis occidentalis*), oaks (*Quercus spp.*), and elm (*Ulmus spp.*). Wildlife species commonly found within BLH habitat in the project area include white-tailed deer, raccoon, woodpeckers, owls, various songbirds, rabbits, mice, wild turkey, and grey and fox squirrels. Cottontail rabbit, mourning dove, raccoon, coyote, and opossum are species commonly found in agricultural lands. Other wildlife common to the project area include waterfowl, herons, egrets, and wood ducks.

which commonly use open water habitats. In addition, muskrats, nutria (invasive), swamp rabbits, minks, river otters, and beavers are commonly found in wetlands.

3.2.2.1 Terrestrial Habitat Suitability Index (HSI) Models/ Habitat Evaluation Procedures (HEP)

To assess terrestrial BLH forest habitat and the associated wildlife communities within the project area, the habitat evaluation procedures (HEP) (USFWS 1980) were used. Baseline habitat suitability was determined for four avian and two mammalian target species using published habitat suitability index (HSI) models. The same species chosen for the 1998 SEIS effort were chosen for the current effort. These species included the barred owl (BDOW; *Strix varia*), fox squirrel (FOSQ; *Sciurus niger*), carolina chickadee (CACH; *Poecile carolinensis*), pileated woodpecker (PIWO; *Dryocopus pileatus*), wood duck (WODU; *Aix sponsa*), and mink (*Mustela vison*). These species represent the overall wildlife community, including sensitive and state-listed species, that uses BLH in the project area and that could be impacted by the proposed activities. HSI model input variables are derived from species-specific habitat requirements for specific species in a defined area. HSI models rate the quality of available habitat using a scale of 0 (unsuitable) to 1.0 (optimal). The HSI model variables calculated for the target species in this analysis are summarized in Table 3-3 below.

Table 3-3. Habitat variables collected during the MRL SEIS II and the species for which the data contributed to individual HSI models.

No.	Variables	Species
1	Overall canopy closure (%) for entire plot	Carolina Chickadee, Fox Squirrel, Mink, Pileated Woodpecker
2	Overall midstory canopy closure (%) for entire plot	Fox Squirrel, Mink
3	Overall herbaceous cover for entire plot	Mink
4	Canopy closure (%) of hard mast trees	Fox Squirrel
5	Canopy height (average height of overstory trees, >80% of tallest trees)	Carolina Chickadee
6	# of trees with dbh \geq 51 cm	Barred Owl, Pileated Woodpecker
7	Average dbh of overstory trees (>80% of tallest trees)	Barred Owl, Fox Squirrel
8	# of snags or dying trees >38 cm dbh	Pileated Woodpecker
9	Average dbh of snags >38 cm dbh	Pileated Woodpecker
10	Combined # of trees and snags with >1 cavity (trees >10 cm dbh)	Carolina Chickadee
11	# of tree cavities with dimensions of 7.6 x 10.0 cm (in live trees or snags).	Wood Duck
12	# of tree stumps; # of log	Pileated Woodpecker

Table 3-3. Habitat variables collected during the MRL SEIS II and the species for which the data contributed to individual HSI models.

No.	Variables	Species
13	# of artificial nest boxes	Wood Duck
14	% of the terrestrial ground surface within 100 m of a wetland's edge that is shaded by vertical projection of woody vegetation canopy	Mink
15	% of the vegetation/structural complexity at the water/land interface (<1 m from water's edge)	Mink
16	% water surface covered by brood cover	Wood Duck
17	Distance (m) between nesting and brooding-rearing habitat	Wood Duck
18	% area of optimum nesting habitat	Wood Duck
19	% area of optimum brood-rearing habitat	Wood Duck
20	Distance from plot center to nearest source of grain (m)	Fox Squirrel

The spatial extent of the proposed 143 Work Items was used to quantitatively assess terrestrial habitat within the assessment area. A summary of the land cover within the assessment area is shown in Table 3-4 below. For HEP analyses, approximately 90 percent of the land area within Alternative 3 Work Item footprints (6,494 of 7,283 acres) and 80 percent (5,778 of 7,204 acres) of the land area within Alternative 2 Work Item footprints was not considered suitable habitat for the target species because of a lack of forest.

Table 3-4. Land cover acreage and percent cover for two project alternatives (Alternative 2 - Traditional Construction and Alternative 3 - Avoid/Minimize) within the MRL-SEIS II Work Items according to USACE District.

District	Land Cover	Alt. 2		Alt. 3	
		Total Acres	Percent Cover	Total Acres	Percent Cover
Memphis	Cropland	665	24.9	1,090	40.9
	Forested	723	27.1	303	11.4
	Levee	1,145	42.9	1,144	42.9
	Marsh	0	0.0	0	0.0
	Non-forested	9	0.3	8	0.3
	Open Water	6	0.2	6	0.2
	Pasture, Old Field	53	2.0	54	2.0
	Scrub/Shrub	8	0.3	1	0.0
	Urban	62	2.3	61	2.3

(cont.)

Table 3-4. Land cover acreage and percent cover for two project alternatives (Alternative 2 - Traditional Construction and Alternative 3 - Avoid/Minimize) within the MRL-SEIS II Work Items according to USACE District.

District	Land Cover	Alt. 2		Alt. 3	
		Total Acres	Percent Cover	Total Acres	Percent Cover
Memphis Total		2,669	100.0	2,668	100.0
Vicksburg	Cropland	314	17.9	449	24.6
	Forested	490	28.0	367	20.1
	Levee	793	45.3	834	45.6
	Marsh	0	0.0	0	0.0
	Non-forested	9	0.5	7	0.4
	Open Water	4	0.2	3	0.2
	Pasture, Old Field	22	1.3	36	2.0
	Scrub/Shrub	110	6.3	126	6.9
	Urban	6	0.3	6	0.3
Vicksburg Total		1,749	100.0	1,829	100.0
New Orleans	Cropland	230	8.3	136	4.9
	Forested	119	4.3	213	7.6
	Levee	2,123	76.2	2,123	76.2
	Marsh	13	0.5	13	0.5
	Open Water	1	0.0	1	0.0
	Pasture, Old Field	87	3.1	87	3.1
	Scrub/Shrub	5	0.2	5	0.2
	Urban	208	7.5	208	7.5
New Orleans Total		2,786	100.0	2,786	100.0
Project Total		7,204		7,283	

The HEP analyses also accounted for differences in forest communities within the batture (riverside of the levee) versus those outside of the batture (landside of the levee). HSI model variables were calculated on 253 random sampling plots (173 riverside of the levees; 80 landside of the levees) at 29 different forested locations within a one-half mile buffer of the MRL during 2018-2019, extending from Cape Girardeau, Missouri to Head of Passes, Louisiana. Overall, HSI values were moderate to high for most species, with the exception of wood duck receiving lower

scores due to low numbers of suitable tree cavities and no observed nest boxes. Wood duck HSI scores were also low for many sampling units because of the lack of suitable brood-rearing habitat that resulted from insufficient hydrology combined with suitable cover. HSI values were higher in the Memphis District (MVM) and generally decreased for sampling units further south into the New Orleans District (MVN). A summary of HSI values by District is shown in Table 3-5 below.

Table 3-5. Summary of baseline habitat suitability index (HSI) values by USACE District.

District	Evaluation Species	HSI for Riverside	HSI for Landside
		BLH	BLH
Memphis	Carolina Chickadee	0.81	1
	Barred Owl	0.82	0.75
	Pileated Woodpecker	0.52	0.34
	Fox Squirrel	0.42	0.64
	Wood Duck	0.29	0
	Mink	0.77	na
Vicksburg	Carolina Chickadee	0.56	0.52
	Barred Owl	0.73	0.71
	Pileated Woodpecker	0.39	0.3
	Fox Squirrel	0.62	0.73
	Wood Duck	0.33	0
	Mink	0.69	0.59
New Orleans	Carolina Chickadee	0.37	0.34
	Barred Owl	0.55	0.65
	Pileated Woodpecker	0.26	0.15
	Fox Squirrel	0.27	0.74
	Wood Duck	0.31	0
	Mink	0.44	0.77

Riverside HSI values for the pre-project baseline suggested moderate, and in some cases high, habitat value for the focal species. Riverside HSI values ranged from 0.37-0.81 for Carolina chickadee, 0.55-0.82 for barred owl, 0.26-0.52 for pileated woodpecker, 0.27-0.62 for fox squirrel, 0.29-0.33 for wood duck, and 0.44-0.77 for mink. Landside HSI values were lower than Riverside values for all evaluation species except fox squirrel and mink. Values ranged from 0.34-1.0 for Carolina chickadee, 0.65-0.75 for barred owl, 0.15-0.34 for pileated woodpecker, 0.64-0.74 for fox squirrel, 0.00-0.00 for wood duck, and 0.59-0.77 for mink. Higher HSI values landside for fox squirrel were primarily influenced by proximity to agricultural fields. Available

habitat in the New Orleans District differed significantly between landside and riverside as much of the area includes narrow strips of forest within the batture.

Additional details regarding the terrestrial habitat within the project area and associated assessment can be found in Appendix 6.

3.2.3 Bats

The assessment area encompasses the distribution of 16 bat species (Table 3-6). Although individual species may differ in their life histories, there are broad habitat use patterns applicable to all bat species. Bats of the eastern United States are nocturnal insectivores that forage in a variety of habitat types including riparian habitat, forest openings, agricultural fields, and urban (other) areas (Geggie and Fenton 1985, Furlonger et al. 1987, Sparks et al. 2004, Brooks et al. 2017). The habitat in which a species prefers to forage is related to its wing morphology and echolocation call structure (Aldridge and Rautenbach 1987, Norberg and Rayner 1987). Therefore, altering foraging habitat may have negative, positive, or neutral effects on bat activity. During the day, bats roost in structures such as snags (Carter and Feldhamer 2005), exfoliated bark (Foster and Kurta 1999), foliage (Mager and Nelson 2001), tree cavities (LaVal et al. 1977, Kurta et al. 1993, Decher and Choate 1995) or buildings (Kurta and Baker 1990). These structures can also serve as maternity roosts for females to rear their young. In the fall, bats either enter a hibernacula or migrate to warmer climates (Barbour and Davis 1969). Many species hibernate in caves (Caceres and Barclay 2000) although some species will enter torpor in tree foliage (Mager and Nelson 2001). During the hibernation season, bats will occasionally emerge to forage and drink especially in warmer climates farther south (Barbour and Davis 1969). Migratory bats do not enter caves for hibernation but instead travel hundreds of miles to forage in warmer climates. These species may also enter torpor during cold conditions, but they do not enter caves or remain in torpor for long periods of time. A summary of the life history and habitat of bat species within the project area is shown in Table 3-6.

Table 3-6. Summary of life history and habitat of bat species within the project area.

Species	Diurnal Roost	Foraging	Hibernation/ Migration	References
Hoary Bat	Foliage	Open habitat	Migratory	Constantine 1966; Heinrich et al. 1999; Sparks et al. 2005; Andrusiak 2009; Cryan et al. 2014
Rafinesque's Big-eared Bat	Tree hollows	Forest interiors	Cave hibernator	Hurst and Lacki 1999; Lance et al. 2001; Trousdale and Beckett 2005
Northern Yellow Bat	Foliage, Spanish moss	Open habitat	Tree hibernator/migratory	Hutchinson 2006; Chapman 2007; Coleman et al. 2012
Big Brown Bat	Buildings, tree hollows	Open habitat	Cave hibernator	Duchamp et al. 2004; Brooks and Ford 2005; Reimer et al. 2014

Species	Diurnal Roost	Foraging	Hibernation/ Migration	References
Silver-haired Bat	Snags, tree crevices	Open habitat	Migratory	Barclay 1985; Parsons et al. 1986; Barclay et al. 1988; Crampton and Barclay 1998; Cryan 2003; Patriquin and Barclay 2003
Eastern Red Bat	Foliage	Forest edge	Tree hibernator/ migratory	Shump and Shump 1982; Furlonger et al. 1987; Mager and Nelson 2001
Seminole Bat	Foliage	Forest edge	Tree hibernator/ migratory	Wilkins 1987; Menzel et al. 1998; Perry and Thill 2007
Southeastern Myotis	Tree hollows	Riparian habitat/ bottomland	Cave hibernator	Barbour and Davis 1969; Carver and Ashley 2008
Gray Bat	Caves	Riparian habitat	Cave hibernator	LaVal et al. 1977; Decher and Choate 1995
Eastern Small-footed Bat	Rocky outcroppings, caves	Forest interiors	Cave hibernator	Furlonger et al. 1987; Best and Jennings 1997; Roble 2004; Johnson and Gates 2008; Johnson et al. 2009
Little Brown Bat	Tree hollows	Riparian habitat/ bottomland	Cave hibernator	Humphrey 1971; Fenton and Barclay 1980; Furlonger et al. 1987; Crampton and Barclay 1998; Psyllakis and Brigham 2006; Grieneisen et al. 2015; Nelson and Gillam 2017
Northern Long-eared Bat	Tree hollows	Forest interiors	Cave hibernator	Caceres and Barclay 2000; Patriquin and Barclay 2003; Brooks and Ford 2005; Timpone et al. 2010; Pauli 2014
Evening Bat	Tree hollows	Forest edge	Migratory	Watkins 1972; Duchamp et al. 2004
Tri-colored Bat	Tree foliage/ Tree hollows	Forest edge	Cave hibernator	Veilleux et al. 2003; Vincent and Whitaker 2007; Morris et al. 2010
Brazilian Free-tailed Bat	Caves	Open habitats	Migratory	Bernardo and Cockrum 1962; Wilkins 1989; Best and Geluso 2003; Russell et al. 2005

Species	Diurnal Roost	Foraging	Hibernation/ Migration	References
Indiana Bat	Snags/tree hollows/ exfoliated bark	Forest interiors/ bottomland	Cave hibernator	LaVal et al. 1977; Murray and Kurta 2004; Carter and Feldhamer 2005; Ford and Chapman 2007; Timpone et al. 2010

Additional details regarding individual bat species and their associated habitat within the project area can be found in Appendix 7.

3.2.4 Migratory Birds

The Migratory Bird Treaty Act (MBTA) (16 U.S.C. 703, et seq.) is the primary legislation in the United States established to conserve migratory birds. The MAV is critically important as a major migration corridor for many bird species with more than 40 percent of the waterfowl that breed in North America using the MAV as migratory stopover, wintering or breeding habitat; the alluvial land located between the river at low-water stage and the levees (i.e., batture) is an important corridor for songbird migration. In addition, at least 107 species of land birds breed in the MAV, with 70 of those depending upon bottomland hardwood forests for most or all of their life cycle. Over the last few decades, documented long-term population declines of migratory bird species have spurred significant concern over the persistence of many species and has contributed to widespread investigations into the causes of these declines, including habitat loss, feral and free-ranging domestic cats, pesticides, and a variety of other stressors.

To determine potential occurrences of priority birds occurring within the project area, the USFWS Information for Planning and Consultation (IPaC; USFWS 2019c) was used as a primary source. The project area extends from the Head of Passes, Louisiana, on the lower extremity of the Mississippi River to Cape Girardeau, Missouri. The assessment area consists of all lands and waters between the mainline MRL and the lands and waters within approximately 3,000 feet landside or riverside of the toe of the levees. The IPaC is a project planning tool that streamlines the environmental review process by providing information on the location of federally listed species and other USFWS trust resources that could potentially be affected by a project. Species listed as threatened and endangered under the ESA of 1973 (and subsequent amendments), Neotropical migrants (primarily those designated by the USFWS as Birds of Conservation Concern), and other migratory birds known to regularly use or occupy the project area, as determined through IPaC were identified between Cape Girardeau, Missouri, and Head of Passes, Louisiana. These thirty-five species are listed in Table 3-7.

Table 3-7. Migratory birds within the lower Mississippi River Valley listed as threatened and endangered under the Endangered Species Act of 1973 (and subsequent amendments), Neotropical migrants (primarily those designated by the U.S. Fish and Wildlife Service (USFWS) as Birds of Conservation Concern), and other migratory birds known to regularly use or occupy the project area, as determined through the USFWS Information for Planning and Consultation (IPaC; USFWS 2019c).

Species	Scientific Name	Status
Rallidae		
Black Rail (Eastern)	<i>Laterallus jamaicensis</i>	PT ^a
Clapper Rail	<i>Rallus crepitans</i>	BoCC ^b
King Rail	<i>Rallus elegans</i>	BoCC
Gruidae		
Whooping Crane	<i>Grus americana</i>	FE ^c
Charadriidae		
American Golden Plover	<i>Pluvialis dominica</i>	BoCC
Piping Plover (wintering)	<i>Charadrius melodus</i>	FT ^d , FE
Scolopacidae		
Marbled Godwit	<i>Limosa lapponica</i>	BoCC
Ruddy Turnstone	<i>Arenaria interpres</i>	BoCC
Semipalmated Sandpiper	<i>Calidris pusilla</i>	BoCC
Red Knot	<i>Calidris canutus</i>	FT
Dunlin	<i>Calidris alpina</i>	BoCC
Short-billed Dowitcher	<i>Limnodromus griseus</i>	BoCC
Willet	<i>Tringa semipalmata</i>	BoCC
Lesser Yellowlegs	<i>Tringa flavipes</i>	BoCC
Laridae		
Least Tern (Interior)	<i>Sternula antillarum</i>	FE
Gull-billed Tern	<i>Gelochelidon nilotica</i>	BoCC
Black Skimmer	<i>Rynchops niger</i>	BoCC
Ciconiidae		
Wood Stork	<i>Mycteria americana</i>	FT
Fregatidae		
Magnificent Frigatebird	<i>Fregata magnificens</i>	BoCC
Ardeidae		
Reddish Egret	<i>Egretta rufescens</i>	BoCC
Accipitridae		
Swallow-tailed Kite	<i>Elanoides forficatus</i>	BoCC
Golden Eagle	<i>Aquila chrysaetos</i>	BoCC
Bald Eagle	<i>Haliaeetus leucocephalus</i>	BoCC

Picidae

Red-headed Woodpecker *Melanerpes erythrocephalus* BoCC

Turdidae

Wood Thrush *Hylocichla mustelina* BoCC

Calcariidae

Smith's Longspur *Calcarius pictus* BoCC

Parulidae

Golden-winged Warbler *Vermivora chrysoptera* BoCC

Prothonotary Warbler *Protonotaria citrea* BoCC

Kentucky Warbler *Geothlypis formosa* BoCC

Cerulean Warbler *Setophaga cerulea* BoCC

Emberizidae

Henslow's Sparrow *Ammodramus henslowii* BoCC

LeConte's Sparrow *Ammodramus leconteii* BoCC

Nelson's Sparrow *Ammodramus nelsoni* BoCC

Seaside Sparrow *Ammodramus maritimus* BoCC

Icteridae

Rusty Blackbird *Euphagus carolinus* BoCC

^a PT: Proposed as Federally Threatened

^b BoCC: USFWS Bird of Conservation Concern (USFWS 2008)

^c FE: Federally Endangered

^d FT: Federally Threatened

Additional details regarding individual migratory bird species and their association with specific Work Items can be found in Appendix 8.

3.2.5 Threatened and Endangered Species

The USFWS identified seven federally-listed threatened and endangered species within the project area that should be addressed in this SEIS (Table 3-8). A copy of the USFWS Planning Aid Letter is contained in Appendix 21.

Table 3-8. List of threatened and endangered species within the project area according to the U.S. Fish and Wildlife Service.

<u>Species</u>	<u>Status</u>
Interior least tern (<i>Sterna antillarum</i>)	Threatened
Pallid sturgeon (<i>Scaphirhynchus albus</i>)	Endangered
Wood stork (<i>Mycteria Americana</i>)	Threatened
Fat pocketbook mussel (<i>Potamilus capax</i>)	Endangered
Indiana bat (<i>Myotis sodalis</i>)	Endangered
Northern long eared bat (<i>Myotis septentrionalis</i>)	Threatened
Gray bat (<i>Myotis grisescens</i>)	Endangered

Interior Least Tern

The interior least tern was listed as federally endangered in 1985 (50 FR 21784). The interior population of least terns are fish-eating birds that nest primarily on open sandbars along large rivers in the central United States. Rangewide population estimates are approximately 17,500 individuals (Lott 2006). The LMR has the largest portion of these individuals with the reach between Cape Girardeau, Missouri and Baton Rouge, Louisiana, accounting for approximately 10,000 individuals annually (USACE 1984-2012, 2018g). Habitat is sparse below approximate Mississippi RM 300 and coastal populations become dominant below Baton Rouge as the river deepens. Reductions in threats to the species and an increase in abundance and range resulted in the USFWS proposing to remove the species from the Federal List of Endangered and Threatened Wildlife in 2019 (84 FR 56977).

Pallid sturgeon (*Scaphirhynchus albus*)

The pallid sturgeon was listed as federally endangered in 1990 (55 FR 36641). Pallid sturgeon are benthic fish found within large rivers of the Mississippi and Missouri River basins, including the Mississippi and Atchafalaya Rivers, where they inhabit turbid, free-flowing riverine habitat with rock or sandy substrates. Pallid sturgeon are a main channel fish species that avoids backwaters and small tributaries. Pallid sturgeon are morphologically similar to the more abundant shovelnose sturgeon (*S. platyrhynchus*) sharing the same range and often hybridizing with this related species (Kallemeyn 1983; Killgore et al. 2007).

Wood stork (*Mycteria Americana*)

The wood stork was listed as federally endangered in 1984 (49 FR 7332), and reclassified as threatened in 2014 (79 FR 37077). The United States breeding population of the wood stork occur primarily in the southeastern swamps and wetlands, usually nesting in cypress or mangrove swamps and feeding in freshwater or brackish wetlands. The wood stork may have formerly bred in all the coastal southeastern United States from Texas to South Carolina. Currently, United States breeding is restricted primarily to Florida. Another distinct, non-endangered population breeds from Mexico to northern Argentina. A post-breeding dispersal brings birds (Mexican population) north up the Mississippi River Valley. The current population of birds is believed to number 11,000 adults. Mexican immigrants number approximately 1,000 to 5,000 birds, depending on the year. In Mississippi, most all detections from the endangered eastern population of wood storks are detected in northeastern Mississippi, based on satellite tagged birds. However, most all storks detected in western Mississippi are likely non-endangered Mexican wood storks (Mississippi Museum of Natural Science 2014). Additional information on wood stork can be found in Section 3.2.4 and Appendices 8-9).

Fat pocketbook mussel (*Potamilus capax*)

The fat pocketbook mussel was listed as federally endangered in 1976 (41 FR 24062). Fat pocketbook mussels prefer sand, mud and fine gravel bottoms of large rivers, with their primary fish host being freshwater drum. The species range currently includes the St. Francis River Basin

in Arkansas, the Ohio River Basin, and a recent range expansion into some secondary channels on the LMR (USFWS 2019a).

Indiana bat (*Myotis sodalis*)

The Indiana bat was listed as federally endangered in 1967 (32 FR 4001). Indiana bats are found over most of the eastern United States. They hibernate in large numbers in relatively few caves and are thus, vulnerable to disturbances. During summer, they roost under the peeling bark of dead and dying trees and often forage on flying insects along rivers or lakes and in upland forests. Threats contributing to their decline include commercialization of caves, loss of summer habitat, pesticides and other contaminants, and the disease white-nose syndrome. Indiana bats could be found roosting in trees within the Work Item footprints during the summer, mainly within the northerly portions of the project area in the MVM. Additional information on Indiana bats can be found in Section 3.2.3 and Appendices 7 and 9.

Northern long eared bat (*Myotis septentrionalis*)

The northern long eared bat (NLEB) was listed as federally threatened with an interim 4(d) rule in 2015 (80 FR 17973). NLEB are found throughout the continental United States. During summer, NLEB roost singly or in colonies underneath bark, in cavities, or in crevices of both live and dead trees. The NLEB seems opportunistic in selecting roosts, using tree species based on suitability to retain bark or provide cavities or crevices. It has also been found, rarely, roosting in structures like barns and sheds. In winter, NLEBs hibernate in caves and mines. NLEB could be found roosting in trees within the Work Item footprints during the summer, mainly within the northerly portions of the project area in the Memphis District. Additional information on NLEB can be found in Section 3.2.3 and Appendices 7 and 9.

Gray bat (*Myotis grisescens*)

The gray bat was listed as federally endangered in 1976 (41 FR 17736). The gray bat is one of the largest species in the genus *Myotis* in eastern North America, and one of the few bat species in North America that inhabit caves year-round. The primary range of gray bats is concentrated in the cave regions of Alabama, Arkansas, Kentucky, Missouri, and Tennessee. The species primarily forages over open water of rivers, streams, lakes or reservoirs. Gray bats alternate between cold hibernating caves or mines in winter and warmer caves in summer, often migrating considerable distances between the two. There are no caves within any of the proposed Work Item footprints, but the species could pass through the area during migration. Additional information on gray bats can be found in Section 3.2.3 and Appendices 7 and 9.

3.2.5.1 At Risk Species

The USFWS has defined “at-risk species” as those that are: 1) proposed for listing under the ESA by the USFWS; 2) candidates for listing under the ESA by the USFWS, and 3) petitioned for listing under the ESA, which means a citizen group has requested that USFWS add them to the list of protected species. USFWS listed the following species currently designated as “at-

risk” that may occur within the project area. A copy of the USFWS Planning Aid Letter is shown in Appendix 21.

Eastern Black Rail (*Laterallus jamaicensis* spp.)

The eastern black rail is currently proposed for federal listing under the ESA. The black rail is the smallest rail species in North America. Black rails can be found in tidally or non-tidally influenced freshwater or brackish salt water meadows and marshes. These habitats are usually densely vegetated; however, this species may occasionally occupy upland portions of these habitats. In addition, black rails may occupy impounded and non-impounded wetlands. Little is known about the black rail during migration; however, some evidence suggests that it may use wet prairies, meadows and hayfields during migration. Documented detections of this species inland along the Mississippi River are exceptionally rare, though there have been scattered reports. Within the footprints of the proposed Work Items, a combined 27 acres of marsh habitat potentially suitable for black rails exist.

Alligator Snapping Turtle (*Macrochelys temminckii*)

The alligator snapping turtle (*Macrochelys temminckii*) may be found in large rivers, canals, lakes, oxbows, and swamps adjacent to large rivers. It is most common in freshwater lakes and bayous, but also found in coastal marshes and sometimes in brackish waters near river mouths. Typical habitat is mud bottomed waterbodies having some aquatic vegetation. Floodplain water bodies near the MRL, including associated borrow areas, are conducive habitat for alligator snapping turtle.

Golden-Winged Warbler (*Vermivora chrysoptera*)

The golden-winged warbler breeds in higher elevations of the Appalachian Mountains and northeastern and north-central U.S., but could be found in forested habitats throughout the MAV during spring and fall migrations. This imperiled songbird depends on forested habitats to provide food and water resources before and after trans-Gulf and circum-Gulf migration. Population declines correlate with both loss of habitat owing to succession and reforestation and with expansion of the blue-winged warbler into the breeding range of the golden-winged warbler.

Monarch Butterfly (*Danaus plexippus plexippus*)

The monarch butterfly lives in a variety of habitats throughout North America but needs milkweed for breeding. Recent research has shown dramatic declines in monarchs (~80 percent in 20 years) and their habitats leading conservation groups to petition the USFWS to list the species under the ESA. On June 20, 2014, President Obama signed a Presidential Memorandum, “Creating a Federal Strategy to Promote the Health of Honey Bees and Other Pollinators,” outlining an expedited agenda to address the devastating declines in honey bees and native pollinators, including the monarch butterfly. Monarch butterflies could be found in much of the available habitat where flowering plants are present in the assessment area.

3.2.6 Wetland Resources

Wetlands provide a variety of functions (e.g., water storage, floral and faunal habitat) and values (e.g., flood risk reduction; recreation) within the Mississippi River Valley (Smith and Klimas

2002). However, historic landscape alteration has resulted in significant (greater than 70 percent) declines in forested wetland acreage, and associated losses of wetland functional capacities in the region (King et al., 2006). Wetland disturbances resulted from a combination of factors, including conversion of forested wetlands to agriculture, implementation of drainage networks, and alteration of hydrology at large spatial scales through the development of over 2,000 miles of levees (Hefner and Brown 1995). Recent efforts to assess and restore wetlands have been implemented, resulting in the development of technical approaches to evaluate wetland conditions under a variety of management scenarios.

For this project, three models certified by the USACE National Ecosystem Restoration Planning Center of Expertise were used within their applicable ranges for the wetlands assessment across the project area. The wetland value assessment (WVA) methodology was used in all areas within Louisiana. The WVA Bottomland Hardwoods Community Model for Civil Works (Version 1.2) was used in all WVA assessments that contained forested areas (USACE 2018f). The WVA Coastal Marsh Community Models for Civil Works (Version 2.0) was used in locations dominated by marsh vegetation (USACE 2017). All Work Items located outside of Louisiana were assessed using the Regional Guidebook for Applying the Hydrogeomorphic Approach to Assessing Functions of Forested Wetlands in the Mississippi Alluvial Valley (Murray and Klimas 2013). Wetland assessment results reflect the effects of landscape position (*i.e.*, riverside, landside), disturbance history, and current conditions associated with the MAV. Additionally, results differ by methodology (*i.e.*, WVA, HGM). Notably, these results do not suggest that one method provides more accurate representations of wetland condition/functional capacity.

To quantitatively assess and analyze wetland resources at each of the 143 proposed Work Item locations, wetland assessment areas were defined as a one-half mile buffer extending from the levee on both the river and land side of each Work Item, similar to other resource analyses. This allows for the documentation of conditions in areas where project implementation is expected to occur while accounting for differences in wetland structure and function within the batture (riverside of the levee) and outside of the batture (landside of the levee). Detailed maps and data at each of the proposed Work Item locations are included in Appendix W1 within Appendix 10. Summaries of the land cover classes within the wetland assessment areas are shown in Tables 3-9 and Table 3-10 below.

Table 3-9. Acreage of land cover classes within the wetland assessment area (defined as one-half mile buffer around each Work Item) within each USACE District (35 Work Items within Memphis District, 16 Work Items within MVK, 92 Work Items within New Orleans District).

	Memphis		Vicksburg		New Orleans	
	Riverside	Landside	Riverside	Landside	Riverside	Landside
Brackish Marsh	0	0	0	0	0	491
Cropland	10,121	21,629	526	8,574	480	19,9927
Forest	6,558	3,746	8,593	2,954	10,377	11,049
Intermediate Marsh	0	0	0	0	0	320
Levee	1,223	2,339	1,043	1,575	2,590	3,006
Open Water	5,617	348	3,711	41	48,864	627
Pasture	1,002	268	67	420	54	5,952
Saline Marsh	0	0	0	0	0	211
Urban	202	2,062	18	158	1,583	26,396
Total	24,723	30,392	13,958	13,722	63,947	67,979
Combined Total	55,115		27,680		131,926	

Table 3-10. Acreage of land cover classes within the wetland assessment area within each State.

	Arkansas	Illinois	Kentucky	Louisiana	Mississippi	Missouri	Tennessee
Brackish Marsh	0	0	0	491	0	0	0
Cropland	12,106	1,194	260	27,928	1,580	9,470	8,721
Forest	5,481	742	103	31,047	1,927	2,014	1,965
Intermediate Marsh	0	0	0	320	0	0	0
Levee	2,125	204	28	7,684	530	699	507
Open Water	2,414	1,891	171	52,516	727	1,212	278
Pasture	313	0	1	6,388	104	107	848
Saline Marsh	0	0	0	211	0	0	0
Urban	143	1,437	67	27,979	176	605	14
Total	22,582	5,468	629	154,563	5,043	14,105	12,330

The appropriate model (WVA marsh, WVA forested wetland, HGM) was applied at each individual levee Work Item. This required on-site data collection, which was conducted at 321 sample plots within the project area. Additional details on data acquisition is included in Appendix 10.

3.2.6.1 Wetland Value Assessment (WVA)

The majority of Work Items in Louisiana were assessed using the WVA models for BLH forests. That approach incorporates seven variables into the wetlands assessment, including: V1 - tree species composition, V2 - stand maturity, V3 - understory/midstory, V4 – hydrology, V5 - size

of contiguous forested area, V6 - suitability of surrounding lands, and V7 – disturbance. Variable metric scores are converted to habitat suitability on a scale of 0.0 (i.e., no habitat value) to 1.0 (highest possible habitat suitability). The forested WVA HSI values ranged from 0.26 – 0.79 (mean HSI = 0.55). The HSIs remain limited by landscape position and surrounding land use, disturbance regime, and patterns of species succession. Notably, most assessment locations within the WVA area of application are adjacent to areas of active agriculture and/or non-habitat. This results in low scores for V₆ – suitability and traversability of surrounding land uses. Additionally, V₇ – disturbance scores are constrained by the location of the levee Work Items that exhibit a minimum of frequently/moderately used roads and waterways within 500 feet of the assessment area. Some HSI values are also limited with respect to V₅ - size of the contiguous forest, especially in areas exhibiting urban development.

Forested wetland species composition and maturity also limit the WVA HSI values under existing conditions at the majority of levee Work Item locations. The overstory species composition within forested areas are dominated by sugarberry, cottonwood, willow, and other non-mast/soft-mast producing species. Species composition is not expected to improve since landscape position, flood frequency and duration, disturbance, and other factors dictate patterns of forest succession, which limit the extent of oak and hickories within the assessment area.

A summary of the measured riverside and landside forested wetland values from the WVA are shown in Tables 3-11 and 3-12 below.

Table 3-11. Summary of WVA forested wetland assessment inputs and outputs - riverside.

Assessment metric	unit	Mean	Minimum	Maximum
Hardwood trees	%	20	0	80
Softwood trees	%	24	0	65
Diameter at breast height	inches	13	7	34
Understory vegetation	%	51	10	100
Midstory vegetation	%	29	0	70
Contiguous forest area	acres	5,685	17	38,199
Forested buffer	%	9	2	39
Abandoned agriculture buffer	%	1	0	4
Pasture buffer	%	8	4	25
Active agriculture buffer	%	57	38	78
Non-habitat buffer	%	24	0	55
Variable subindex scores				
Tree species composition (V1)	unitless	0.60	0.20	1.00
Stand maturity (V2)	unitless	0.46	0.08	1.00
Understory/midstory (V3)	unitless	0.89	0.35	1.00
Hydrology (V4)	unitless	0.85	0.85	0.85
Forested area (V5)	unitless	0.78	0.40	1.00
Suitability (V6)	unitless	0.25	0.12	0.53
Disturbance (V7)	unitless	0.50	0.50	0.50
Habitat suitability model outputs				
HSI	unitless	0.55	0.27	0.79

Table 3-12. Summary of WVA forested wetland assessment inputs and results - landside.

Assessment metric	unit	Mean	Minimum	Maximum
Hardwood trees	%	20	0	80
Softwood trees	%	24	0	65
Diameter at breast height	inches	13	7	34
Understory vegetation	%	51	10	100
Midstory vegetation	%	29	0	70
Contiguous forest area	acres	5,685	17	38,199
Forested buffer	%	9	2	39
Abandoned ag buffer	%	1	0	4
Pasture buffer	%	8	4	25
Active ag buffer	%	57	38	78
Non-habitat buffer	%	24	0	55
Variable subindex scores				
Tree species composition (V1)	unitless	0.60	0.20	1.00
Stand maturity (V2)	unitless	0.46	0.08	1.00
Understory/midstory (V3)	unitless	0.89	0.35	1.00
Hydrology (V4)	unitless	0.65	0.65	0.65
Forested area (V5)	unitless	0.78	0.40	1.00
Suitability (V6)	unitless	0.25	0.12	0.53
Disturbance (V7)	unitless	0.50	0.50	0.50
Habitat suitability model outputs				
HSI	unitless	0.53	0.26	0.76

The WVA method for assessing marsh landscape features incorporates six variables: V1 – Emergent Vegetation, V2 – Open water, V3 – Marsh edge interspersions, V4 – open water <1.5-ft., V5 – Salinity, and V6 – organism access. Variable scores are then converted to suitability index (SI) values and combined to generate a Habitat Suitability Index HSI. All of the marshes encountered during the wetland evaluation occurred in the intermediate, brackish, and saline subclasses (Visser et al., 2000). The WVA results for marshes exhibited mean habitat suitability unit (HSU) values of 0.78 HSI units (range = 0.6-0.96 HSI units). A summary of the marsh wetland values are shown in Table 3-13 below.

Table 3-13. WVA marsh wetland assessment inputs and results.

Assessment metric	unit	Mean	Minimum	Maximum
Emergent vegetation	%	51	30	70
Open water	%	35	20	50
Marsh edge interspersion	ordinal	2	1	3
Open water <1.5 ft	%	45	20	70
Salinity	ppt	3	1	5
Organism access	ordinal	1	1	1
Variable subindex scores				
Emergent vegetation (V1)	unitless	0.80	0.55	1.00
Open water (V2)	unitless	0.53	0.32	0.79
Marsh edge interspersion (V3)	unitless	0.63	0.50	0.75
Open water <1.5 ft (V4)	unitless	0.64	0.33	1.00
Salinity (V5)	unitless	1.00	1.00	1.00
Organism access (V6)	unitless	1.00	1.00	1.00
Habitat suitability model outputs				
Marsh HSI	unitless	0.81	0.62	0.97
Open water HSI	unitless	0.70	0.53	0.93
HSI	unitless	0.78	0.60	0.96

3.2.6.2 Hydrogeomorphic (HGM) Wetland Assessment

The HGM method approved for use in the Mississippi Alluvial Valley uses several wetland subclasses. The current assessment used the riverine overbank subclass in all areas on the riverside (i.e., batture) of the levee and the riverine backwater subclass on the landward side of the levee (Murray and Klimas 2013). The HGM method for both subclasses includes evaluation of a combination of 13 off-site and onsite variables, including the following: 1. wetland tract (V_{TRACT}), 2. core area (V_{CORE}), 3. habitat connectivity ($V_{CONNECT}$), 4. flood frequency (V_{FREQ}), 5. flood duration (V_{DUR}), 6. soil integrity (V_{SOIL}), 7. micro-depressional ponding (V_{POND}), 8. tree basal area (V_{TBA}), 9. litter cover (V_{LITTER}), 10. strata present (V_{STRATA}), 11. tree composition (V_{COMP}), 12. downed woody debris biomass and snags ($V_{DWD\&S}$), and 13. tree size classes ($V_{TREESIZE}$). Variable metric data was transformed into variable subindex scores ranging from 0.0 to 1.0, and wetland functional capacity index (FCI) scores were calculated using empirical equations. The HGM forested wetland assessment results indicate moderate to high levels of wetland functional capacity. Where less than optimal conditions occurred, the assessment scores are limited by a combination of landscape and onsite factors. Some forested areas are small, surrounded by active agricultural lands, and/or occur in narrow bands, reducing the variable subindex scores for V_{TRACT} , V_{CORE} , and $V_{CONNECT}$. Additionally, some areas exhibit limited micro-depressional ponding potential (V_{POND}), tree basal area (V_{TBA}), and tree size ($V_{TREESIZE}$). Note that levee Work Items located on the landside do not increase FCI values because they currently exhibit the optimum basal area prescribed for the riverine backwater wetland subclass. Non-forested wetland areas (i.e., agriculture and pasture cover types) yielded FCI values of 0.20 and 0.15 in riverside and landside positions, respectively. The absence of trees and other strata results in low functional capacities for most functions, although riverside non-forested wetlands continue to provide a moderate capacity to detain precipitation (FCI = 0.54). A summary of the

riverside and landside forested wetland values from the HGM are shown in Tables 3-14 and 3-15 below.

Table 3-14. HGM forested wetland assessment inputs and results - riverside.

Assessment metric	unit	Mean	Minimum	Maximum
Wetland tract	ha	5486	27	20709
Core area	ha	42	1	78
Habitat connectivity	%	38	6	100
Flood frequency	ordinal	normal	normal	normal
Flood duration	ordinal	normal	normal	normal
Soil integrity	%	100	100	100
Micro-depressional ponding	%	44	3	85
Tree basal area	count	15	9	24
Litter cover	%	76	2	100
Strata present	count	2.95	2.00	3.00
Tree composition	weighted average	0.84	0.50	1.00
Downed woody debris/snags	ordinal	normal	normal	normal
Tree size classes	count	3.88	1.00	4.00
Variable subindex scores				
V _{TRACT}	unitless	0.57	0.10	1.00
V _{CORE}	unitless	0.92	0.00	1.00
V _{CONNECT}	unitless	0.93	0.40	1.00
V _{FREQ}	unitless	1.00	1.00	1.00
V _{DUR}	unitless	1.00	1.00	1.00
V _{SOIL}	unitless	1.00	1.00	1.00
V _{POND}	unitless	0.79	0.40	1.00
V _{TBA}	unitless	0.86	0.70	1.00
V _{LITTER} *	unitless	1.00	1.00	1.00
V _{STRATA}	unitless	0.99	0.85	1.00
V _{COMP}	unitless	0.84	0.50	1.00
V _{DWD&S} *	unitless	1.00	1.00	1.00
V _{TREESIZE}	unitless	0.98	0.30	1.00
Wetland functional capacity model outputs				
Detain Floodwater	unitless	0.95	0.85	1.00
Detain Precipitation	unitless	0.90	0.70	1.00
Cycle Nutrients	unitless	0.97	0.86	1.00
Export Organic Carbon	unitless	0.96	0.89	1.00
Maintain plant communities	unitless	0.90	0.78	1.00
Provide fish and wildlife habitat	unitless	0.88	0.54	1.00
Average functional capacity	unitless	0.94	0.83	1.00

Variable subindex scores for V_{LITTER} and V_{DWD&S}* were prescribed values of 1.0 to account for potential flood effects.

Table 3-15. HGM forested wetland assessment inputs and results - landside.

Assessment metric	unit	Mean	Minimum	Maximum
Wetland tract	ha	5486	27	20709
Core area	ha	42	1	78
Habitat connectivity	%	38	6	100
Flood frequency	ordinal	normal	normal	normal
Flood duration	ordinal	normal	normal	normal
Soil integrity	%	100	100	100
Micro-depressional ponding	%	44	3	85
Tree basal area	count	15	9	24
Litter cover	%	76	2	100
Strata present	count	2.95	2.00	3.00
Tree composition	weighted average	0.84	0.50	1.00
Downed woody debris and snags	ordinal	normal	normal	normal
Tree size classes	count	3.88	1.00	4.00
Variable subindex scores				
V _{TRACT}	unitless	0.57	0.10	1.00
V _{CORE}	unitless	0.92	0.00	1.00
V _{CONNECT}	unitless	0.93	0.40	1.00
V _{FREQ}	unitless	1.00	1.00	1.00
V _{DUR}	unitless	1.00	1.00	1.00
V _{SOIL}	unitless	1.00	1.00	1.00
V _{POND}	unitless	0.94	0.10	1.00
V _{TBA}	unitless	0.98	0.70	1.00
V _{LITTER}	unitless	0.86	0.10	1.00
V _{STRATA}	unitless	0.99	0.85	1.00
V _{COMP}	unitless	0.84	0.50	1.00
V _{DWD&S}	unitless	1.00	1.00	1.00
V _{TREESIZE}	unitless	0.98	0.30	1.00
Wetland functional capacity model outputs				
Detain Floodwater	unitless	0.99	0.85	1.00
Detain Precipitation	unitless	0.93	0.55	1.00
Cycle Nutrients	unitless	0.99	0.86	1.00
Export Organic Carbon	unitless	0.96	0.66	1.00
Maintain plant communities	unitless	0.94	0.72	1.00
Provide fish and wildlife habitat	unitless	0.90	0.54	1.00
Average functional capacity	unitless	0.95	0.78	1.00

*Variable subindex scores for V_{LITTER} and V_{DWD&S} were prescribed values of 1.0 to account for potential flood effects.

Additional details of the wetland assessment within the project area can be found in Appendix 10.

3.2.7 Aquatic Resources

The assessment area consists of approximately 577,000 acres of open water (including the Mississippi River, tributaries, lakes, borrow areas, floodplain ponds, etc.). Most of the aquatic resources in the project area are centered around mainstem and floodplain habitats of the Mississippi River. Seasonal hydrologic fluctuations support these habitats with numerous aquatic functions and provide spawning and rearing habitat for a variety of fish species. Borrow areas excavated for construction of the MRL are common aquatic habitats associated with the project, comprising approximately 42,000 acres in the LMR (Baker et al. 1991). Aquatic communities within borrow areas are similar to other floodplain water bodies along the LMR, with 95 macroinvertebrate species and 75 fish species having been documented (Miranda et al. 2013 and Cobb et al. 1984). Dominant macroinvertebrate communities include: oligochaetes, *Chaoborus*, and chironomids, and dominant fish communities include: gizzard shad, threadfin shad, and juvenile sunfishes.

3.2.7.1 Aquatic Habitat Suitability Index (HSI) Model

To assess aquatic communities within borrow areas near the MRL, a HSI model certified for use by the USACE National Ecosystem Restoration Planning Center of Expertise was developed specifically for borrow areas within the project area. Multiple regression models were developed to predict fish diversity (dependent or response variable) as a function of habitat parameters (the independent or predictor) that describe the morphology and water quality of borrow areas. Additionally, the fisheries data were used to develop a relative value index (RVI) to account for differences in the fish communities for landside borrow areas not connected to the Mississippi River with lower fish diversity. Precipitation maintains water levels in landside borrow areas whereas periodic connection to the river and hyporheic flow maintains water levels in riverside areas. Data used in model development were derived from 1-acre rotenone samples in 25 borrow areas collected in 1981 for the USACE Lower Mississippi River Environmental Program, and eight borrow areas in the mid-1990s for the 1998 SEIS. In addition, riverside and landside borrow areas were sampled in 1997 and 2019, for a total sample size of 15, to compare differences in fish assemblages on both sides of the levee. Location information of the sampled borrow areas is shown in Appendix 11.

The same water quality, hydrologic, and morphometric variables measured by Cobb et al. (1984) were obtained by survey crews in 1996-97. Water quality was measured at the water's surface with calibrated multi-parameter meters. Variables included water temperature, dissolved oxygen, pH, conductivity, and turbidity. Bathymetric and ground surface elevations were measured by survey teams to calculate mean depth, maximum depth, area, volume, percent area with depth greater than 5 feet, and percent area with depth greater than 10 feet. Borrow area morphometry was expressed as a volume development index (VDI) and shoreline development index (SDI).

Borrow areas sampled in the batture represented a wide range of morphometric and water quality characteristics (Table 3-16).

Table 3-16. Mean values for water quality and morphometrics of borrow areas sampled in 1981 and 1996-97, lower Mississippi River. Water quality was measured 0.5 m below water surface generally in the middle of the borrow area.

Year	Variable	Mean	Median	Standard Deviation	Minimum	Maximum
1981 N=25	Water Temperature, °C	31.7	31.8	2.0	27.0	35.5
	Conductivity, µmhos/cm	310.7	315.0	89.3	75.0	505.0
	Dissolved Oxygen, mg/l	6.8	6.5	2.5	0.6	11.0
	pH	8.1	8.2	0.6	7.0	9.4
	Turbidity, NTU	26.6	18.0	21.0	8.0	85.0
	Surface Area, acres	19.2	12.7	16.5	3.3	53.4
	Average Depth, ft	3.1	2.8	1.8	0.5	7.2
	Maximum Depth, ft	6.5	5.5	4.2	1.1	17.7
	Percent Area > 5 ft	27.5	17.1	27.6	0.0	71.7
	Percent Area > 10 ft	3.2	0.0	7.9	0.0	33.0
	Shoreline Length, ft	6471	4839	3941	1916	15224
	Shoreline Development Index	2.1	2.0	0.6	1.2	3.4
	Volume, ft ³	109039	71813	105021	4056	348228
	Volume Development Index	1.5	1.6	0.3	0.7	1.9
	Basin Slope	0.0	0.0	0.0	0.0	0.1
	Number of Days Flooded Annually	81.3	84.0	23.5	24.0	117.0
1996-97 N=8	Water Temperature, °C	31.4	31.7	4.4	24.2	37.9
	Conductivity, µmhos/cm	281	283	49	205	344
	Dissolved Oxygen, mg/l	6.8	7.3	1.7	3.6	8.6
	pH	8.0	8.0	0.4	7.5	8.4
	Turbidity, NTU	26	26.6	14	7	50
	Surface Area, acres	17.0	17.2	13.3	3.3	41.0
	Depth, ft	3.3	3.4	1.5	1.3	5.8
	Maximum Depth, ft	6.5	5.7	3.5	2.6	12.4
	Percent Area > 5 ft	15.9	10.9	19.6	0.0	53.8
	Percent Area > 10 ft	2.9	0	6.4	0	18
	Shoreline Length, ft	8456	7677	6491	1751	20297
	Shoreline Development Index	2.7	2.4	1.5	1.3	5.8
	Volume, ft ³	88249	77550	77519	7075	175935
	Volume Development Index	1.6	1.6	0.3	0.9	2
	Basin Slope	0.01	0.01	0.08	-0.17	0.1
	Number of Days Flooded	69	64	27	25	114

Borrow areas ranged in size from 3 to 53 acres with mean depths of approximately 3 feet during all three sampling periods (Table 1-2). Maximum depth measured in any one borrow area was 17.7 feet, but mean percent area greater than 10 feet was only 3 percent. Overall, the typical borrow area in the LMR batture was less than 20 acres and averaged 3 feet in depth. The mean SDI ranged from 2.1 to 2.7, depending on sampling years, with a maximum value measured of 5.8. Most borrow areas are rectangular or bowl shaped (i.e., VDI>1.0) and shorelines often become more irregular over time increasing SDI above 2.0. Water quality was typical for summer conditions in relatively shallow, permanent water bodies in the batture. Mean water temperature was high (>31 °C) with no observable flow, and some borrow areas were hypoxic (< 3 mg/l dissolved oxygen) and turbid (> 50 NTU).

Floodplain water bodies provide critical habitat for riverine fishes and thus the frequency and timing of connection (connection frequency) between the river and the water body is an important factor in determining the fish community. To calculate connection frequency, the river stage at the borrow pit was calculated for each day from 1 January 1970 to 31 December 2019 using the upstream and downstream gage river mile and stage and the river mile of the borrow pit. Once the river stage at each borrow pit was calculated, the connection frequencies for 1 month, 6 months, overwintering 6 months, 1 year, 5, years and 10 years prior to the sampling date were calculated. These time periods were chosen because they capture short term movements, spawning, overwintering (6 month period prior to spawning 6 months), overwintering and spawning, and longer-term changes reflecting water year variability. To study the relationship between changes in area and volume and connection frequency, the connection frequency between the 1981 sampling date and the 1996/97 or 2019 sampling date was also calculated. The mean (± 1 standard deviation) connection frequency per year was 90 ± 101 days, including all sampling periods. The variation of connection frequencies among the three sampling periods contributed to the high standard deviation. The mean annual connection frequency for the 1981 data was just 23 days, increased to 91 days for the 1996-97 period, and rose to 254 days for the 2019 period, illustrating changes in flood frequency over the last few decades. Other connection frequencies follow the same trend. Based on recent flood frequency data, most borrow areas would be connected to the river annually as floodwaters approach the levees, mixing both riverine and wetland fish species creating a more diverse assemblage.

Long-term changes in habitat were evaluated by comparing borrow areas sampled repeatedly (Appendix 11). Comparing the borrow areas sampled in 1981 and 2019 (38 years) showed moderate differences in average depth, decreasing 17 percent overall, indicating patterns of sedimentation. However, surface acres were similar during the evaluation period. The mean percent area greater than 5 feet and the VDI showed substantial decreases of 33 percent and 40 percent, respectively. The mean shoreline length and SDI increased 38 percent and 39 percent, respectively. Number of days flooded annually increased during this same time period. Comparison of these morphological and bathymetric variables over the 38-year period indicate that the shorelines of most borrow areas become more sinuous over time. However, water depth and overall volume decreases as vertical accretion of sediments during flood events. More frequent floods may exacerbate this long-term trend.

Overall, 75 species of fish were collected from riverside borrow areas in 1981 and 1996-1997. The number of species collected per borrow area ranged from 18 to 50 with a mean (± 1 SD) of 31

± 8 . The number of fish per acre ranged from 829 to 62,160 with a mean of $11,320 \pm 11,579$. Taxonomically dominant groups were minnows (16 species) and sunfishes (13 species). Catfishes, suckers, and darters were moderately speciose (7-8 species). Invasive carps (minnow family) were only collected in 1996-97 (grass carp, silver carp, and bighead carp). Numerically abundant species were forage fishes, including gizzard shad, threadfin shad, and juvenile sunfishes. None of the species collected are federally listed as threatened or endangered, but several species are regionally imperiled (Robison and Buchanan 1988; Jelks et al. 2008). Paddlefish are listed by eight southern states, including Arkansas, and are protected year-round in the state of Louisiana and seasonally in the state of Mississippi. Listing was proposed by the Committee on International Trade in Endangered Species (CITES) in 1998 (Cites 1997). Alligator gar have declined substantially during the past 40 years and are listed by the States of Tennessee and Arkansas. Taillight shiner typically occur in undisturbed oxbow lakes and swamps and are listed by the State of Arkansas. Golden topminnow, also an inhabitant of oxbows and swamps, are assumed extirpated in Missouri and listed by the State of Tennessee. Borrow areas with riverine connections function similarly to oxbow lakes and may provide alternate habitat and refugia during high water events for riverine and wetland species declining elsewhere in their range (Miranda et al. 2013). For the model, three different measures of species diversity were used to describe the fish communities: standardized species richness (S), Pielou's evenness index (J'), and Simpson's dominance index (D) (Magurran 1988; Ludwig and Reynolds 1988). Standardized species richness ranged from 18 to 44 species/11,500 individuals (i.e., approximates mean number of fish per acre), similar to total observed number of species that ranged from 18 to 50. Pielou's evenness index ranged from 0.2, indicating the presence of a few dominant species, to 0.7 indicating similarity in abundances among the species. Simpson dominance index ranged from 0.2 to 0.9 corresponding to the evenness metric that some borrow areas are dominated by only a few species. Gizzard shad, threadfin shad, and juvenile sunfishes comprised almost 75 percent of the total individuals in borrow areas contributing to low evenness and high dominance. Other species represented 5 percent or less of the total individuals. Comparison of the diversity measures between decades showed species richness increasing from 1981 to 1996-97, evenness remaining steady, but dominance shifting either up or down. In addition to the three dominant species mentioned previously, bluegill sunfish, channel catfish, orangespotted sunfish, and white crappie were common in the collections and further contributed to low evenness and high dominance of riverside borrow area fish communities. These species are widespread throughout the LMR and most are considered generalists in their tolerance to habitat and water quality fluctuations.

HSI values were developed using multiple regression for the three measures of fish diversity. The multiple regression analysis retained four independent habitat variables: VDI, maximum depth, percent area greater than 5 feet, and turbidity. VDI and maximum depth were positively correlated to species richness, while percent area greater than 5 feet and turbidity were negatively correlated possibly due to low dissolved oxygen near the bottom. The predicted standardized species richness was divided by the maximum richness value (i.e., 43 species) observed in the sampled borrow areas retained in the analysis to normalize a HSI score between 0 and 1 (Equation 1).

Equation 1:

$$\text{HSI} = \frac{31.2(\text{VDI}) + 2.2(\text{Maximum Depth}_{\text{ft}}) - 0.2(\text{Percent Area} > 5\text{ft}) - 0.1(\text{Turbidity}_{\text{NTU}}) - 24.3}{43}$$

Overall, fish were more abundant and diverse in riverside borrow areas than landside. A total of 18 species were collected with gillnets in landside borrow areas during 1997 compared to 31 and 30 species in riverside borrow areas during 1997 and 2019, respectively. Gizzard shad was the most abundant species in all borrow areas. Species associated with riverine environments were common in riverside borrow areas but mostly absent or in low abundance in landside borrow areas. These include mooneye, alligator gar, white bass, river carpsucker, and sauger. Seining had similar results. A total of 17 species were collected landside compared to 38 and 44 species riverside during the 2007 and 2019 collections, respectively. Four species comprised over 80 percent of the total individuals in landside borrow areas: orangespotted sunfish, largemouth bass, inland silverside, and bluegill. With the exception of inland silverside, the three remaining species are habitat generalists and often found in isolated ponds and lakes. Species diversity measures showed the same trends of being much higher in riverside borrow areas compared to landside. The average percent difference in standardized species richness between landside and riverside borrow areas based on seining and gillnet data, designated as the RVI was 0.6. Thus, for landside borrow areas, the HSI value calculated from the equation 1 can be multiplied by 0.6, to take into account lower species richness in landside borrow areas.

Additional details of the aquatic resource assessment within the project area can be found in Appendix 11.

3.2.8 Water Quality

3.2.8.1 Mississippi River

Multiple studies have been conducted to determine the overall aquatic health of the Mississippi River. The passage of the Clean Water Act (CWA) in 1972 initiated slow improvements to the water quality of the streams flowing into the Mississippi River. Although the water quality in the Mississippi River is improved since the passage of the CWA, it still carries a high load of nutrients to the Gulf of Mexico. The Spatially Referenced Regression On Watershed attributes (SPARROW) model was constructed for the Mississippi/Atchafalaya River basin (MARB) to help identify the major sources of nitrogen and phosphorus loads to the continental watershed. Catchments located in the middle Mississippi and Ohio River basins were found to deliver the highest nitrogen yields while the highest phosphorus yields were located throughout the central region of the MARB. Agricultural inputs from manure, fertilizer, and legume crops were the largest sources of nitrogen. High phosphorus inputs were found to come from areas with a high concentration of crop and animal agriculture and wastewater treatment plants (Robertson and Saad, 2014, Robertson et al., 2014). Long-term sampling efforts have been conducted by the United States Geological Survey (USGS) for the last 50 years at many stations along the LMR. To describe water quality in the Mississippi River within the assessment area, water quality data from multiple stations along the LMR were retrieved from the USGS National Water Information System (NWIS), an online database, and the data were analyzed using Statistical Analysis System (SAS) software (PROC MEANS). Due to the low number of samples collected

in any given year, the data were sorted and analyzed by decade. Full details on the water quality analysis are included in Appendix 12 and summarized below.

The mean value of *in situ* water quality measurements from 1970 to 2019 were compared as they move downstream from Thebes, Illinois to New Orleans, Louisiana. All of these measurements (temperature, pH, dissolved oxygen, specific conductance, and turbidity) were within acceptable limits for the National Recommended Water Quality Criteria for freshwater published by the EPA.

The mean value for the period of record of the five highlighted nutrient concentrations were compared as they move downstream from Thebes to New Orleans. At the time this document was written, no standard criteria for rivers and streams (fresh water) for nutrients had been published by EPA or the representative environmental state agencies for Louisiana, Mississippi, Arkansas Missouri, Tennessee, Kentucky and Illinois. The mean total nitrogen (TN) concentration decreased approximately 1.0 mg/L from Thebes to Memphis and continued to fall at a slower rate to New Orleans from 3.46 mg/L to 2.38 mg/L and then an average of 1.80 mg/L, respectively. The mean nitrogen oxide (NOx) concentration of 2.46 mg/L at Thebes decreased slowly to a concentration of 1.37 mg/L at Arkansas City before increasing slightly to an average of 1.48 mg/L at the lower three stations. It should be noted that the slight increase in concentration between Arkansas City and Vicksburg can likely be attributed to the predominant time frame of sample collection. Approximately 75 percent of the samples for Arkansas City were collected in the 1980s and prior, while approximately 90 percent of the samples collected for Vicksburg were from the 2000 and 2010 decades. The mean concentration for total organic nitrogen (TON) demonstrated a more consistent downward trend from Thebes to New Orleans except for the lower concentration at Memphis. The concentration for the TON parameter fell from 0.97 at Thebes to 0.57 mg/L at New Orleans. The total phosphorous (TP) mean concentration of 0.34 mg/L at Thebes decreased to 0.19 mg/L at Memphis and then slowly increased to 0.24 mg/l as flow moves to New Orleans. The mean concentration for orthophosphate decreased from 0.100 mg/L at Thebes to 0.059 mg/L at Vicksburg and then increased back to 0.100 mg/L at New Orleans.

Trace metal samples in the Lower Mississippi River were not collected as frequently in recent decades as they were in the earlier decades. The most substantial sets of trace metal concentrations were found at the Thebes and St. Francisville stations during the decade of 2000. These data included concentrations for arsenic, cadmium, chromium, copper, iron, lead, nickel, selenium, lithium, silver and zinc. The National Recommended Water Quality Criteria for fresh water published by the EPA was used for comparison. The mean hardness values from the 2000 decade of 202 and 144 mg/L for Thebes and St. Francisville, respectively, were used to compute hardness dependent criteria. No data was reported for mercury at either of these stations for the 2000 decade. The mean dissolved trace metal concentrations were within acceptable aquatic life limits for acute and chronic fresh water (FWA & FWC) for all metals.

3.2.8.2 Borrow Areas

In the period leading up to the 1998 SEIS, efforts were made to document water quality conditions from over 25 borrow areas on both the riverside and landside of the levee scattered throughout all three Districts of the LMR. The findings of this monitoring effort were documented in the 1998 SEIS report. Follow up studies were conducted in 2019 at five of the previously documented borrow areas where additional *in-situ* water quality measurements were collected, and one additional borrow area. These borrow areas were located on both the riverside and landside of the levee throughout the project area from RM 180 above Head of Passes to RM 733. The water quality parameters collected include: water temperature, specific conductivity, dissolved oxygen, pH and turbidity. Additional details of the locations and data analyses are included in Appendix 12.

Water temperature varied both spatially and temporally among the sampled borrow areas. While depth appeared to influence the temperature measurements on many of the sample dates, all but one of the values were above 27.7 degrees Celsius. These measurements were consistent with the warmer southern climate during the summer months. Temperatures varied as much as 9 degrees Celsius at the surface between the three sample dates at one borrow area. However, the water temperature range for the other 4 previously sampled borrow areas (see Appendix 12) was only 3 to 5 degrees Celsius at the surface over the same time frame. Water temperature range between the surface and the bottom of the borrow areas went from 0.0 to 1.9 degrees for four of the sampled borrow areas (see Appendix 12), where maximum depth was less than 4.5 feet. Temperature readings varied as much as 7.4 degrees Celsius in one borrow area (see Appendix 12), where the maximum depth exceeded 11 feet. Many of the temperature readings exceeded EPA's national criteria for maximum temperature for freshwater aquatics of 32.0 degrees Celsius. The specific conductivity ranged between 279 and 536 $\mu\text{S}/\text{cm}$ at the surface in one borrow area (see Appendix 12), over the multiple measurement events. Specific conductivity varied less than 31 $\mu\text{S}/\text{cm}$ between measurements taken at the surface and at the bottom. The dissolved oxygen concentration at the surface ranged from 3.14 to 12.2 mg/L for all of the borrow areas. Dissolved oxygen measurements ranged from 0.15 to 6.46 mg/L at the bottom of the borrow areas. All of the recent measurements were collected in August and September of 2019 from five of the sampled borrow areas (see Appendix 12), and at least one of the two sites in each borrow area failed to meet the EPA minimum dissolved oxygen concentration for freshwater of 5.0 mg/L. These borrow areas likely suffered from excessive oxygen demand propagated by the concurrent backwater flood. Hydrogen ion concentrations (pH) ranged from a high of 11.96 at the surface of one borrow area to a low of 7.0 at the bottom of another borrow area (see Appendix 12). The criteria range of 6.0 to 9.0 set by EPA's national standard was exceeded on the upper criterion from measurements taken at the surface from five of the sampled borrow areas (see Appendix 12). These high pH measurements are likely the result of primary productivity. Turbidity measurements taken at the surface ranged from 7.2 to 40.7 NTUs with one outlier reaching 68.9 NTU. The quiescent surface of most borrow areas allows for optimal settling conditions for many of the summer months. The water quality measurements reported from the selected borrow areas were collected during warmer summer months allowing temperatures to exceed the national standard for fresh water. In some instances, dissolved

oxygen concentrations were observed to fall below national standards and pH was observed above of the basic criteria set for aquatic health. The *in-situ* water quality values for the six borrow areas can be seen in Table 3-17 below.

Table 3-17. *In-Situ* water quality measurements collected from borrow areas from the LMR in 1980, 1997 and 2019.

In-Situ Water Quality Measurements Recently Documented for Existing Borrow Pits Along the LMR																
New Date	Location	WQ Depth S	WQ Max Depth (ft)	S Water Temp	M Water Temp	B Water Temp	S Cond	M Cond	B Cond	S DO	M DO	B DO	S pH	M pH	B pH	S Turb
7/10/1981	Borrow_Pit_13	0.65	0.75	34.5			315			8.65			8.4			8
7/21/1997	Borrow_Pit_13		11.4	35.3	32.8	27.86	269	272	303	7.27	4.5	0.33	8	7.64	7	7.2
8/21/2019	Borrow_Pit_13	0.12	11.1	33.9	30.1	29.7	440.2	443.4	450.8	12.2	18.2	4.1	8.93	9.17	8.92	8.3
8/21/2019	Borrow_Pit_13	0.18	11.5	30.3	30.3	29.4	443.3	444.3	453.1	3.41	3.44	0.15	7.59	7.98	8.2	9.4
7/13/1981	Borrow_Pit_15	0.45	0.6	33.25			355			6.2			7.7			11
7/28/1997	Borrow_Pit_15			37.89		36.11	228		235	8.14		6.46	8.4		8.01	33.4
7/29/1997	Borrow_Pit_15			33.24		33.16	234		234	3.2		2.4	7.45		7.52	68.9
8/19/2019	Borrow_Pit_15	0.15	2.3	31.6	30.9	29.9	455.3	438.8	438.7	7.19	6.97	6.35	9.3	9.29	9.33	8.6
8/19/2019	Borrow_Pit_15	0.21	2.7	28.3	28.4	28.3	403.5	409.1	401.4	3.4	3.45	3.33	7.97	8.05	8.03	8.3
7/20/1981	Borrow_Pit_17	0.75	0.85	33.25			235			9.65			8.05			16
8/5/1997	Borrow_Pit_17		2.5	24.15			205			3.62			7.49			26.6
9/11/2019	Borrow_Pit_17	0	2.6	29.7	29	28.6	369.8	367.5	367.2	7.24	6.82	6.31	10.5	10.46	10.4	25.2
9/11/2019	Borrow_Pit_17	0.007	2.4	27.7	27.7	27.7	367.4	367.4	367.3	3.51	3.51	3.63	9.02	9.43	9.55	11.8
8/4/1981	Borrow_Pit_25	0.95	1.05	32.5			335			5.35			7.85			10
8/18/1997	Borrow_Pit_25		4.5	32.6	31.1	31	279	283	283	7.4	2.5	2.15	7.5	7.3	7.5	
9/24/2019	Borrow_Pit_25	0.14	4	31.8	27.7	29	536	535	542	10.52	9.42	5.72	12	12.02	11.9	24
9/24/2019	Borrow_Pit_25	0.04		28.4	28.4	28.4	546	546	546	3.77	3.66	3.8	10.4	10.76	10.8	30.3
8/12/1997	Borrow_Pit_26		4	31.26	30.1	29.8	288	293	298	8.19	3.5	2.5	8.4	8.1	8	31.2
9/25/2019	Borrow_Pit_26	0	4	30.5	28.2	28.1	277	281.1	282.4	9.98	2.53	2.07	9.87	9.57	9.35	43.2
9/25/2019	Borrow_Pit_26	0	4	28.1	28.1	28.1	278.2	278.2	278.6	3.14	3.04	3	8.44	8.53	8.59	40.7
8/20/2019	MODOC	0.052	4.8	34.4	31.8	31	375.8	390.4	409.6	19.88	9.42	0.28	9.57	9.28	8.62	15.5
8/20/2019	MODOC	0.026	4.8	31.3	30.9	30.9	395.3	396.8	397.6	5.2	3.48	2.83	8.47	8.71	8.72	18.5

3.2.8.3 Groundwater

The primary aquifer systems in the project area include: 1) the surficial Mississippi River Alluvial Valley Aquifer (MRVAA) extending from the northern reaches of the project in Missouri down through northeastern Louisiana; 2) the Coastal Lowlands Aquifer system extending south from the MRVAA in southern Louisiana and southern Mississippi; and 3) the more extensive Mississippi Embayment Aquifer system, which underlies the MRVAA and Coastal Lowlands Aquifer system from the northern reaches of the project area south through Baton Rouge, Louisiana. The MRVAA is a surficial aquifer consisting of gravel, sand, silt, and clay of Quaternary age that is hydraulically connected with the Mississippi River, and water levels fluctuate seasonally with precipitation and river stages. The quality of water generally meets the standards recommended for public water supplies by the EPA. The coastal lowlands aquifer system in southern Louisiana and Mississippi consists of alternating beds of sand, gravel, silt, and clay deposited under fluvial, deltaic, and marine conditions. The aquifer system is comprised of sediment from the late Oligocene age to Holocene that thicken and dip toward the Gulf Coast. The Mississippi Embayment Aquifer System is the most extensive aquifer system underlying the entire project area and touching nine states: Alabama, Mississippi, Tennessee, Kentucky, Illinois, Missouri, Arkansas, Louisiana, and Texas. The Mississippi Embayment Aquifer system is comprised of sand, silt, and clay sediments ranging from the late Cretaceous to

middle Eocene age. The Mississippi Embayment Aquifer system is hydraulically connected to the shallower aquifer systems. Because of the prolific nature of the groundwater in the project area, demand for groundwater for agricultural, municipal, and industrial use exceeds the demand for surface water across the same region. As such, this large dependency imposes a key risk: water resource sustainability. Already, signs of drastic groundwater level decline, land surface subsidence, abandonment of shallow wells for deeper groundwater sources, saltwater intrusion, contamination by volatile organics and heavy metals, and other detrimental occurrences are stressing the longevity of and reliance on these water resources (USGS 1998). Additionally, surface water features are strained as they are tapped to supplement water demand. As these demands for water escalate within the area, so too has the pressure to ensure fresh water sustainability resulting in increased attention on groundwater (Barlow et al. 2016, Capel et al. 2018, Clark and Hart 2009, McGuire et al. 2019). One localized issue in the project area includes an upward migration of salt water found in lower geological formations into the MRVAA. Previous studies of this ground water salinity suggest that the aerial extent of high salinity water is scattered in the Mississippi Alluvial Plain of northeastern Louisiana and southeastern Arkansas (Huff and Bonck 1993; USGS 2017). In some areas of northeast Louisiana and southeastern Arkansas the salt concentration in water withdrawn from the MRVAA for agricultural irrigation exceeds the upper limit of salt concentration for crop production. Within this reach, there has been some recent concerns from local landowners regarding the possibility higher salinity water flowing from relief wells along the MRL into nearby surface waters. USACE began measuring relief wells along this reach in 2020. Recent water quality measurements have revealed discharge from each well did not exceed applicable standards for aquatic life for temperature, specific conductivity and pH. However, the dissolved oxygen was measured between 1.34 and 2.25 mg/L. These anoxic conditions are expected from ground water until the water has adequate time to re-aerate. Samples collected from the discharge of each well were also analyzed in a laboratory to determine the anion (chloride, sulfate, alkalinity) and cation (calcium, magnesium, sodium, potassium) concentrations allowing for the sodium adsorption ratio (SAR) to be calculated. These values are useful for water used for irrigation giving some sense of suitability for sensitive crops like rice. The SAR values from the groundwater wells adjacent to the Mississippi River ranged from 0.25 to 1.54 all of which are conducive for agriculture. USACE plans to continue these monitoring efforts to better understand these groundwater and surface water interactions. Additional details on the *in situ* measurements and extent of these efforts are included in Appendix 12.

3.2.9 Air Quality

Federal air quality policies are regulated through the Clean Air Act. In accordance with this act, the EPA has established National Ambient Air Quality Standards (NAAQS) for six criteria pollutants considered harmful to public health and the environment, which include: carbon monoxide (CO), NO_x, ozone (O₃), lead, particulates of 10 microns or less in size (PM-10 and PM-2.5), and sulfur dioxide (SO₂). The EPA is required to designate counties or air basins as in attainment or nonattainment for each criteria pollutant. If an area is in nonattainment, the state must develop an implementation plan to achieve compliance. Once in compliance with NAAQS, the area becomes a maintenance area.

The EPA has issued regulations addressing the applicability and procedures for ensuring that Federal activities comply with the Clean Air Act. The EPA Final Conformity Rule (58 FR 63214) requires Federal agencies to ensure that Federal actions in designated nonattainment or maintenance areas conform to an approved or promulgated State implementation plan or Federal implementation plan to ensure that a Federal action would not cause a new violation of the NAAQS, contribute to any increase in the frequency or severity of violations of existing NAAQS, or delay the timely attainment of any NAAQS interim or other attainment milestones. If a project would result in a total net increase in pollutant emissions that is less than the applicable *de minimis* threshold established in 40 CFR 93.153(b), or if the action is otherwise exempt, detailed conformity analyses are not required.

3.2.9.1 Memphis District

The Memphis metropolitan area that includes Crittenden County, Arkansas; Shelby County, Tennessee; and northern Desoto County, Mississippi was designated as a maintenance area of the currently applicable 2008 8-hour O₃ standard on 25 July 2016. All other areas in the MVM are classified as in attainment for air quality standards.

3.2.9.2 Vicksburg District

All areas in the MVK are classified as in attainment for air quality standards.

3.2.9.3 New Orleans District

There are two areas within the MVN that are designated as nonattainment or maintenance: the Baton Rouge five-parish area that includes East Baton Rouge, West Baton Rouge, Iberville, Livingston, and Ascension Parishes was designated as a maintenance area of the currently applicable 2008 8-hour O₃ standard on 21 March 2017. St. Bernard Parish was designated as nonattainment for SO₂ under the 1-hour standard on 4 October 2013. All other areas in MVN are classified as in attainment for air quality standards.

3.2.10 Cultural Resources

The consideration of impacts to historic and cultural resources is mandated as part of the NEPA, which calls for the evaluation of a broad range of historic and cultural resources, including sites of religious and cultural importance to federally-recognized Tribal governments, while the National Historic Preservation Act (NHPA) specifically focuses more narrowly on historic properties. Cultural resources include historic properties, archeological resources, and Native American resources, including sacred sites and traditional cultural properties. They are a broad pattern of material and non-material locations, objects, or resources that represent contemporary, historic, and pre-historic human life ways or practices. Common cultural resources in the area include prehistoric Native American archeological sites, historic archeological sites, shipwrecks, and structures such as bridges and buildings. Historic properties have a narrower meaning and are defined in § 101(a)(1)(A) of the NHPA; they include districts, sites (archaeological and

religious/cultural), buildings, structures, and objects that are listed in or determined eligible for listing in the National Register of Historic Places (NRHP). Historic properties are identified by qualified agency representatives in consultation with SHPO, Tribes, and other consulting parties.

USACE contracted R. Christopher Goodwin & Associates to conduct a literature and records review to collect data pertaining to cultural resources identified within and adjacent to the 143 proposed Work Items (Hornum et al. 2020; Maymon and Kosack 2020; and Meaden et al 2020). Research focused on previously conducted cultural resources inventories in the vicinity of the project area, archeological sites, and cemeteries located within the project area and recorded standing structures and NHRP properties situated within or near the proposed Work Items. Records were examined generally in a 1-mile radius of each Work Item, except for the inventoried historic standing structures, which used a 500-foot radius. This information was mapped on current and historic maps. Results of this cultural resources assessment were extensive due to the large geographic area and redacted versions are available upon request. A summary of the report findings are contained in Appendix 14. In summary, approximately 4,355 cultural resources were identified in the 1-mile radius to the Work Items, these resources span the full range of occupation of the LMV and are composed of buildings, structures, sites and districts. They include the NPS defined Trail of Tears, many hundreds of pre-contact and contact period Native American mound sites, historic districts in both towns and cities, cemeteries related primarily to plantation development or historic church yards, thousands of historic archaeological sites, and one prominent national historic landmark, the Vieux Carre in New Orleans. There are 451 such resources near projects in the Memphis District; 58 in the Vicksburg District, and 3,846 in the New Orleans District (Hornum et al. 2020; Maymon and Kosack 2020; and Meaden et al 2020). To have a context to evaluate the significance of the resources and to appreciate the frequency of some types of cultural resources, a brief summary of the cultural history of the central and MAV is presented below, with timelines for each of the states in Appendix 14, Tables A14-1 through A14-7.

3.2.10.1 Central and Lower Mississippi Valley Cultural History

Cultural and historic resources are past and present expressions of human activity across the landscape. What follows is a description of the various cultural periods derived primarily from comprehensive state plans prepared by the region's various SHPO and academic communities. Material cultures of the east and west became distinct early in North American prehistory, represented by the pan-continental Clovis culture (circa 9500-9000 B.C.), characterized by semi-nomadic hunters following large game animals across a landscape consisting of a series of interwoven, braided streams, within which were small prairies. As the climate warmed to one more characteristic of today's climate around 8000 B.C., the region's indigenous populations became increasingly more sedentary and socially and culturally complex, as expressed in food production and storage, material culture/technology, cultural features, and architecture. Across the Mississippi River Valley, this transformation from "simple" to "complex" societies took place over the next eight to ten thousand years and has been subdivided into different periods based upon various technological, social, subsistence, and settlement criteria: the Archaic (circa 8000 – 1000/500 B.C.), Woodland (1000/500 B.C. – A.D. 900/1000), and Mississippian (A.D. 900/1000 – 1500/1550).

The trend toward greater regional specialization and adaptation initiated during the Archaic period continued and resulted in distinct cultural adaptations expressed as individual cultures. Significant and influential cultural traditions that merit special mention during the last 4,000 years of prehistory include the production of ceramic vessels (Early Woodland [800/500 B.C. – 0 B.C.]), widespread use of the bow-and-arrow (Late Woodland [A.D. 400-1000]), and the following traditions: Poverty Point (Late Archaic [1730 – 1250 B.C.]), Hopewell (Middle Woodland [100 B.C. – A.D. 500]), and Cahokia (Mississippian [A.D. 1000 – 1300]). Poverty Point (which spanned much of the Lower Mississippi Valley, to include parts of Louisiana, Mississippi, and Arkansas) and Hopewellian ways of life (which spanned most of the eastern and mid-western United States) are distinguished by sites containing substantial amounts of tools and ornaments made from nonlocal lithic sources received by peoples living in the major trading and manufacturing areas, who then converted the materials into products and exported them through local and regional exchange networks.

After circa A.D. 1000, the many regional cultural traditions coalesced into a single community heralding the redefinition of society (Mississippian period), which was characterized by an increase in population, larger, fortified towns, flat-topped, pyramidal earthen mounds, large ceremonial centers and more highly stylistic shell-tempered pottery spread out of the site now known as Cahokia, the largest Mississippian site in North America, located near St. Louis, Missouri. From there, these characteristics spread in all directions along the river systems to much of the Southeast, Midwest, and Midsouth regions, though there remained some regional variants that did not subscribe to Cahokian lifeways.

The DeSoto Entrada of 1540-1541 represents the first appearance of Europeans in the assessment area, but this intrusion was not followed by later explorers moving along the Mississippi River until A.D. 1673 and after. This limbo period is most commonly referred to as Post-Contact/Protohistoric period. Social and political instability follows after the initial encounter with Europeans, spreading undocumented epidemics among the indigenous populations and prompting the mass movement and migration of many native groups, often into areas that were not previously occupied or vacated by decimated and now transitory native populations. The upheaval in native communities may have been exacerbated by changing climatic conditions across the eastern United States that were consistently cooler with inconsistent rainfall patterns that affected settlement patterns and food availability between A.D. 1300 and 1850.

During the period of European Colonization, roughly A.D. 1680 to 1763, the assessment areas remained home to many native groups while European powers pursued control of the Mississippi River. In the beginning of the period, the entirety of the assessment areas was claimed as a portion of New France, a vast area centered on the Saint Lawrence and Mississippi Rivers, Great Lakes, and other major tributary rivers explored and claimed by France. After a series of conflicts during the mid-1700s, the assessment area transitioned to British or Spanish control following the French and Indian War (1763), before ultimately passing to the United States in the 1783 Treaty of Paris and the Louisiana Purchase (1803). While initially concentrated along the major waterways and slow in its spread, European settlement following the French and Indian War rapidly intensified, particularly in the MAV, bringing with it expansion of public infrastructure, establishment of more communities, development of industry and a regional economic system that included the use of major rivers to transport goods, establishment of a

national banking system, and ship supplies and goods to an ever-increasing network of regional markets. Further expansion occurred after the Louisiana Purchase in 1803, and with it industrial improvements, including the crystallization of sugar, the cotton gin, and the steam engine that helped spur the growth and diversification of the region's economy and demographics through the establishment and growth of sugar and cotton plantations, which created intensive labor demands of large numbers of enslaved peoples.

Indigenous groups suffered drastic decreases in population and territory during the 1700s and early-1800s as they adjusted to increasingly complex commercial, political, and social interactions with first the French and Spanish, then the British, and ultimately the Americans. Native population losses resulted in fewer villages through time, native economies grew increasingly dependent on trade, raiding livestock, hunting and fishing, and in some cases employment on ranches and farms owned by peoples of European descent. There was a general trend away from traditional farming practices and lifeways. Relations remained tense between the settlers and the native inhabitants, prompting many eastern groups to seek new lands to the South and West, some even crossing the Mississippi River. Demands by the rapidly growing settler population for the removal of these indigenous groups resulted in the drafting and signing of several treaties, primarily during the first three decades of the 1800s, culminating in the constriction and eventual loss of ancestral lands and relocation of a majority of native groups west of the Mississippi River, freeing these lands for U. S. settlement.

The Civil War (1861-1865) radically transformed many segments of the multi-ethnic social, economic, and political structure, leading to new shifts in settlement and commercial production, such as timber harvesting and the oil industry, as evidenced through examination of historic cartography (United States Geological Survey [USGS] quadrangle maps, military maps, Government Land Office [GLO] plats, county and parish soils surveys, transportation atlases, etc.). Most of these trends continued to develop during the late A.D. 1800s through the 1900s, greatly altering earlier configurations of settlements, industries, economies, and natural landscape features with accompanying overland infrastructure growth and connectivity.

The "Great Flood of 1927" inundated over 26,000 square miles of land across the alluvial valley. In response, Congress directed the USACE to develop a flood damage reduction system intended to prevent such massive flooding. The current series of proposed Work Items are phases of the MR&T Project authorized by Congress in the Flood Control Act of 1928. The decision to construct this civil works project has shaped the physical and economic environment of the MAV from the 1930s to the present. With the intensification of agriculture, the development of extractive industries, and the co-location of refining facilities along the banks of the river, small-scale land use by individual farmers or traditional use by Native American peoples has become infeasible. Human occupation, mostly of European or African extraction, nucleated around industry and large-scale farming. Native Americans, who had not already been removed in the 1800s, were concentrated on comparatively small reservations on the margins of the fertile lands of the alluvial valley. The current land-use patterns were set in place. As in all previous periods, the Mississippi River played a central role in shaping the habitation of the landscape.

3.2.11 Socioeconomic Resources

3.2.11.1 Past Social Profile

The history of the MRL area corresponds with the early development of communities along the alluvial delta of the LMR. The earliest known inhabitants were prehistoric men who lived in the area at least 10,000 years before Hernando de Soto and his Spanish soldiers came in search of gold in 1541. Little is actually known of their earliest occupation, but they left considerable evidence in village sites and burial mounds scattered throughout the project area. As long ago as 3,000 years, Native Americans farmed the wide Mississippi flood plain and Native American agriculture was not uncommon by the year A. D. 1000. Hernando de Soto was the first recorded explorer of the region, nearly 150 years before La Salle led his French expedition through the Mississippi River valley in 1682, claiming the entire drainage basin as a French colony.

Traders began using the Mississippi River as a mode of transporting goods as early as 1705. Records show the first cargo was floated down the river from the Indiana-Ohio area to Baton Rouge, Louisiana, then through several bayous, rivers, and lakes in southern Louisiana and on to Biloxi, Mississippi. From there, the goods were shipped to France. Natchez, Mississippi, built as Fort Rosalie in 1716, was the first permanent white settlement on the Mississippi River followed by New Orleans, Louisiana in 1718.

Upon the end of the French and Indian War in 1763, the British took control of the area east of the Mississippi River. This resulted in the venturing of early American pioneers into the area, carving farmsteads from the forests that covered the natural levees along the river. In addition, as a result of Native American treaties of the 1830's, much Native American land was ceded to the U.S. Government, creating an influx of settlers pouring into the delta in what has become to be known as "the Great Migration", mostly from Virginia, South Carolina, Kentucky, and Tennessee.

Agriculture, primarily cotton, was the principal economic base for the Mississippi River Delta during the early 1800s. With steamboats providing accessible river transportation for hauling crops to market, cotton plantations developed along the Mississippi River as far north as the Ohio River. After the Civil War, many of the large landholdings were broken into smaller units, and single-crop family farms were soon widespread. Lumbering became an intensive industrial activity in the late 19th century, as landowners realized a double return from the land as clear-cutting for timber products was followed by cotton production which had become easier to transport to market by steamboat.

Around 1900, petroleum was discovered in the MAV and, for the next several decades, there was a slow, but steady, increase in industrialization. As the Nation recovered from the depression and boomed during the post-World War II era, increasing national demands for rice, cotton, and livestock generated additional land clearing by large farm enterprises and forested acreage steadily declined through the 1950's. Much of the estimated 900,000 acres cleared in the 1950s in the MAV was attributed to the development of permanent pasture land for cattle. During the same time, there was an influx of industry along the banks of the Mississippi and its tributaries. Increasingly thereafter, economic emphasis shifted from agriculture to commercial forestry,

mining, quarrying, petroleum production, and the manufacturing of food, textile, chemical, and paper products.

Flood risk management is, and has historically been, a primary catalyst in the economic and physical development of the MAV. Without flood risk management, the region could not sustain its present population, and those residing in the area would be under continuous threat of natural disaster. Without the flood damage reduction provided by the present system of MRL, the entire alluvial valley, which contains the most productive soils in the region, would be subject to frequent flooding.

In 1820, Congress began its long history of influencing the economic development of the alluvial valley by authorizing the expenditure of \$5,000 for a navigation study of the Ohio and Mississippi Rivers by the USACE. The floods of 1849 and 1850 caused widespread damage and destruction in the Mississippi River Valley. Together with the growing river commerce, this created a demand for Federal participation in navigation improvements and flood protection. In the early 1850s, Congress expanded the authority for topographical and hydrological surveys in addition to conducting a Mississippi River Delta study. The first concerted flood damage reduction program began with the establishment of the Mississippi River Commission in 1879 as a result of a recognized need for coordinating improvements and engineering operations through a centralized organization. Prior to that time, piecemeal protection of flood plains was carried out by levee districts formed by State legislatures. After back-to-back floods in 1912 and 1913, which caused many deaths and left hundreds homeless, Congress at last authorized flood damage reduction resulting in hundreds of miles of levees being raised and strengthened.

However, in 1927, a great flood erupted in the alluvial valley, which inundated over 26,000 square miles of land and caused over \$236 million in property damage (current 1927 dollars). In 1928, Congress directed the USACE to develop a flood damage reduction system that would prevent such massive flooding from ever occurring again. After reviewing over 300 competing flood damage reduction plans, Congress finally adopted the proposal of Major General Edgar Jadwin, Chief of Engineers, in 1928. The Jadwin Plan had two principal innovations: floodways would be used to divert peak flows and maintain stages in the main channel, and all works would be designed according to a "project flood" using historic rainfall and runoff patterns. This plan and its comprehensive approach to the river's management resulted in the MR&T Project authorized by Congress in the Flood Control Act of 1928, as amended.

3.2.11.2 Present Social Profile

The MRL economic base area encompasses about 50,000 square miles of total land area in seven states (Arkansas, Illinois, Kentucky, Louisiana, Mississippi, Missouri, and Tennessee) and comprises areas considered to be physically, socially, or economically impacted by the Mississippi River main stem levee project.

The northernmost region of the MRL area is located within the bounds of the MVM. This area covers approximately 17,900 square miles in total land area in 31 counties of 6 states (12 counties in Arkansas; one county in Illinois; one county in Kentucky; one county in Mississippi;

eight counties in Missouri; and eight counties in Tennessee). With approximately 22,400 square miles of land area in three states, the MVK portion of the assessment area comprises almost one-half of the total land area in the economic base area. It includes six counties in Arkansas, 11 parishes in Louisiana, and 19 counties in Mississippi. The MVN segment is the southernmost portion of the lower Mississippi River region. It is located entirely in the State of Louisiana and covers about 9,000 square miles of land in 18 parishes along the Mississippi River from the Red River to the gulf.

3.2.11.2.1 Population

Historically, population totals of the overall region have gradually increased; although, there have been some periods of outmigration in localized rural areas, where the number of persons moving out of an area was greater than the combined number of immigrating residents and the natural population growth. Population for the overall seven-state area exceeded 4.7 million in the year 2018, and data for the years 1990 to 2018 for the MRL area are displayed by USACE District in (Table 3-18).

Table 3-18. Historical population statistics for the Mississippi River levee area.

Study Area by District	Population by Year (#)			
	1990	2010	2018	1990
				2018
				Growth (%)
CEMVK - Vicksburg District	932,375	854,261	815,742	-13%
Arkansas Study Area	173,376	149,444	141,821	-18%
Louisiana Study Area	302,300	301,260	293,003	-3%
Mississippi Study Area	456,699	403,557	380,918	-17%
CEMVM - Memphis District	1,749,237	1,976,922	1,977,824	13%
Arkansas Study Area	352,148	350,597	340,796	-3%
Illinois Study Area	7,523	6,161	5,463	-27%
Kentucky Study Area	8,271	6,813	6,120	-26%
Mississippi Study Area	67,910	161,252	182,001	168%
Missouri Study Area	274,009	272,881	262,816	-4%
Tennessee Study Area	1,039,376	1,179,218	1,180,628	14%
CEMVN - New Orleans District	1,937,085	1,896,470	1,971,726	2%
Louisiana Study Area	1,937,085	1,896,470	1,971,726	2%
TOTAL MRL AREA	4,618,697	4,727,653	4,765,292	3%

Population density for the total MRL area was estimated to be 96 persons per square mile in 2017 (36 persons per square mile in the MVK assessment area; 95 persons in the MVM; and 219 persons in the MVN) and ranged from a low of three persons per square mile in Issaquena

County, located in the rural delta of Mississippi, to a high of 2,160 persons in Orleans Parish, Louisiana.

Despite the large percentage of the urban population in the MRL area, the number of persons per square mile was generally less than the comparable state densities for each assessment area. This indicates that the rural population is dispersed over a relatively large geographical area for most of the assessment area counties. Population by age distribution for the MRL assessment area is depicted in Table 3-19.

Table 3-19. Population by age statistics for the Mississippi River Levee area.

Study Area by District	Population By Years of Age Group (#)			
	Under 5	5-17	18-65	Over 65
CEMVK - Vicksburg District	52,982	194,022	434,197	134,542
Arkansas Study Area	8,379	31,107	76,900	25,434
Louisiana Study Area	19,675	71,464	152,219	49,645
Mississippi Study Area	24,928	91,450	205,077	59,463
CEMVM Memphis District	130,049	477,898	1,058,665	301,091
Arkansas Study Area	23,362	82,810	174,489	60,186
Illinois Study Area	339	1,180	2,721	1,224
Kentucky Study Area	404	1,340	3,140	1,236
Mississippi Study Area	11,102	46,774	100,647	23,478
Missouri Study Area	14,975	56,896	135,079	45,695
Tennessee Study Area	79,867	288,897	642,591	169,272
CEMVN - New Orleans District	126,791	446,795	1,100,286	297,855
Louisiana Study Area	126,791	446,795	1,100,286	297,855
TOTAL MRL AREA	309,822	1,118,714	2,593,148	733,487

According to 2017 Census statistics, the total number of households or residences in the MRL area was estimated to be 1.1 million, resulting in about 2.6 persons per household. The median value of a residence in the MRL area was \$83,600 in 2017, representing approximately \$114 billion in total residential structure values in the overall economic base area. Median household values in 1990 estimated by assessment area in each USACE District were as follows: MVK, \$47,500; MVM, \$67,600; and MVN, \$81,200.

Although the overall MRL region is predominantly rural, there are 55 cities within the assessment area that have populations of 10,000 people or greater. Additionally, there were an estimated 107 towns counted with populations between 2,500 and 10,000 people in 1990. Altogether, there are over 164 cities and towns that could be subjected to the trauma and damages incurred by a flood event without the protection afforded by the MRL. This accounts for over 71 percent of the 1990 assessment area population.

In addition to their close vicinity to the Mississippi River, each of the major metropolitan centers has international air service and is accessible by multiple interstate and Federal highway systems. Interstate Highways 10, 55, 350, 510, and 610 and U.S. Highways 11, 51, 61, and 90 connect New Orleans to Baton Rouge, Hammond, Metairie, and Slidell. Also, New Orleans has close access to Interstates 12 and 59. Baton Rouge is accessible via Interstates 10, 12, and 110 and U.S. Highways 61 and 190. Memphis is traversed by Interstates 40, 55, and 240 and U.S. Highway 61, 64, 70, 72, 78, and 79.

3.2.11.2.2 Economic Resources and Employment

The labor force consists of the working-age subset (*i.e.*, 16 years of age or older and not retired) of the total population of an area. Those persons in the working-age population who are not in the military and who are either employed or unemployed are defined as the civilian labor force. The size of the civilian labor force in the total MRL area increased from 2.1 million people in 1990 to approximately 2.7 million in 2017, an increase of over 32 percent in 27 years (Table 3-20). Although labor force statistics show that each District assessment area experienced overall increases during this period, this is not indicative of individual county patterns. Labor force declines occurred in 23 of the 85 counties in the economic base area, while increases of greater than 50 percent occurred in 12 counties. Additionally, growth in the labor force was much greater than the rate of population growth since 1990.

Table 3-20. Employment statistics (Year 2017) for the Mississippi River levee area.

Study Area by District	Civilian Labor Force	Total Employment	Unemployment Rate
	(#)	(#)	(%)
CEMVK - Vicksburg District	412,414	230,161	7.5
Arkansas Study Area	71,814	36,909	5.0
Louisiana Study Area	153,097	89,972	7.7
Mississippi Study Area	187,504	103,280	8.1
CEMVM Memphis District	1,062,332	743,477	6.3
Arkansas Study Area	194,085	113,144	4.5
Illinois Study Area	2,469	574	8
Kentucky Study Area	2,907	1,488	5.7
Mississippi Study Area	124,489	53,045	3.8
Missouri Study Area	140,086	79,608	5.3
Tennessee Study Area	793,358	495,618	5
CEMVN - New Orleans District	1,221,604	1,021,120	5.4
Louisiana Study Area	1,221,604	1,021,120	5.4
TOTAL MRL AREA	2,696,351	1,994,758	6.4

The total number of people employed in the MRL area in 2017 was estimated to be 2.0 million. Of this number, the MVN and MVM comprised 42 and 40 percent, respectively, of the total. The

MVK represented 18 percent of the total employment in 2017. Total employment in the MRL area has increased since 1990, increasing from 1.9 million in 1990 to 2.7 million in 2017, with most increases being attributable to metropolitan centers in these areas. However, 74 of the 85 counties have experienced employment decreases since 1990, with increases only in Ouachita Parish, Louisiana and Tunica County, Mississippi in the MVK, 4 of 31 counties in the MVM, and 5 of 18 counties in the MVN. A breakdown of employing industries and earnings within the assessment area is shown in Table 3-21.

Table 3-21. Employment by industry statistics (Year 2017) for the Mississippi River levee area.

2017 EMPLOYMENT BY INDUSTRY						
Study Area by District	Total	Construction	Retail	Professional	Health	Government
	Earnings a/		Trade	& Technical	Care	
	(\$000)	%	%	%	%	%
CEMVK - Vicksburg District	95,933	4.4	7.3	2.8	11.7	27.2
Arkansas Study Area	80,009	5.1	6.4	2.3	12.4	27.2
Louisiana Study Area	6,663	4.5	8.6	3.7	13.7	27.2
Mississippi Study Area	9,261	3.7	7.0	2.5	8.9	27.4
CEMVM - Memphis District	65,155	6.9	7.1	3.1	10.7	22.9
Arkansas Study Area	7,546	3.9	8.0	2.3	12.4	24.7
Illinois Study Area	107	5.2	3.6	b/	b/	44.1
Kentucky Study Area	159	6.2	4.6	b/	b/	14.7
Mississippi Study Area	2,873	16.2	10.6	3.8	8.2	11.4
Missouri Study Area	5,587	4.8	8.6	2.8	13.9	19.8
Tennessee Study Area	48,882	5.4	7.3	3.4	8.2	22.9
CEMVN - New Orleans District	61,187	8.1	6.7	4.0	8.3	21.3
Louisiana Study Area	61,187	8.1	6.7	4.0	8.3	21.3
TOTAL MRL AREA	222,275	6.5	7.0	3.3	10.2	23.8
a/ Expressed in millions of constant 2017 dollars.						
b/ Data are not shown to avoid disclosure of individual firms.						

3.2.11.2.3 Agricultural and Industry

Each year the region provides substantial contributions toward the Nation's food and fiber requirements. In 2017, the economic base area contributed 17.1 million acres of land toward the production of agricultural goods utilized worldwide, including the major agricultural commodities of cotton, soybeans, rice, and corn. The total value of farm products sold was valued at almost \$8.7 billion in 2017, an 8 percent decrease over the \$10.2 billion reported in 1992. The Memphis District represented 51 percent of the sales from farm products sold for the MRL area in 2017, followed by the Vicksburg District with 43 percent. The primary counties which have contributed to and benefited economically from agricultural production (as reflected by the 2017 statistics) are Arkansas, Craighead, Mississippi, and Poinsett counties in Arkansas; St. Bernard Parish in Louisiana; Bolivar, Humphreys, Sunflower, and Washington counties in Mississippi; and New Madrid and Stoddard counties in Missouri. Farm products sold reported by state and the Nation (expressed in 2017 dollars) are as follows for 2017: Arkansas, \$9.7

billion; Illinois, \$17 billion; Kentucky, \$5.7 billion; Louisiana, \$3.1 billion; Mississippi, \$6.2 billion; Missouri, \$10.5 billion; and Tennessee, \$3.8 billion. General agricultural characteristics and total sales from agricultural products for the year 2017 are displayed in Table 3-22

Table 3-22. General agricultural statistics for the Mississippi River levee area.

Study Area by District	Total Number of Farms (#)	Average Size of Farms (acres)	Total Land in Farms (acres)	Total Value of Farm Products \$
CEMVK - Vicksburg District	12,244	605	7,413,480	3,707,744
Arkansas Study Area	2,042	679	1,385,936	939,324
Louisiana Study Area	4,850	460	2,229,892	921,729
Mississippi Study Area	5,352	710	3,797,652	1,846,691
CEMVM Memphis District	12,750	628	8,007,102	4,387,571
Arkansas Study Area	3,908	958	3,742,441	2,013,459
Illinois Study Area	222	456	101,286	180,572
Kentucky Study Area	146	669	97,615	62,127
Mississippi Study Area	398	304	120,998	39,367
Missouri Study Area	4,025	600	2,416,455	1,388,388
Tennessee Study Area	4,051	377	1,528,307	703,658
CEMVN - New Orleans District	4,761	355	1,687,880	561,981
Louisiana Study Area	4,761	355	1,687,880	561,981
TOTAL MRL AREA	29,755	575	17,108,462	8,657,296
a/ Expressed in millions of constant 2017 dollars				

The era of the "Sunbelt movement" of the 1970's resulted in the emergence of the manufacturing, trade, and services industries as significant contributors to local economies. Industries such as construction, manufacturing, and professional (*i.e.*, sales volume of merchandise) and selected services (*i.e.*, hotels and motels; repair services; and dental, medical, and legal services) have now emerged and compete with agriculture, especially in the metropolitan areas, as the major economic contributors to many of the assessment area counties. Table 3-23 include the number of establishments for construction, manufacturing, professional, and selected services for the years 2016.

Table 3-23. Number of establishments for construction, manufacturing, professional, and selected services for the Mississippi River levee area.

Study Area by District	Construction 1/	Manufacturing	Professional	Selected Services
	(#)	(#)	(#)	(#)
CEMVK - Vicksburg District	1,234	602	2,221	16,352
Arkansas Study Area	197	133	279	3,640
Louisiana Study Area	575	222	1,114	6,169
Mississippi Study Area	462	247	828	6,543
CEMVM Memphis District	2,868	1,599	5,952	39,481
Arkansas Study Area	534	312	846	7,526
Illinois Study Area	8	3	5	69
Kentucky Study Area	7	7	13	144
Mississippi Study Area	227	119	414	2,638
Missouri Study Area	451	233	613	7,267
Tennessee Study Area	1,641	925	4,061	21,837
CEMVN - New Orleans District	4,683	1,852	11,659	48,950
Louisiana Study Area	4,683	1,852	11,659	48,950
TOTAL MRL AREA	8,785	4,053	19,832	104,783

1/ From 2016 Bureau of Economic Analysis statistics

3.2.12 Environmental Justice

Consistent with Executive Order (EO) 12898, this section identifies low-income and minority populations within the counties and parishes and for the 143 Work Items based on the most recent socioeconomic statistics currently available from the U.S. Census Bureau's American Community Survey (ACS) five-year estimates from 2014 to 2018. This analysis considered public comments provided during the scoping process. Tables 1 through 6 in Appendix 16 present data on key demographic indicators in the 31 parishes and counties comprising the assessment area.

EJ is institutionally significant because of EO 12898 of 1994 and the Department of Defense's Strategy on Environmental Justice of 1995. Minority populations are those persons who identify themselves as Black, Hispanic, Asian American, American Indian/Alaskan Native, Pacific Islander, some other race, or a combination of two or more races. A minority population exists where the percentage of minorities in an affected area either exceeds 50 percent or is meaningfully greater than in the general population. Low-income populations as of 2018 are those whose income are below \$25,100 for a family of four and are identified using the Census Bureau's statistical poverty threshold. The Census Bureau defines a "poverty area" as a census tract or block group with 20 percent or more of its residents below the poverty threshold and an "extreme poverty area" as one with 40 percent or more below the poverty level.

Sources for the methodology used in preparing the EJ assessment include Council on Environmental Quality's (CEQ) "Environmental Justice Guidance under the National Environmental Policy Act" released in December 1997, DOD's 1995 release of "Strategy on Environmental Justice" provides guidance on EJ methodology, as does EPA's "Promising Practices for EJ Methodologies in NEPA Reviews", prepared in March 2016.

Existing Conditions

Minority and Ethnicity

The 143 levee or floodwall improvements are in 31 counties or parishes across seven states. Fifteen of the 31 parishes or counties in the assessment area are within the Memphis District (MVM) boundary. The largest MVM county is Shelby. Of the 15 counties in MVM, five have a majority of residents identifying as Black/African American, American Indian and Alaska Native, Asian, Native Hawaiian and Other Pacific Islander, some other race, or two or more races. Crittenden County, Arkansas; Shelby County, Tennessee; Lee and Phillips Counties, Arkansas; and Tunica County, Mississippi, all have a majority minority population. Most of the minority population identifies as Black/African American. The 2018 ACS total population of the counties in MVM is approximately 1.3 million. Hispanic population represents the largest ethnicity of the parishes and counties and is between 0.8 percent and 6.2 percent of total population.

Four of the 31 parishes or counties in the MRL assessment area are in the MVK. Of the four counties in MVK, three have a majority of residents identifying as Black/African American, American Indian and Alaska Native, Asian, Native Hawaiian and Other Pacific Islander, some other race, or two or more races. Desha County, Arkansas; Bolivar and Warren Counties, Mississippi; and Concordia Parish, Louisiana all have a majority minority population. Most of the minority population identifies as Black/African American. The 2018 ACS total population of the counties in MVK is approximately 111,500. Hispanic population represents the largest ethnicity of the parishes and counties and is between 1.4 percent and 5.9 percent of total population.

Twelve of the 31 parishes or counties in the assessment area are in the MVN. Of the 12 parishes in MVN, five have a majority of residents identifying as Black/African American, American Indian and Alaska Native, Asian, Native Hawaiian and Other Pacific Islander, some other race, or two or more races. East Baton Rouge, Iberville, St. James, St. John the Baptist, and Orleans Parishes all have a majority minority population. Most of the minority population identifies as Black/African American. The 2018 ACS total population of the counties in MVN is just over 1.6 million. Hispanic population represents the largest ethnicity of the parishes and counties and is between 1.6 percent and 14.4 percent of total population.

Poverty

Over half of the counties/parishes in the assessment area (17 of 31) have 20 percent or more of individuals living below poverty, which in 2018 is \$25,100 for a family of four. Tables 4 through 6 in Appendix 16 provide information for population living below poverty level. Twelve of the 17 counties are located in the MVM. The range is 20.6 percent of the population in Shelby County, Tennessee, to 33.2 percent in Phillips County, Arkansas, that live below the poverty level. Table 5 in Appendix 16 provides information for population living below poverty level for the MVK. All four counties in MVK, including Desha County, Arkansas; Bolivar and Warren

counties, Mississippi; and Concordia Parish, Louisiana, have at least 20 percent of residents living below the poverty level, ranging from 20.6 percent to 34.6 percent. Table 6 in Appendix 16 provides information for population living below poverty level for the MVN. Only one of the 12 parishes in the MVN, Orleans Parish, has at least 20 percent of residents meeting the poverty threshold.

3.2.13 Agricultural Lands

Agricultural production is a significant resource in the region. Farming is one of the dominant land uses in the project area with 2,737 acres in agricultural production and 498 acres in pasture. Agricultural lands in the Work Item footprints were analyzed using the 2018 USDA Cropscape spatial land cover. Among the major agricultural commodities supplied by the region are cotton, soybeans, rice, corn, and sugarcane. General agricultural characteristics of the combined alternatives' footprint for the year 2018 are displayed in Table 3-24.

Table 3-24. Summary of acreage of agricultural crops within MRL SEIS II Work Item footprints (both Alt. 2 and Alt. 3) according to the 2018 USDA Cropscape spatial land cover layer.

	Vicksburg		Memphis		New Orleans		All Districts	
Crop/Land Cover Type	Total Acres	% Land Cover	Total Acres	% Land Cover	Total Acres	% Land Cover	Total Acres	% Land Cover
Corn	3.8	0%	61.1	4%	0.2	0%	65.1	2%
Cotton	9	1%	155.1	10%	0	0%	164.2	6%
Dbl Crop WinWht/Cotton	0	0%	3	0%	0	0%	3	0%
Dbl Crop WinWht/Soybeans	1.7	0%	283.2	18%	0	0%	285	10%
Fallow/Idle Cropland	7.1	1%	34.3	2%	6.6	3%	48	2%
Grass/Pasture	207.1	23%	129.2	8%	161.9	66%	498.2	18%
Other Hay/Non Alfalfa	112.9	13%	20.1	1%	4.2	2%	137.3	5%
Pecans	11.7	1%	1.2	0%	0	0%	12.9	0%
Rice	1.7	0%	0.8	0%	0.1	0%	2.6	0%
Sorghum	0.6	0%	0.2	0%	0	0%	0.8	0%
Soybeans	534.3	60%	904.1	57%	34.8	14%	1473.2	54%
Sugarcane	0.7	0%	0	0%	39.2	16%	39.9	1%
Winter Wheat	2.1	0%	4.3	0%	0.1	0%	6.5	0%
Grand Total	892.7	100%	1596.6	100%	247.1	100%	2736.7	100%

3.2.13.1 Prime and Unique Farmland

The Farmland Protection Policy Act (FPPA), 7 U.S.C. § 4201 et seq. (2012) was enacted in 1981 to minimize the extent to which Federal programs contribute to the unnecessary and irreversible conversion of farmland to nonagricultural uses, and to assure that Federal programs are administered in a manner that, to the extent practicable, would be compatible with State, unit of local government, and private programs and policies to protect farmland.

The policy of the Natural Resources Conservation Service (NRCS) is to protect agricultural lands from conversions that are irreversible and result in the loss of an essential food and environmental resource. Prime farmland has been identified by NRCS as important agricultural resource that warrants protection. The FPPA defines prime farmland as land that has the physical and chemical characteristics for producing food, feed, fiber, forage and oilseed crops, and is available for these uses. Prime farmland has the soil quality, growing season and moisture supply needed to economically produce sustained high yields of crops when treated and managed, including water management, according to acceptable farming methods.

NRCS provided prime farmland data on May 14, 2020, for the project area to estimate acreages within the footprints of each alternative. Prime farmland acreage within the footprints of each Work Item for Alternative 2 and Alternative 3 is 748 and 971, respectively. A breakdown of total acres of cropland and total acres of prime farmland within each State are shown in Table 3-25.

Table 3-25. Total acres of cropland and prime farmland within the footprints of the Work Items for Alternative 2 and 3, summarized by State.

State	Alternative 2	Alternative 3
Arkansas		
Acres of Cropland*	375	435
Acres of Prime Farmland*	300	326
Illinois		
Acres of Cropland*	4	13
Acres of Prime Farmland*	4	4
Kentucky		
Acres of Cropland*	40	40
Acres of Prime Farmland*	40	40
Louisiana		
Acres of Cropland*	399	565
Acres of Prime Farmland*	205	315
Mississippi		
Acres of Cropland*	51	114
Acres of Prime Farmland*	19	71
Missouri		
Acres of Cropland*	89	128
Acres of Prime Farmland*	23	41

Table 3-25 (cont.). Total acres of cropland and prime farmland within the footprints of the Work Items for Alternative 2 and 3, summarized by State.

Tennessee		
Acres of Cropland*	158	476
Acres of Prime Farmland*	157	174
Total Acreage of Prime Farmland	748	971

*acreage taken from cropland land cover.

3.2.14 Hazardous, Toxic, and Radioactive Wastes (HTRW)

3.2.14.1 General Information

Site assessments were conducted to assess the potential for HTRW materials within the footprints of the proposed 143 Work Items following the guidelines and procedures outlined in the USACE Engineering Regulation No. 1165-2-132, Hazardous, Toxic, and Radioactive Waste (HTRW) Guidance For Civil Works Projects (26 June 1992) and the American Society for Testing and Materials (ASTM) E 1527-13, Standard Practice for Environmental Site Assessments: Phase 1 Environmental Site Assessment Process (ASTM, 1997). The objective of the HTRW assessments was to identify HTRW problems early in the design of Work Items to ensure appropriate consideration of HTRW problems during detailed design. The HTRW assessments included: 1) a review of HTRW Phase I Environmental Database Review Corridor Reports and State and Federal databases (e.g., Resource Conservation and Recovery Act Information, Toxic Release Inventory, Superfund Enterprise Management System, Assessment, Cleanup and Redevelopment Exchange System, and state databases on underground storage tanks and hazardous waste programs, etc.) to identify recognized environmental conditions (RECs), and 2) site reconnaissance to determine if RECs are within the proposed Work Item footprints. It should be noted that access to each of the proposed borrow areas were not available during the site reconnaissance due to access and entry limitations as well as prolonged flooding from the high Mississippi River stages. Individual site assessments are included in Appendix 19; summaries of significant findings for each District are included below.

3.2.14.2 Memphis District

Record searches did not reveal sites of concern within the proposed Work Item footprints. Site reconnaissance revealed one site of concern, various drums and containers near an old fish market adjacent to the riverside levee toe in Cairo, Illinois, associated with the following Work Item:

- Fish Market Gate/High 51 Closure, Item 955-R

There was no obvious discoloration of vegetation, water sheens, or discoloration of soils observed during the site reconnaissance, but several drums, containers, and a dilapidated structure were present.

3.2.14.3 Vicksburg District

Record searches did not reveal sites of concern within one-mile of the proposed footprints of each Work Item. Site reconnaissance revealed five sites which would warrant further attention during the initial design phase. The following list highlights the potential HTRW findings and their corresponding Work Item within the MVK:

- multiple drums of unknown contents on property adjacent to levee toe within footprint of proposed seepage berm (Work Item 577-L Berm Construction)
- residential structure within footprint of proposed seepage berm. (Work Item 345-R)
- petroleum tank battery at the toe of the levee on the southern end of the proposed relief well field (Work Item 341-R)
- petroleum tank battery that appeared to bisect a string of existing relief wells where future Work Items are proposed (Work Item 337-R)
- agricultural chemical mixing station on the eastern edge of the ROW limits of the proposed seepage berm (Work Item 333-R)

There were no obvious signs of discoloration of vegetation or soils and no observed water sheens found in the available ROW during the site reconnaissance.

3.2.14.4 New Orleans District

Overall, it was determined that no HTRW issues currently exist within the proposed Work Item footprints within the MVN. Based on land-use history, agency coordination, and field inspection, the risk of encountering HTRW throughout the MVN assessment area was determined to be low. Vegetation of the levee embankment and batture exhibited no visible signs of chemical spills or runoff, or aerial deposition of pollutants; therefore, levee soils were determined to be unlikely to contain contaminants.

3.2.15 Recreation

A vast array of recreational resources is available in the assessment area which includes all lands and water between the MRL, including 3,000 feet landside, beginning at Cape Girardeau, Missouri, and extending downstream to Head of Passes, Louisiana. Approximately 980 RMs are within the assessment area, which runs along or through 53 river-counties and parishes. Over 100 publically-managed areas including parks, natural areas, historic sites, fish and wildlife areas, scenic areas, and trails are in these river-counties and parishes. These publically-managed areas provide more than 60 boat-launch access points, with many providing direct access into the Mississippi River. Several thousand acres of land along this corridor of the Mississippi River provide wildlife observation, hunting, fishing, and other recreational opportunities (*See Appendix 17-Table 17.01: Recreation Resources by Project*).

According to the United States Department of the Interior NPS Land & Water Conservation Fund (LWCF), nearly \$50 million in funding has supported 502 public recreation projects in these river-counties and parishes between 1965 and 2011 (*See Appendix 17-Land & Water Conservation Fund Recreation Projects Table 17.02 and Table 17.03*). Section 6(f)(3) of the

LWCF Act assures that once an area has been funded with LWCF assistance, it is continually maintained in public recreation use unless the NPS approves substitution property of reasonably equivalent usefulness and location and of at least equal fair market value. The table below illustrates the economic impact of recreation to the seven river states in the project area.

Table 3-26. Economic impact of recreation to the seven States in the project area

State	Consumer Spending (Billions)	Jobs	Wages / Salaries (Billions)	Tax Revenue Annually (Billions)	Recreation Participants (Millions)	Contribution to State Economy (Billions)
Arkansas	\$ 9.7	96,000	\$ 2.5	\$ 0.698	1.7	\$ 2.1
Illinois	\$ 25.8	200,000	\$ 7.8	\$ 1.700	3.6	\$ 2.4
Kentucky	\$ 12.8	120,000	\$ 3.6	\$ 0.756	2.3	\$ 1.9
Louisiana	\$ 12.2	103,000	\$ 3.4	\$ 0.893	1.2	\$ 2.0
Mississippi	\$ 8.0	79,000	\$ 2.1	\$ 0.620	1.3	\$ 1.1
Missouri	\$ 14.9	133,000	\$ 4.6	\$ 0.889	3.5	\$ 3.4
Tennessee	\$ 21.6	188,000	\$ 6.5	\$ 1.400	2.8	\$ 2.3
Total	\$ 105.0	919,000	\$ 30.5	\$ 6.956	16.4	\$ 15.2

Source: State Fact Sheets May 2019 - www.lwcfcoalition.org

Within the project area, urban areas like Memphis, Baton Rouge, and New Orleans provide walking and biking trails as an integral part of the recreation development along the river. Within the lands between the levees, numerous timber companies have leased land to hunting clubs, and State wildlife management lands are also available to the public. These clubs and managed lands promote consumptive recreation activities, including fishing and hunting. Forested areas within the project area boundaries are predominantly BLH. These public and private forested areas provide numerous opportunities for non-consumptive recreation activities, including wildlife observation, hiking, camping, environmental education, nature photography, and other related activities. In addition, these forested lands and associated flood plains and cropland (i.e., corn, rice, and soybeans) provide valuable habitat for waterfowl. From the Headwaters of the Mississippi River to the Gulf of Mexico, more than 325 bird species make the round-trip each year along the Mississippi Flyway. Consumptive recreation uses within the project area are predominantly big game hunting (deer and turkey), small game hunting (squirrel, rabbit, raccoon, dove, etc.), waterfowl hunting, and sport fishing. In addition to hunting activities, numerous borrow areas, oxbow lakes, and boat-launching sites provide access to the Mississippi River.

3.2.16 Aesthetics

The Mississippi River is the most visually outstanding aspect of the project area landscape. Large bodies of water serve as an important element of visual composition because of their horizontal extent, color, and texture. The Mississippi River's sinuosity provides the additional visual characteristic of surprise. Inactive parts of the river, such as oxbows, fulfill a similar role. The natural and cultural land uses within the project area complement the river by their contrasting geometry, color, and texture, or are aesthetically significant in their own right, as with BLH forests. The relatively natural land uses, such as BLH forests, also provide for any species of wildlife that can be considered aesthetically significant components of the landscape. The Great River Road National Scenic Byway, which follows the course of the Mississippi River, provides the primary source of visual access to the project area and adjoining lands. The designation by the U.S. Department of Transportation Federal Highway Administration recognizes archeological, cultural, natural, recreational and scenic qualities of River Road from Minnesota to Louisiana.

Bluffs and adjacent hills provide some of the most impressive scenic opportunities along the river. Examples include the area in west Kentucky above Hickman and along the river from Reelfoot Lake to Memphis. Bluffs begin where the Obion and Forked Deer Rivers meet in Tennessee and provide the eastern boundary from there to Memphis. Proceeding south, there are Petit Gulf Hills, Ellis Cliffs, Tunica Bluff, Balls Bluff, and Mobile Ridge. Bluffs exist on the east side of the river from Vicksburg to Baton Rouge. There are overlooks and cliffs ending with Scott Bluffs at Southern University in Baton Rouge.

The project area contains many man-made features that either contribute to or detract from the aesthetic quality of the project area. The River is constrained on the west bank by levees for almost the entire distance from Cape Girardeau to the Gulf. The east bank has considerably fewer miles of levee, with approximately 25 percent of the river bank leveed from Cape Girardeau to Memphis, almost all of the east bank leveed from Memphis to Vicksburg, and no levees from Vicksburg to Baton Rouge. Below Baton Rouge, approximately 90 percent of the east bank of the River is leveed. Other man-made features along the River include revetments constructed on both banks to protect the river channel. From Cairo, Illinois, to Old River Control Structure, dikes have been built into the River, most several hundred feet long, but some as long as one mile. Almost all these dikes are under water at mid-bank stage; however, many are not only visible at lower river stages, but have greatly influenced the development of sand islands and bars as a result of the still water areas created by the dikes. Below Old River Control Structure, dike construction has been limited.

Other major man-made features are the river crossings for roadways, railroads, pipelines, and overhead utilities. These are landmarks along their river stretches, and can be either aesthetically pleasing, or displeasing depending on one's point of view. The project area is relatively poor in architecturally outstanding manmade structures which can be considered aesthetically pleasing, since it is used primarily for flood control, protection of adjacent areas, and navigation. The manmade features that do exist in the project area are generally of a utilitarian nature. For a detailed breakdown of aesthetic resources by Work Item number, refer to the *Appendix 18-Table 18-01: Aesthetic Resources by Work Item*.

Although the River is vast, it is nearly featureless, and the observer often cannot get a true sense of its dimensions. A tow and barge provide a measure of scale for the scene and a reference point for the observer. Where wooded land has been cleared, the clearings provide edge definition of the natural wooded areas, and may serve to break up the visual monotony of continuous stretches of nearly identical woodlands. There is, of course, some point at which the presence of man-made elements can overwhelm the natural landscape and produce a system that some observers may find aesthetically distressing, such as the industrialized corridor from Baton Rouge to New Orleans.

The levees provide visual access to the project area and adjoining lands where visibility is limited by the nearly level terrain. Bridges perform a similar function for the river and batture. In addition, bridges and large flood control structures may have an aesthetic value to some observers as engineering works.

Other man-made features that contribute to the aesthetic experience of the project area are archaeological and historical sites, which are further detailed in the cultural section of this document. Although not always visually impressive in themselves, once understood, these places can provide an appreciation of the past, thus imbuing the physical scene with cultural ambience. Thus, while not a physically dominating feature of the landscape, historical and archaeological sites aid the observer in his perception of the project area by enhancing the likelihood of using imagination to view the scene as it must have seemed to prehistoric and historical people who participated in the development of the assessment area.

3.2.17 Noise

Federal and State governments provide guidelines for construction noise in regards to worker protection and protection of the general public. Noise is generally described as unwanted sound, which can be based either on objective effects (i.e., hearing loss, damage to structures, etc.) or subjective judgments (e.g., community annoyance). Sound is usually represented on a logarithmic scale with a unit called the decibel (dB). Sound on the decibel scale is referred to as sound level. The threshold of human hearing is approximately 3 dB, and the threshold of discomfort or pain is around 120 dB. Sound levels are typically expressed as A-weighted dB (dBA), which describes the relative loudness of sounds as perceived by the human ear.

Noise levels occurring at night generally produce a greater annoyance than do the same levels occurring during the day. People generally perceive intrusive noise at night as being 10 dBA louder than the same level of noise during the day. This perception is largely because background environmental sound levels at night in most areas are also about 10 dBA lower than those during the day. Noise levels are computed over a 24-hour period and adjusted for nighttime annoyances to produce the day-night average sound level (DNL). DNL is the community noise metric recommended by the EPA and adopted by most Federal agencies (EPA 1974). The U.S. Department of Housing and Urban Development (HUD) established acceptable DNL noise for construction activities in residential areas (HUD, 1984):

- **Acceptable (not exceeding 65 dBA)** – The noise exposure may be of some concern, but common building construction will make the indoor environment acceptable, and the outdoor environment will be reasonably pleasant for recreation and play.
- **Normally Unacceptable (above 65 dBA but not greater than 75 dBA)** – The noise exposure is significantly more severe; barriers may be necessary between the site and prominent noise sources to make the outdoor environment acceptable; special building construction may be necessary to ensure that people indoors are sufficiently protected from outdoor noise.
- **Unacceptable (greater than 75 dBA)** – The noise exposure at the site is so severe that the construction costs to make the indoor noise environment acceptable may be prohibitive, and the outdoor environment would still be unacceptable.

A DNL of 65 dBA is the impact threshold most commonly used for noise planning purposes and represents a compromise between community impact and the need for activities like construction. EPA identified a DNL of 55 dBA as a level below which there is no adverse impact (USEPA 1974).

Various noise ordinances have been identified at both the State(s) level and the county/parish, municipal, and local level, all of which would be adhered to under each respective Work Item.

4.0 ENVIRONMENTAL CONSEQUENCES

The following section describes the potential environmental impacts of the alternatives to those significant resources described in Section 3.0. Thus, the discussion of resources in this section coincides chronologically with Section 3.0. For the purposes of analysis, it is assumed that all of the 143 Work Items proposed in the alternatives would occur during the life of the project based on availability of annual Congressional appropriations. Since detailed designs are not complete on the 143 Work Items and would not be complete until Congressional appropriations are received, this section also describes many of the general assumptions used for the analyses and the programmatic framework for determining detailed site-specific impacts and conducting the necessary coordination for compliance with environmental laws. Additional details on the assumptions for the analyses are described in the accompanying Appendices.

The MRL is already in place and designed for the PDF. As described in Section 2.0, this SEIS II does not analyze a change in the authorized level of protection. The alternatives to the No Action (both Alternatives 2 and 3) only address deficient reaches of the existing levee. Thus, indirect effects, such as induced changes in patterns of land use, are not expected or are negligible to the majority of the resources described below with any project alternative, unless otherwise stated. When this project is considered in conjunction with other projects and actions occurring in the project area, impacts can become cumulative. The discussion of cumulative impacts to significant resources is presented separately in Section 4.3, unless otherwise stated.

4.1 Land Use/Land Cover

Alternative 1 - No Action (Future without project)

As discussed in Section 3.1, there were no major changes in the percent composition of land use within the assessment area from 1997 to 2017. Historically, the most significant land use conversion within the assessment area, from BLH forest to cropland, mostly pre-dates this timeframe and no large-scale changes in this trend is expected with the next 50 years (Karstensen and Sayler 2009, Oswalt 2013, Gardiner 2015). Existing land cover within the footprints of each alternative is shown in Table 4-1 and the maps in Appendix 1. Without the project, no significant changes to the land cover within these footprints are expected unless catastrophic flooding occurs.

Alternatives 2 (Traditional Construction) and Alternative 3 (Avoid and Minimize Alternative)

Land within the Work Item footprints will remain in ownership by the Non-Federal Sponsor and local landowners after construction. Due to this uncertainty coupled with additional uncertainties from the current level of design, as described in Appendix 4, a conservative approach that all land cover impacts would be considered permanent, including features that could be temporary (e.g., haul roads used during construction and subsequently removed), was used for quantitative purposes in the resource assessments. Similarly, some activities may not alter the complete Work Item footprint analyzed. For example, the installation of relief wells has a relatively small physical footprint compared with other activities (e.g., levee enlargement). However, as, with haul roads, the entire area surrounding where relief wells would be installed was assumed to be directly impacted to allow for drainage features and to represent the most conservative approach possible. Table 4-1 shows the existing land cover directly impacted with each alternative.

Table 4-1. Land cover impacts associated with each alternative.

	<u>Alternative 2 - Traditional Construction</u>		<u>Alternative 3 - Avoid and Minimize</u>	
<u>Overall LandCover</u>	<u>Total Acreage</u>	<u>Percent composition</u>	<u>Total Acreage</u>	<u>Percent composition</u>
Cropland	1,209	17%	1,675	23%
Forested	1,332	18%	883	12%
Levee	4,061	56%	4,101	56%
Marsh	13	0%	13	0%
Non-forested Wetland	18	0%	15	0%
Open Water	11	0%	10	0%
Pasture, Old Field	162	2%	177	2%
Scrub/Shrub	123	2%	132	2%
Urban	276	4%	275	4%
Total	7,205	100%	7,281	100%

The major difference in direct effects to land cover between alternatives is the reduction in BLH forest impacts and associated increase in cropland impacts with Alternative 3 (avoid and minimize) due to siting of borrow areas.

4.2 Significant Resources

4.2.1 Waterfowl Resources

Acreage and available DUD was calculated for the eight habitat types discussed in Section 3.2.1 within the MAV for each Work Item that flood less than 18 inches during the period 1 November to 28 February according to the ENVIRO-DUCK hydrological model and DUD manual. The ENVIRO-DUCK model uses daily stage data and stage area curves from 1969 – 2018 to calculate the daily acres flooded during the 120-day wintering waterfowl season. It calculates daily acres for resting and feeding, in addition to annual averages and the mean, minimum and maximum stage observed during the winter waterfowl season at all of the gage locations. Energy values were related to a DEE for a mallard (1 mallard DEE = 452.44 kcal/day) and divided by the number of flooded habitat acres to determine the potential DUDs/acre/specified time period. Although there are multiple species of waterfowl present in the project area, the mallard was selected to standardize all of the habitats found in the project area. Mallards are the most abundant duck species in the Mississippi Flyway during migration periods. Mallards use a variety of flooded forests and inundated agricultural fields, and a large amount of scientific research has been conducted on their habitat requirements and foraging ecology.

The basic formula for calculating energy values is:

$$\text{Species } 1\dots m \text{ DUD} = \frac{\sum(F_{1..j})(T_{1..l})}{D_{1\dots m}}$$

Where,

F = the potential food yield (g/ha) for food types 1..j in the habitat type 1..k

T = TME (kcal/g) of specific food types 1..l

D = DEE of species 1..m in kcal/day and is 4x RMR

RMR = $100.7W^{0.74}$

And, W = weighted body mass of species 1..m in kg

Flooded acres of each habitat category (according to Heitmeyer 2010) were compiled. To factor resource availability during the wintering waterfowl period (1 November- 28 February), the total of each month summed together to use as the total DUD value. Differences (losses or gains) between future without project conditions and the preferred alternative were then calculated. Using the acreage removed from the flood regime (less than 18 inches) and multiplying them by the DUD/acre provided in the DUD Manual (Heitmeyer 2010), a net change in DUD is

generated. The same methodology is also used for calculating DUD for mitigation lands to be reforested as BLH forest.

Alternative 1 – No Action

Waterfowl habitat provides and would continue to provide 783,809 and 662,951 DUD within the traditional construction and avoid and minimize Work Item footprints, respectively, as described in Section 3.2.1. While land use conversions are not expected within the Work Item footprints, existing trends of waterfowl populations are expected to continue. It is likely that catastrophic flooding from any potential levee failure(s) would have short term adverse impacts to local waterfowl populations, while the long term effects would be uncertain as reconstruction occurred.

Alternative 2- Traditional Construction

For Alternative 2, approximately 639 acres (of the total 7,287 acres) within proposed Work Item footprints would experience a loss of flooded (less than 18 inches) habitat for waterfowl. The MVK would experience the greatest habitat reductions, as approximately 550,068 DUD would be lost from the implementation, compared to 141,330 DUD and 92,411 DUD for the MVM and MVN, respectively (Table 4-2). Riverside borrow areas account for the highest percentage of suitable habitat impacts across all three Districts, as well as total DUD reductions with the exception of the MVM.

Table 4-2. Summary of impacted suitable habitat acres and DUD reductions by work type by District with implementation of Alternative 2 (traditional construction).

	Memphis		Vicksburg		New Orleans	
	Total DUD (Nov-Feb)	Impacted Acres	Total DUD (Nov-Feb)	Impacted Acres	Total DUD (Nov-Feb)	Impacted Acres
Floodwall Replacement					728	0.6
Landside Borrow Area					17,536	25.4
Landside Haul Road			128	0.1		
Levee Enlargement	73,184	73.0	31,434	15.0	2,938	1.7
Relief Wells	3,177	4.4				
Riverside Borrow Area	64,968	79.3	323,028	249.2	71,209	64.3
Riverside Haul Roads			191,484	122.4		
Seepage Berm			3,995	3.8		
Total	141,329	156.7	550,069	390.5	92,411	92.0

In addition to the MVK having the greatest loss of flooded acres, it also has significantly more habitat consisting of SHM-passively unmanaged that has a higher DUD contribution compared to other habitat types. While in the MVM, the majority of anticipated DUD reductions are from floodplain forest categories (Table 4-3).

Table 4-3. Summary of DUD and suitable habitat loss by DUD land cover category within each District with implementation of Alternative 2 (traditional construction).

	Memphis		Vicksburg		New Orleans	
	DUD	Acres	DUD	Acres	DUD	Acres
FP Forest (Five Percent Canopy)	22,176	33.9	59,676	91.3	24,573	37.6
FP Forest (Ten Percent Canopy)	10,486	13.4	31,367	40.0	15,415	19.7
FP Forest (20 Percent Plus Canopy)	85,101	81.5	106,457	101.9	25,623	24.5
Open Water	19	0.2	8	0.1	0	0.0
Scrub/Shrub	2,642	2.3	12,564	10.8	126	0.1
SHM Passively Unmanaged	11,859	4.3	330,585	120.8	26,498	9.7
Corn	2,097	1.9	139	0.1	122	0.1
Rice	5	0.0	254	0.4		
Soybeans	6,945	19.2	9,019	24.9	54	0.1
Total	141,330	156.7	550,069.0	390.3	92,411.0	91.8

Table 4-4 shows waterfowl impacts by State and USACE District. The greatest loss of wintering waterfowl habitat would occur in Louisiana, as approximately 75 percent of the lost acreage within MRL Work Items (approximately 478 out of 639 acres) are within the State. Arkansas and Missouri would lose approximately 80 and 56 acres of waterfowl habitat, respectively, while Illinois, Kentucky, Mississippi, and Tennessee would have losses of less than 20 acres combined (Table 4-4).

Table 4-4. Reduced total number of duck-use-days and impacted suitable habitat acreage by State and USACE District associated with implementation of Alternative 2 (traditional construction).

	Memphis		Vicksburg		New Orleans		MAV	
	Total DUD (Nov-Feb)	Acres	Total DUD (Nov-Feb)	Acres	Total DUD (Nov-Feb)	Acres	Total DUD (Nov-Feb)	Acres
Arkansas	67,150	79.6					67,150	79.6
Illinois	6,250	5.9					6,250	5.9
Kentucky	876	0.3					876	0.3
Louisiana			546,522	386.1	92,411	91.9	638,933	478.0
Mississippi	10,152	13.1	3,546	4.3			13,698	17.4
Missouri	56,476	56.6					56,476	56.6

Tennessee	426	1.2					426	1.2
Total	141,330	156.7	550,068	390.4	92,411	91.9	783,809	639.0

Alternative 3 – Avoid and Minimize

For the Avoid and Minimize Alternative, approximately 522.4 acres (of the total 7,287 acres) within proposed Work Item footprints would experience a loss of flooded (less than 18 inches) habitat for waterfowl. Similar to the traditional plan, the MVK would experience the greatest habitat reductions, as approximately 545,677 DUD would be lost from the implementation of Alternative 2, compared to 99,029 DUD and 18,246 DUD for the MVM and MVN, respectively (Table 4-5). When compared to Alternative 2, approximately 120,857 less DUD and 117 less suitable habitat acres would be impacted with implementation of the avoid and minimize plan.

Table 4-5. Summary of impacted suitable habitat acres and DUD reductions by work type by District with implementation of Alternative 3 (avoid and minimize).

	Memphis		Vicksburg		New Orleans	
	Total DUD (Nov-Feb)	Impacted Acres	Total DUD (Nov-Feb)	Impacted Acres	Total DUD (Nov-Feb)	Impacted Acres
Floodwall Replacement					55	0.0
Landside Borrow Area					12,747	17.9
Landside Haul Road			2,767	2.0		
Levee Enlargement	72,893	72.9	31,432	15.0	5,444	2.8
Relief Wells	2,918	4.4				
Riverside Borrow Area	23,218	48.3	326,776	243.7		
Riverside Haul Roads			180,718	111.5		
Seepage Berm			3,984	3.8		
Total	99,029	125.6	545,677	376.0	18,246	20.7

Impacted suitable habitat distribution is similar to the traditional plan, although reduced, across all three Districts. However, significant reductions in both impacted DUD and suitable habitat were noted in the MVN (Table 4-6).

Table 4-6. Summary of DUD and suitable habitat loss by DUD land cover category within each District with implementation of Alternative 3 (avoid and minimize).

	Memphis		Vicksburg		New Orleans	
	DUD	Acres	DUD	Acres	DUD	Acres
FP Forest (Five Percent Canopy)	3,519	5.4	29,772	45.6	8,445	12.8
FP Forest (Ten Percent Canopy)	3,250	4.2	10,260	13.1	3,169	4.0
FP Forest (20 Percent Plus Canopy)	56,826	54.4	139,276	133.4	1,498	1.5
Open Water			4	0.0		
Scrub/Shrub	2,642	2.2	12,873	11.1	616	0.5
SHM Passively Unmanaged	10,771	4.0	335,047	122.4	4,395	1.5
Corn	2,905	2.5	139	0.1	87	0.0
Rice	5	0.0	254	0.5		
Soybeans	19,111	52.9	18,052	49.9	36	0.0
Total	99,029	125.5	545,677.0	376.2	18,246.0	20.3

As with Alternative 2, the avoid and minimize plan shows the greatest loss of wintering waterfowl habitat would occur in Louisiana, as approximately 75 percent of the lost acreage within Work Items (approximately 392 out of 522 acres) are within the State. Arkansas, Illinois, Kentucky, Louisiana, Mississippi, and Missouri all see reductions in lost acreages of suitable waterfowl habitat (Table 4-7).

Table 4-7. Reduced total number of duck-use-days and impacted suitable habitat acreage by state and USACE District associated with implementation of Alternative 3 (avoid and minimize).

	Memphis		Vicksburg		New Orleans		MAV	
	Total DUD (Nov-Feb)	Acres	Total DUD (Nov-Feb)	Acres	Total DUD (Nov-Feb)	Acres	Total DUD (Nov-Feb)	Acres
Arkansas	57,001	76.3					57,001	76.3
Illinois	0	0.0						
Kentucky	19	0.0					19	0.0
Louisiana			542,614	371.7	18,246	20.7	560,860	392.4
Mississippi			3,062	4.3			3,062	4.3
Missouri	41,512	48.1					41,512	48.1
Tennessee	497	1.2					497	1.2
Total	99,029	125.6	545,676	376.0	18,246	21	662,951	522.3

4.2.2 Terrestrial Habitat

Alternative 1 - No Action

The six focal species (barred owl, fox squirrel, Carolina chickadee, pileated woodpecker, wood duck, and mink) used in the HEP analyses represent the wildlife community using the dominant terrestrial habitat (BLH forest) in the project area. Total acreages and habitat quality (HSIs) of these focal species are described in Section 3.2.2, and no significant changes to these values are expected under the No Action Alternative. While land use conversions are not expected within the Work Item footprints, existing trends of individual wildlife populations utilizing the terrestrial habitat are expected to continue. It is likely that catastrophic flooding from any potential levee failure(s) would have short term adverse impacts to local wildlife populations utilizing the terrestrial habitat, while the long term effects would be uncertain as reconstruction of the surrounding areas occurred.

Alternatives 2 (Traditional Construction) and Alternative 3 (Avoid and Minimize Alternative)

Impacts to terrestrial habitat consist of the direct conversion of BLH due to enlarging the levee back to its authorized grade, installation of seepage measures adjacent to the levee toe, flattening the slope of the levee at unstable locations, and the associated borrow areas to construct these features. Approximately 90 percent of the land area within the footprint of the Alternative 3 Work Item footprints (6,494 of 7,283 acres) and 80 percent (5,778 of 7,204 acres) of the land area within Alternative 2 Work Item footprint was not considered suitable habitat for the target species because of a lack of forest. As discussed in Section 4.1, the entire Work Item footprints were assumed to remain in a cleared condition throughout the life of the project.

The HEP analysis consists of calculating habitat units (HU) (the product of habitat quality (HSI) and habitat area (acres)) to compare between alternatives. Carolina chickadee, barred owl, and fox squirrel would be most affected by Work Item construction based on the loss of average annual habitat units (AAHU) within the Work Items, while pileated woodpecker and wood duck would experience moderate losses. Mink would be the only species to benefit from Work Item activities as the creation of borrow areas would create or enhance habitat (i.e., creation of surface water) resulting in a net gain of AAHUs. Overall, Alternative 2 (traditional construction) would result in a loss of 3,075 HUs; whereas, Alternative 3 (avoid and minimize) results in loss of 1,605 HUs. Overall, summaries of the HUs impacted by USACE District and state are presented in Tables 4-8 and 4-9 below. Alternative 3 reduces the impacts by 1,470 HUs across the period of analysis.

Table 4-8. The number of habitat units (gain/loss)^a for Alternative 2 and 3 within each USACE District for each of the six target species used in the HEP analysis.

Species	Alternative 2 - Traditional Const.				Alternative 3 - Avoid and Minimize			
	District				District			
	MVK	MVM	MVN	All Districts	MVK	MVM	MVN	All Districts
Carolina Chickadee	-297	-698	-86	-1081	-231	-283	-48	-562
Barred Owl	-369	-584	-132	-1085	-280	-256	-79	-615
Pileated Woodpecker	-196	-324	-41	-561	-153	-155	-26	-334
Fox Squirrel	-309	-401	-104	-814	-239	-150	-79	-468
Wood Duck	-176	-86	-55	-317	-128	-58	-13	-200
Mink	+239	+450	+93	+782	+164	+363	+47	+573
Overall Change in AAHU	-1108	-1643	-325	-3075	-867	-540	-198	-1605

^a Minus sign denotes a loss in AAHU's and a plus sign denotes a gain in AAHU's.

Table 4-9. The number of habitat units (gain/loss)^a for Alternative 2 and 3 within each State for each of the six target species used in the HEP analysis.

Alternative 2 - Traditional Construction

Species	States						All States
	Arkansas	Illinois	Louisiana	Mississippi	Missouri	Tennessee	
Carolina Chickadee	-187	-17	-321	-78	-94	-385	-1081
Barred Owl	-168	-16	-393	-124	-89	-294	-1085
Pileated Woodpecker	-105	-10	-192	-57	-56	-140	-561
Fox Squirrel	-106	-8	-327	-91	-43	-239	-814
Wood Duck	-36	-5	-192	-47	-25	-11	-317
Mink	125	40	275	83	165	93	781
Overall Change in AAHU	-477	-18	-1150	-314	-142	-976	-3076

Alternative 3 – Avoid and Minimize

Carolina Chickadee	-154	-9	-235	-44	-62	-58	-562
Barred Owl	-134	-9	-287	-72	-60	-53	-615
Pileated Woodpecker	-81	-6	-146	-33	-38	-31	-334
Fox Squirrel	-88	-4	-258	-60	-28	-31	-468
Wood Duck	-25	-3	-118	-24	-17	-13	-200
Mink	87	29	167	43	123	123	573
Overall Change in AAHU	-394	-1	-876	-190	-82	-63	-1606

4.2.3 Bats

Alternative 1 - No Action

Analyzing potential impacts to the 16 bat species described in Section 3.2.3, whose ranges at least partially overlap the proposed Work Items included matching life-history needs of each species then projecting changes in major land cover types. Baseline habitat conditions were established by determining land cover types within a half-mile buffer surrounding all Work Items and borrow areas for Alternative 2 (traditional construction) and Alternative 3 (avoid and minimize). Land cover types within the half-mile buffers were obtained from USDA's Cropscape (USDA National Agricultural Statistics Service Cropland Data Layer 2018) GIS dataset. A total of 39 land cover types were defined within the Work Item boundaries; however, many of these land cover types have similar significance to bats. Therefore, the land cover classes were summed to create four land cover categories: open, forest, urban (other), and water. Land cover classes within the footprints of the proposed borrow areas were broken out separately to assist in determining how borrow area excavation would alter baseline habitat conditions. Existing land cover descriptions for the half-mile buffer and proposed borrow area footprints with each alternative is shown in Table 4-10 below.

Table 4-10. Land cover class by District within the half-mile buffers and borrow pit areas for each alternative.

Alternative 2 – Traditional Construction Half-mile Buffer			
Cover Type	Area (acres)		
	Vicksburg	Memphis	New Orleans
Open	12,765.0	56,575.0	30,732.9
Forest	11,673.4	19,693.8	25,152.4
Urban (other)	2,299.1	6,780.0	40,479.0
Water	7,220.0	10,193.3	55,970.0
Borrow Areas			
Cover Type	Area (acres)		
	Vicksburg	Memphis	New Orleans
Open	190.6	56.3	51.0
Forest	281.1	488.0	190.9
Urban (other)	4.9	9.2	5.9
Water	81.0	3.8	40.5
Alternative 3 – Avoid and Minimize Half-mile Buffer			
Cover Type	Area (acres)		
	Vicksburg	Memphis	New Orleans
Open	13,378.5	57,316.7	32,160.2
Forest	11,269.2	19,021.9	24,262.6
Urban (other)	2,332.7	6,747.1	40,794.1
Water	7,057.8	10,008.9	55,473.2
Borrow Areas			
Cover Type	Area (acres)		
	Vicksburg	Memphis	New Orleans
Open	271.2	509.2	142.1
Forest	187.1	34.7	108.4
Urban (other)	4.0	6.9	7.2
Water	95.0	5.8	30.6

As previously discussed, no significant changes in land use practices are expected to occur within or adjacent to the levee system; thus, future without project conditions were determined to

be the same as existing conditions. While land use conversions are not expected within the Work Item footprints, existing trends of bat populations are expected to continue. It is likely that catastrophic flooding from any potential levee failure(s) would have short term adverse impacts to local bat populations, while the long term effects would be uncertain as reconstruction of the surrounding areas occurred.

Alternatives 2 (Traditional Construction) and Alternative 3 (Avoid and Minimize Alternative)

For the impact analyses, it was assumed that all borrow areas would be converted from their present land cover class to water. The area of each land cover class within borrow areas, not including water, was subtracted from its respective land cover class within the half-mile buffer. This area was then added the water class to arrive that the change in land cover type for each alternative (Table 4-11). Breakdowns by District are included in Appendix 7.

Table 4-11. Bat habitat land cover changes for each alternative.

Alternative 2 – Traditional Construction

Cover Type	Before	Change	After	Percent Change
Open	10,0072.9	-297.9	99,775.0	-0.30
Forest	56,519.5	-960.0	55,559.5	-1.70
Urban (other)	49,558.1	-20.0	49,538.0	-0.04
Water	73,383.3	+1277.9	74,661.2	+1.74

Alternative 3 – Avoid and Minimize

Cover Type	Before	Change	After	Percent Change
Open	102,855.4	-922.5	101,932.9	-0.90
Forest	54,553.7	-330.1	54,223.6	-0.61
Urban (other)	49,873.9	-18.1	49,855.8	-0.04
Water	72,539.9	+1,270.7	73,810.6	+1.75

With both Alternatives 2 and 3, bat species that roost in tree cavities, exfoliated bark, or snags would be most negatively impacted since forested land cover would be the greatest loss. These species include the endangered Indiana bat, the threatened northern long-eared bat, Rafinesque's big-eared bat, silver-haired bats, southeastern myotis, little brown bats, evening bats, and tri-colored bats. However, Alternative 3 (avoid and minimize) would have 1,336 acres of fewer

impacts to forested habitat (Table 4-11). Changes in land cover due to borrow pit excavation would be small compared to the overall assessment area (i.e., within the half-mile buffers). Considering the small area impacted by borrow area excavation relative to the scale of the overall project area, the negative impacts of bat habitat loss would be small. Bat species that roost in foliage or leaf litter, including the hoary bat, northern yellow bat, eastern red bat, and seminole bat, may also experience a small negative impact from the loss of forested habitat with Alternatives 2 and 3. However, this loss is expected to have minimal impact. Bat species in the *Lasiurus* and *Dasypterus* genera have much larger maximum foraging distances compared to those in the genus *Myotis*, diluting the effect of habitat loss. Furthermore, tree and leaf litter roosting species are less sensitive to white nose syndrome and have experienced little change in population status.

Species that do not use forests for roosting habitat would experience no significant impact from Alternatives 2 and 3. Gray bats use caves for diurnal roosting and their distribution is mostly outside the project area. Species that primarily roost in buildings, such as the big brown bat and Brazilian free-tailed bat, would also experience no impact from the loss of forested habitat. Big brown bats and Brazilian free-tailed bats tend to forage in open habitat; therefore, borrow area excavation is not likely to have a significant negative impact on their foraging ability. Removal of forest habitat for borrow area excavation at locations surrounded by extensive forest may reduce foraging habitat for bat species adapted to forage in forest interiors. These species include the Rafinesque's big-eared bat, small-footed bat, northern long-eared bat, and Indiana bat. However, considering the small proportion of forested habitat being lost and the high mobility of bats, these species (if present) likely would be able to relocate to new foraging areas. Reforestation of agricultural lands associated with compensatory mitigation efforts would provide benefits to those bat species adapted to forests and other wildlife species, as described in Section 5.0.

Excavation of borrow areas may have positive impacts for species that forage in open areas, along edges, or over water. Table 4-11 shows the expected increases of open water available to bats with Alternatives 2 and 3. By excavating borrow areas in forested habitat, open areas and edge would be created. When borrow areas fill with water, riparian habitat also would become available. Species that would benefit from creation of foraging habitat by borrow area excavation include the hoary bat, northern yellow bat, big brown bat, silver-haired bat, eastern red bat, Seminole bat, southeastern *Myotis*, gray bat, little brown bat, evening bat, tri-colored bat, and the Brazilian free-tailed bat.

Reforesting agricultural land as mitigation would have positive benefits for many of bat species and other wildlife over time, as described in Section 5.0. Following initial planting, mitigation areas would continue to provide foraging habitat for open-adapted bat species, including the hoary bat, northern yellow bat, big brown bat, silver-haired bat, eastern red bat, Seminole bat, evening bat, and Brazilian free-tailed bat. As replanted forest stands mature, foraging opportunities for open-adapted bats would diminish. However, these mature forest stands would become suitable roosting habitat for tree roosting bats. Bat species that utilize tree cavities and exfoliated bark for roosting would benefit most if desirable roost trees such as hickories are planted. Implementing forest management practices such as thinning and creating/maintaining snags would further enhance roosting opportunities. Mature forest stands would also provide foraging opportunities for clutter-adapted bat species such as the Rafinesque's big-eared bat,

small-footed bat, northern long-eared bat, and Indiana bat. This benefit would also be further enhanced by implementing forest management practices that create a more open forest understory such as thinning and prescribed burning. Finally, reforesting agricultural land as mitigation would benefit bat species that forage along habitat edges. Replanting forest stands in a landscape dominated by agricultural areas would create new edges which are used for foraging by bats species such as the evening bat and tri-colored bat.

The impact of borrow pit excavation on cave hibernating species would be minimal because few (if any) caves occur within the project area. Migratory bats use similar habitats in both their summer and winter ranges, so the impacts on these species would be similar to the impacts on roosting and foraging habitat.

With both Alternatives 2 and 3, prior to any construction USACE would contact the respective USFWS Ecological Services Field Office, review the most recent Range-wide Indiana Bat Survey Guidelines and northern long-eared bat consultation guidance, and determine feasibility of seasonal tree clearing restrictions to determine if presence/absence surveys for any listed bat species was necessary and the appropriate survey protocol (e.g., acoustic, mist-netting, and/or emergence surveys).

4.2.4 Migratory Birds

Alternative 1 - No Action

As previously discussed, no significant changes in land use practices are expected to occur within or adjacent to the levee system over the period of analysis; thus, future without project conditions were determined to be the same as existing conditions for the migratory bird assessment. While land use conversions are not expected within the Work Item footprints, existing trends of migratory bird populations are expected to continue. It is likely that catastrophic flooding from any potential levee failure(s) would have short term adverse impacts to local migratory bird populations, while the long term effects would be uncertain as reconstruction of the surrounding areas occurred.

Alternative 2 (Traditional Construction) and Alternative 3 (Avoid and Minimize Alternative)

In general, most species of birds identified by IPaC within the assessment area, as described in Section 3.2.4, would experience low or no negative impacts with both Alternatives 2 and 3. Species most likely to be impacted are those that extensively use bottomland and floodplain forests during the breeding or wintering seasons, and those with ranges largely overlapping the assessment area due to the loss of forested habitats with construction. These species include prothonotary warbler (moderate to high negative impact during the breeding season), bald eagle (moderate during the wintering season), wood thrush (moderate during the breeding season), and rusty blackbird (low to moderate during the wintering season). Several species should experience low to no negative impacts on their populations within the project area because their breeding or non-breeding range extents only include a relatively small proportion of the assessment area. Such species include cerulean warbler (low during breeding – only in northern portions of the assessment area), wood stork (low during breeding season in southern to central portions of the

assessment area, and rare breeder in this region), and golden-winged warbler (low during migration season – likely only use small portion of assessment area during migration). The low negative impacts on redheaded woodpecker are due to some potential loss of nesting habitat by removal of mature forest, but this species readily uses open areas and would likely be unaffected by borrow area creation.

The USGS provides the Gap Analysis Program for most listed species and species of conservation concern (<https://gapanalysis.usgs.gov/apps/species-data-download/>). This analysis provides a Species Habitat Model Report, including spatial layers that provide information on species range and suitable habitat within the conterminous United States. Spatial layers were generated that incorporated suitable habitat according to the GAP Analysis Program results (2019) and overlaid those layers with the footprints of the proposed Work Items for species listed in Section 3.2.4 that could potentially be impacted by habitat alterations. A detailed breakdown of impacts by individual Work Item for Alternatives 2 and 3 according to species, season, State, and USACE District is shown in Tables 4-12 and 4-13 below. Detailed descriptions of individual species can be found within Appendix 8.

Table 4-12. Acreage of habitat according to USGS GAP for species within IPaC that likely would be impacted by Work Item impacts to forested habitats within MRL SEIS II Work Items for Alternative 2 (Traditional Construction). Habitats considered for rusty blackbird includes all types of wetlands (e.g., scrub/scrub, marsh, forested, wet meadow).

Species ^a	Season	District			All Districts
		MVK	MVM	MVN	
Bald Eagle	Winter		14.0	11.6	25.6
	Year-round	280.4	231.2	138.3	649.9
Kentucky Warbler	Breeding	248.7	244.3	41.7	534.7
Prothonotary Warbler	Breeding	228.3	105.0	49.8	383.2
	Migration			79.0	79.0
Red-headed Woodpecker	Breeding	31.5	53.0	20.7	105.2
	Winter		3.5		3.5
	Year-round	284.4	272.9	148.9	706.2
Rusty Blackbird	Winter	402.0	520.4	631.1	1553.6
Swallow-tailed Kite	Breeding	182.1		20.4	202.4
Wood Stork	Winter			85.2	85.2
Wood Thrush	Breeding	270.6	249.2	41.1	560.9
Cumulative Total		1,927.9	1,693.6	1,268.1	4,889.6

^a Habitat for cerulean warbler, black rail, and golden-winged warbler was not indicated to occur within Work Items for Alternative 2.

Table 4-13. Acreage of habitat according to USGS GAP for species within IPaC that likely would be impacted by Work Item impacts to forested habitats within MRL SEIS II Work Items for Alternative 3 (Avoid/Minimize). Habitats considered for rusty blackbird includes all types of wetlands (e.g., scrub/scrub, marsh, forested, wet meadow).

Species ^a	Season	District			All Districts
		MVK	MVM	MVN	
Bald Eagle	Winter	0.0	6.3	11.6	18.0
	Year-round	194.9	148.8	124.5	468.3
Kentucky Warbler	Breeding	172.0	132.8	27.9	332.6
Prothonotary Warbler	Breeding	154.3	26.1	23.5	203.9
	Migration	0.0	0.0	79.0	79.0
Red-headed Woodpecker	Breeding	30.5	45.0	19.9	95.4
	Winter		0.8		0.8
	Year-round	199.0	166.2	135.0	500.2
Rusty Blackbird	Winter	324.7	426.0	644.9	1395.6
Swallow-tailed Kite	Breeding	139.9	0.0	19.3	159.2
Wood Stork	Winter	0.0	0.0	85.2	85.2
Wood Thrush	Breeding	185.3	133.1	27.8	346.2
Cumulative Total		1,400.6	1,085.0	1,198.9	3,684.5

^a Habitat for cerulean warbler, black rail, and golden-winged warbler was not indicated to occur within Work Items for Alternative 3 (avoid/minimize).

Alternative 3 (avoid and minimize) would result in fewer direct, indirect, and cumulative impacts to each of these bird species identified by IPaC due to the reduction in forested impacts compared to Alternative 2 (traditional construction). Because of the projected loss of forested wetland habitats, particularly mature forested areas at some borrow sites, mitigation lands would target as large of habitat blocks as possible due to the value of these lands (Elliott et al. 2020, Murray and Klimas 2013). Mitigation sites determined through the terrestrial habitat, wetlands, and aquatic assessments as part of this project would significantly offset habitat losses for the majority of the avian species, as described in Section 5.0. Similar to the ESA consultation, USACE would consult with the local USFWS Ecological Services Field Office with each Work Item, pursuant to the MBTA, after congressional appropriations are received and while detailed plans are being developed. Applicable surveys would be conducted and USFWS recommendations and BMPs (e.g., species-specific seasonal buffer restrictions to colonial nesting waterbirds, tree clearing during fall or winter, etc.) would be followed to avoid and minimize impacts to any protected birds to the extent practicable.

4.2.5 Threatened and Endangered Species

Alternative 1 - No Action (Future without project)

Activities conducted by Federal agencies within the assessment area would still occur in coordination with the USFWS, pursuant to Section 7 of the ESA, to conserve federally listed species and designated critical habitats. No significant changes are expected to threatened and endangered species within the assessment area without the project. It is likely that catastrophic flooding from any potential levee failure(s) would have short term adverse impacts to threatened and endangered species, while the long term effects would be uncertain as reconstruction of the surrounding areas occurred.

Alternative 2 (Traditional Construction) and Alternative 3 (Avoid and Minimize Alternative)

Both Alternatives 2 and 3 consist of USACE addressing the deficient sections of levee at the 143 Work Item locations. Funding for the 143 Work Items would be received through annual congressional appropriations. Thus, the timing of the proposed activities would extend for decades with either alternative. As such, the USFWS proposed to address threatened and endangered species in a programmatic manner, consulting on impacts with individual Work Items after construction details (site-specific conditions, exact timing, etc.) are developed prior to the construction phases of each Work Item (see Fish and Wildlife Coordination Act Report in Appendix 2 and USFWS Planning Aid Letter in Appendix 21). This would ensure that any species or critical habitat designated in the future are addressed and that the best available scientific information is used during the consultation process. Pursuant to Section 7 of the ESA, individual consultations would occur with each Work Item after congressional appropriations are received and detailed plans are being developed.

Most of the listed species would have a very low likelihood to no likelihood of occurrence within the Work Item footprints of both Alternatives 2 and 3, as described in Section 3.2.5 and Appendix 9. Overall, there would not likely be adverse effects to federally listed species listed in Section 3.2.5. Details of potential impacts to individual species are described below.

Interior Least Tern (*Sternula antillarum*)

Interior least tern almost exclusively use the lower Mississippi River main channel habitats, and nest on the sandbars during the summer breeding season. No borrow material is proposed to be dredged from the lower Mississippi River to fix the deficient reaches of levee. USACE anticipates Alternatives 2 and 3 will cause no effects to the interior least tern. As investigations and additional design work for each work item are underway, USACE will re-evaluate this effect determination and will initiate consultation with USFWS as appropriate.

Pallid Sturgeon (*Scaphirhynchus albus*)

Pallid sturgeon are a main channel species that avoid backwaters and small tributaries. They inhabit deep thalwegs with hard-packed, sandy substrate, or channel border areas with steep shorelines near fast water. Pallid sturgeon are not expected to use, and were not collected in any of the borrow area sampling associated with the Work Items. USACE anticipates Alternatives 2

and 3 will cause no effects to pallid sturgeon. As investigations and additional design work for each work item are underway, USACE will re-evaluate this effect determination and will initiate consultation with USFWS as appropriate.

Wood Stork (*Mycteria Americana*)

There is a very low probability of wood storks breeding in the Mississippi Alluvial Valley, as described in Section 3.2.3 and 3.2.4. USACE used the USGS GAP Analysis to assess potential impacts to wood stork with Alternatives 2 and 3, which identified only a single area as potentially having suitable wood stork habitat: a proposed landside borrow area near RM 61-R. Upon further analysis, the identified polygon is unlikely to provide any habitat for this species as it is nearly entirely in cropland. Some birds from the Mexican breeding population occasionally occur within the MAV, but individuals within this population do not have a designated status under the ESA. The year-round frequency of occurrence of the wood storks in the assessment area ranges 0 to 40+ percent of the time, and the vast majority of these birds are likely from the non-endangered Mexican population (Mississippi Museum of Natural History 2014). The Southeast U.S. breeding population of wood storks post breeding dispersal is primarily throughout the Coastal Plain of Florida, Georgia, and South Carolina. A larger number of south Florida wood storks do move into central Alabama and northeastern Mississippi (i.e. Tombigbee Waterway in Alabama to Sam Hamilton NWR in Mississippi) and it is highly unlikely wood storks in the lower delta are from the listed population (William B Brooks, USFWS wood stork Recovery Lead, personal communication, June 15, 2020). While a prior record documented potential nesting attempts by wood storks north of Vicksburg, Mississippi, the breeding attempts were not successful (Mueller and McCabe 1997). Because the likelihood for endangered wood storks to occur in the project area is low, and Work Item construction would have very little effect on local and existing hydrology, USACE anticipates Alternatives 2 and 3 may affect but not likely adversely affect wood storks. As investigations and additional design work for each work item are underway, USACE will re-evaluate this effect determination and will initiate consultation with USFWS as appropriate. If wood storks were observed near any proposed Work Item prior to construction, consultation would take place with USFWS, pursuant to Section 7 of the ESA.

Fat Pocketbook Mussel (*Potamilus capax*)

No work is proposed within any river or stream with known fat pocketbook mussel populations with Alternative 2 or 3. The main channel of the Ohio River, secondary channels in the LMR, and St. Francis River basin streams would not be impacted. USACE anticipates Alternatives 2 and 3 will have no effect to fat pocketbook mussels. As investigations and additional design work for each work item are underway, USACE will re-evaluate this effect determination and will initiate consultation with USFWS as appropriate.

Indiana Bat (*Myotis sodalis*) and Northern Long-eared Bat (*Myotis septentrionalis*)

The federally endangered Indiana bats and federally threatened northern long-eared bats are two listed bat species that use forest and forested wetland habitats, where they are known to roost in tree cavities, exfoliated bark and snags. These species could potentially be found in Work Items

within MVM, specifically, within forested areas near the MRL in Missouri, Illinois, Kentucky, and Tennessee. However, there are currently no known maternity colonies within any of the Work Item footprints with either Alternative 2 or 3. As previously mentioned, funding for these Work Items would come from annual congressional appropriations extending for many years. Under current USFWS bat survey and consultation guidelines (USFWS 2019b), bat surveys must be performed within 2 years of construction on the anticipated ROW limits. Before any tree clearing in these states would occur, USACE would review the most updated Range-wide Indiana Bat Survey Guidelines (currently, USFWS 2019b) and northern long-eared bat consultation guidance to determine if presence/absence surveys for listed bat species was necessary, the feasibility of seasonal tree clearing restrictions, and the appropriate survey methodology (acoustic, mist-netting, emergence surveys), and would be coordinated with the respective USFWS Ecological Services Field Office, pursuant to Section 7 of the ESA. Alternative 3 would have less of a potential impact than Alternative 2 to these species due to fewer impacts to forested lands. Additional details on impacts to bat habitat is discussed in Section 4.2.3 and Appendix 7. USACE anticipates Alternatives 2 and 3 may affect but are not likely to adversely affect Indiana and northern long-eared bats. As investigations and additional design work for each work item are underway, USACE will re-evaluate this effect determination and will initiate consultation with USFWS as appropriate.

Gray Bat (*Myotis grisescens*)

Gray bats could pass through portions of the MVM during migration. However, they only use caves for diurnal roosting. There are no caves within any of the proposed Work Item footprints and few (if any) caves occur near the proposed Work Items. USACE anticipates Alternatives 2 and 3 may affect but are not likely to adversely affect Gray bats. As investigations and additional design work for each work item are underway, USACE will re-evaluate this effect determination and will initiate consultation with USFWS as appropriate.

4.2.5.1 At Risk Species

Eastern Black Rail (*Laterallus jamaicensis* spp.)

The eastern black rail is a secretive marsh bird that utilize salt marsh, freshwater marsh, and/or estuarine marsh habitats. The eastern black rail is currently proposed for Federal listing under the ESA. Documented detections of this species inland along the Mississippi River are exceptionally rare, although there have been scattered reports. The proposed levee enhancements along the LMR would have minimal impacts on marsh habitats; therefore, direct, indirect, and cumulative impacts on the species from Alternatives 2 and 3 are considered to be minimal. Three proposed borrow pits (Items 91.2-L, 90.8-L, and 51-L) include a combined 27 acres of marsh habitat. Prior to any construction activities at these sites, marsh habitat would be inspected to assess the likelihood of presence of black rails and potential suitability as rail habitat. USACE anticipates Alternatives 2 and 3 may affect but are not likely to adversely affect eastern black rails. As investigations and additional design work for each work item are underway, USACE will re-evaluate this effect determination and will initiate consultation with USFWS as appropriate.

Alligator Snapping Turtle (*Macrochelys temminckii*)

Alligator snapping turtles can be found within waterbodies adjacent to the MRL. Alternatives 2 and 3 would both result in the creation of aquatic habitat, as described in Section 4.2.7, resulting

in benefits to alligator snapping turtle. Any environmental features added to borrow areas with Alternative 3 would further benefit alligator snapping turtles. Additional details on these potential environmental features are described in Section 4.2.7 and Appendix 11. USACE anticipates Alternatives 2 and 3 may affect but are not likely to adversely affect alligator snapping turtles. As investigations and additional design work for each work item are underway, USACE will re-evaluate this effect determination and will initiate consultation with USFWS as appropriate.

Golden-Winged Warbler (*Vermivora chrysoptera*)

Golden-winged warblers are uncommon to the region and are likely only impacted by loss of forested wetlands that are used as migratory stopover habitat during the fall and spring. This species was not identified in IPaC as occurring in any reaches in the project area, but is included here because it is a notable species of concern by the USFWS. During spring migration, these birds use mid-story forest vegetation (Confer et al. 2011). During the fall, use of other habitats including scrub/shrub and herbaceous stands of ragweed (*Ambrosia* spp.) have been noted (Confer 2011). Impacts to this species due to proposed levee enhancements and borrow area excavation are estimated to be low. Impacts to golden-winged warbler habitat are encompassed in Sections 4.2.2 terrestrial habitat, 4.2.4 migratory birds, 4.2.6 wetland, and the associated appendices. USACE anticipates Alternatives 2 and 3 may affect but are not likely to adversely affect golden-winged warblers. As investigations and additional design work for each work item are underway, USACE will re-evaluate this effect determination and will initiate consultation with USFWS as appropriate.

Monarch Butterfly (*Danaus plexippus plexippus*)

Monarch butterflies could use open fields and forested areas near the MRL. Conversion of these habitat types into the levee footprint due to Alternatives 2 and 3 would have some impact on monarch butterfly. Impacts to these habitats are analyzed in Sections 4.2.2 for terrestrial habitat and Section 4.2.6 for wetlands. Conservation opportunities for monarch butterfly along the MRL are limited due to USACE guidelines for vegetation management at levees (ETL 11110-2-583 2014). The only acceptable vegetative ground cover within the vegetation-free zone along the levee is perennial grasses with the primary function to reliably protect against erosion. These vegetation-free zones shall, when dry, be mowed to a height of 3–6 in. at any time the grass reaches a height of 12 in. The maximum height of grasses shall be 12 in. Any lands used for compensatory mitigation would provide for nectar producing plants during their succession. There also may be some opportunities to encourage nectar producing plants into areas where tree survivability is poor and other locations maintained as open areas (e.g., around parking areas, etc.) at mitigation sites during site-specific planning and adaptive management efforts with the interagency team. USACE anticipates Alternatives 2 and 3 may affect but are not likely to adversely affect the monarch butterfly. As investigations and additional design work for each work item are underway, USACE will re-evaluate this effect determination and will initiate consultation with USFWS as appropriate.

4.2.5.2 Other Federal Trust Species

Louisiana black bear (*Ursus americanus luteolus*)

The Louisiana black bear was delisted in 2016, and is therefore not a concern as a listed species in 2020. USACE (1998) provided a detailed Biological Assessment of the projected impacts on this species, and the conclusion was that bears would largely be unaffected due to relatively small amounts of impact to forested habitats, habitat improvements due to proposed reforestation efforts, and the amount of large forested habitats available outside of the project area (USACE 1998).

Bald Eagle (*Haliaeetus leucocephalus*)

The bald eagle was removed from ESA protection in 2007, but is still protected by the Bald and Golden Eagle Protection Act (1962). There are currently no known nests within the Work Item footprints with Alternatives 2-3; however, bald eagle nests are not uncommon in mature trees near the Mississippi River and associated MRL. With any alternative, USACE would survey the area for nesting bald eagles, and coordinate with the USFWS per the National Bald Eagle Management Guidelines (USFWS 2007). The likelihood is low for any alternative to have direct, indirect, or cumulative adverse impacts to the bald eagle.

4.2.6 Wetland Resources

Alternative 1 - No Action (Future without project)

For the purposes of the wetland assessment, all lands, excluding developed/urban areas and open water within the one-half mile buffer described above, were assumed to be wetlands. Urban and developed areas were assigned a wetland assessment score of zero, because they fail to meet any of the wetland delineation criteria and do not provide a measurable level of wetland function. Similarly, open water areas were assigned a wetland assessment score of zero. Previous studies classified wetland assessment variables within the assessment region as stable variables (i.e., those unlikely to shift within project time frames), response variables (i.e., variables that shift in decadal time frames) and rapid response variables (i.e., those that shift more readily) (Berkowitz and White 2013). That analysis supports an evaluation of how wetland assessment scores are expected to shift over the period of analysis (i.e., 50 years). In general, landscape scale variables (land use, degree of disturbance, hydropattern) are assumed to remain stable over time. Other factors reflect equilibrium conditions established by environmental processes, ecosystem drivers, and site conditions. For example, the tree species distribution in the assessment area is determined by seed sources, flood frequency and duration, historic logging activities, and other factors. Conversely, tree basal area is anticipated to increase over time regardless of site conditions, increasing HSI and FCI values during the period of analysis. As a result, tree basal area scores were increased incrementally at each target year, until the maximum assessment variable metric score was achieved. The rate of tree basal area increase was based upon 1) basal area measurements for stands 0-20 years old collected at established USACE mitigation sites within the region (values reported in Berkowitz et al., 2018), 2) trajectory curved developed for stands >20 years old (Smith and Klimas 2002), and 3) line formulas presented in the WVA models (USACE 2018). This approach ensured that all forested areas achieved the maximum possible basal area assessment variable subindex score at target year's ≤ 35 years. A summary of

the FCIs/HSIs across target years for the future without project are shown in Tables 4-14 and 4-15 below.

Table 4-14. Summary of HGM FCI values across target years for future without project.

Riverside	Mean	Minimum	Maximum
Target year - 0	0.93	0.84	1.00
Target year - 5	0.93	0.86	1.00
Target year - 10	0.94	0.87	1.00
Target year - 20	0.95	0.89	1.00
Target year - 35	0.95	0.89	1.00
Target year - 50	0.95	0.89	1.00
Landside			
Target year - 0	0.96	0.78	1.00
Target year - 5	0.96	0.78	1.00
Target year - 10	0.96	0.78	1.00
Target year - 20	0.96	0.78	1.00
Target year - 35	0.96	0.78	1.00
Target year - 50	0.96	0.78	1.00

Table 4-15. Summary of forested WVA HSI values across target years for future without project.

Riverside	Mean	Minimum	Maximum
Target year - 0	0.54	0.27	0.76
Target year - 5	0.57	0.28	0.83
Target year - 10	0.65	0.38	0.86
Target year - 20	0.68	0.47	0.90
Target year - 35	0.69	0.49	0.90
Target year - 50	0.69	0.49	0.90
Landside			
Target year - 0	0.52	0.26	0.74
Target year - 5	0.55	0.27	0.80
Target year - 10	0.63	0.36	0.83
Target year - 20	0.66	0.46	0.86
Target year - 35	0.66	0.48	0.86
Target year - 50	0.66	0.48	0.86

For the purposes of the wetland assessment, the WVA marsh HSI values are considered constant and do not increase or decrease over time. Where marsh assessment metrics diverged from the optimum range, HSI values remain limited by the amount of submerged aquatic vegetation observed in open water areas (WVA marsh wetland variable - V2), interspersed class (WVA marsh wetland variable - V3), and the distribution of open water <0.5 ft. (WVA marsh wetland variable - V4). Notably, the levee work where impacts to marshes are anticipated to occur (47.5-

R), exhibited a WVA HSI value of 0.96 HSI units. The assumed constant marsh HSI values are shown in Table 4-16 below.

Table 4-16. WVA marsh wetland assessment inputs and results.

Habitat suitability model outputs				
Marsh HSI	unitless	0.81	0.62	0.97
Open water HSI	unitless	0.70	0.53	0.93
HSI	unitless	0.78	0.60	0.96

The approach described above was used to determine baseline (i.e., without-project) conditions using the land cover mapping and HSI/FCI scores for each levee Work Item location. Anticipated future with-project conditions were determined by analyzing the land cover changes associated with project implementation. The associated changes in land cover were then used to determine shifts in wetland habitat suitability/functional capacity by subtracting the with-project HGM functional capacity units (FCUs)/ WVA HUs from the without-project FCUs/HUs at each levee Work Item location over the 50-year period of analysis. That difference represents the potential project impact to wetland resources. Detailed information on the wetland assessment at each of the 143 Work Items is found in Appendix W1 within Appendix 10. Overall, summaries of the existing WVA FCUs/HUs by USACE District and State are presented in Tables 4-17 and 4-18 below.

Table 4-17. Summary of existing wetland functional capacity units (FCU) and habitat suitability units (HSU) results of land cover classes within the wetland assessment area within each District.

<u>District</u>	<u>FCU/HSU</u>	
	<u>Riverside</u>	<u>Landside</u>
Memphis	423,004	344,855
Vicksburg	296,895	105,642
New Orleans	377,833	412,832
Total	1,097,732	863,330
Combined Total	1,961,062	

Table 4-18. Summary of existing wetland functional capacity units (FCU) and habitat suitability units (HSU) results of land cover classes within the wetland assessment area within each State.

<u>State</u>	<u>Existing FCU/HSU</u>	
	<u>Riverside</u>	<u>Landside</u>
Arkansas	255,292	115,026
Illinois	31,194	13,092
Kentucky	1,101	79
Louisiana	603,106	485,009
Mississippi	71,622	33,466
Missouri	51,175	123,230
Tennessee	84,243	93,429
Total	1,097,732	863,330

Additionally, it is likely that catastrophic flooding from any potential levee failure(s) would have short term adverse impacts to those local wetland resources, while the long term effects would be uncertain as reconstruction of the surrounding areas occurred.

Alternatives 2 (Traditional Construction) and Alternative 3 (Avoid and Minimize Alternative)

Implementation of Alternative 2 (traditional construction) would result in an estimated loss of 48,708 FCUs and 20,826 HUs over the period of analysis. Alternative 3 (the avoid and minimize alternative) decreased the impacts to wetland resources by shifting the location of some borrow areas and other features from forested areas adjacent to the levee to agricultural lands and other cover types. Additionally, some features were moved from the riverside of the levee to the landside. These changes in project design decreased the impacts to wetlands by 20,240 FCU/HUs over the period of analysis using the Avoid and Minimize Alternative. Note that the anticipated impacts to wetlands on the riverside of the levee decreases or remains constant, while impacts increase in some landside locations. This results from the shift in borrow area locations away from forested areas, which are more extensive on the riverside of the levee. Overall, summaries of the impacted wetland by USACE District and State are presented in Tables 4-19 and 4-20 below.

Table 4-19. Summary of wetland FCU/HSU changes in each USACE District comparing Alternative 2 (Traditional Construction) with Alternative 3 (Avoid and Minimize).

District	Alternative 2		Alternative 3	
	Change in FCU/HSU		Change in FCU/HSU	
	Riverside	Landside	Riverside	Landside
Memphis	-21813	-15525	-11194	-12731
Vicksburg	-19743	-4398	-15523	-4863
New Orleans	-5334	-2721	-997	-3986
Total	-46889	-22644	-27714	-21579

Table 4-20. Summary of wetland FCU/HSU changes and mitigation requirements in each State comparing Alternative 2 (Traditional Construction) with Alternative 3 (Avoid and Minimize).

State	Alternative 2		Alternative 3	
	Change in FCU/HSU		Change in FCU/HSU	
	Riverside	Landside	Riverside	Landside
Arkansas	-7030	-6411	-4678	-6411
Illinois	-811	-58	-488	-58
Kentucky	0	-295	0	-6
Louisiana	-16652	-4174	-11166	-5439
Mississippi	-8424	-2945	-5354	-3410
Missouri	-9490	-4382	-3120	-1571
Tennessee	-4482	-4380	-2907	-4685
Total	-46889	-22644	-27714	-21579

4.2.7 Aquatic Resources

For the aquatic resource assessment, changes in aquatic habitat (particularly fish habitat) were analyzed using the HEP, using the acres of borrow areas created, enlarged, or deepened for the alternatives to the no action (Alternatives 2-3). The HSI for fish diversity described in Section 3.2.7 was multiplied by acres to calculate HUs gained as a result of borrow area construction. Other than filling in existing borrow areas from road construction or enlargement of levees, impacts of construction on other resources associated with borrow areas (e.g., terrestrial wildlife, wetlands, and waterfowl) were considered in those sections of the SEIS II.

Alternative 1 - No Action

Aquatic resources within borrow areas, the focal water bodies for this SEIS, are described in Section 3.2.7 based off of aquatic sampling at several timeframes dating from 1981 through the present. Borrow areas in the future without project scenario were assumed to be the same as those described in Section 3.2.7. Existing trends of populations of aquatic species are expected to continue in these water bodies.

Alternative 2 (Traditional Construction) and Alternative 3 (Avoid and Minimize Alternative)

Both Alternatives 2 and 3 include creation of new borrow areas to correct the deficient sections of levee resulting in a corresponding gain in aquatic habitat. Alternative 2 consists of traditional methods to raise and stabilize the deficient sections of the levees and floodwalls and to control seepage. Borrow areas would be located at the nearest sites with suitable soils, often in forested lands adjacent to historic borrow areas. This plan would require no special criteria for siting the location of borrow areas other than for engineering provisions. No provisions would be made for environmental enhancement features for the borrow areas. Alternative 3 differs in the placement of some haul roads and borrow areas. During scoping, the major issues identified were: location of borrow sites, loss of BLH and associated wetlands, and allowing for landowner input. This alternative seeks to avoid and minimize these impacts by placing borrow areas in less environmentally sensitive areas when practicable. Additional environmental features (e.g., irregular shorelines, islands, variable depths, etc.) that could be incorporated into borrow area designs to increase habitat value would be explored with willing landowners and non-Federal sponsors during detailed design.

Construction of levee enlargements, haul roads, seepage berms, and slope flattening requires borrow material. Excavation of borrow material creates depressions that typically fill with water for part or all of the year. Total acres created are almost identical between the two alternatives: 1,403.3 for Alternative 2 and 1,402 acres for Alternative 3 (Table 4-21). However, Alternative 2 has 525.6 acres landside compared to 414.3 landside for Alternative 3. Conversely, Alternative 3 has 987.7 acres riverside compared to 877.7 riverside for Alternative 2. In addition to new open water habitats being created from borrow areas, other types of work (e.g., construction of haul roads, levee enlargements, installation of relief wells etc.) would result in either fill or deepening of minor (<4 acres) amounts of existing open water habitats (Table 4-21).

Table 4-21. A summary of the borrow area acres that would be created on the landside or riverside of the levee under Alternative 2 (traditional construction) and Alternative 3 (avoid and minimize) without environmental features. Habitat Suitability Index values were calculated from equation 1, Section 3.2.7. Habitat values used in this analysis were VDI=1.4, maximum depth=7.5 feet, percent area > 5 ft = 23, and average turbidity=24 NTU's resulting in a HSI=0.7. Relative Value Index (RVI) indicating reduced species diversity was applied to all landside borrow areas by multiplying Habitat Units by 0.6.

District	Location (proposed work)	Alternative 2 (traditional construction)				Alternative 3 (avoid and minimize)			
		Acres	HSI	RVI	Habitat Units	Acres	HSI	RVI	Habitat Units
Gains (+) of open water due to land cover conversions with new borrow areas									
MVM	Landside (borrow)	+349.5	0.7	0.6	+147	+43.5	0.7	0.6	+18
MVM	Riverside (borrow)	+207.9	0.7		+146	+513.1	0.7		+359
MVK	Landside (borrow)	+77.9	0.7	0.6	+33	+147.6	0.7	0.6	+62
MVK	Riverside (borrow)	+479.7	0.7		+336	+409.6	0.7		+287
MVN	Landside (borrow)	+98.2	0.7	0.6	+41	+223.2	0.7	0.6	+94
MVN	Riverside (borrow)	+190.1	0.7		+133	+65	0.7		+46
TOTAL	Landside (borrow)	+525.6			+221	+414.3			+174
TOTAL	Riverside (borrow)	+877.7			+614	+987.7			+691
NET TOTAL		+1403.3			+835	+1402			+865
Gains (+) or losses (-) of existing open water due to other proposed work									
MVM	Riverside: (fill of open water from levee enlargement)	-0.4	0.7		-0.3	-0.4	0.7		-0.3
MVM	Landside: (excavation from relief wells)	+5.7	0.7	0.6	+2.4	+5.7	0.7	0.6	+2.4
MVK	Riverside: (deepening of existing borrow area)	+0.2	0.7		+0.1	+0.2	0.7		+0.1
MVK	Riverside: (fill of open water from haul roads)	-3.8	0.7		-2.6	-2.9	0.7		-2.0

MVN	Riverside: (fill of open water from levee enlargement)	-0.2	0.7		-0.1	-0.2	0.7		-0.1
MVN	Landside: (fill of open water from levee enlargement)	-0.9	0.7	0.6	-0.4	-0.9	0.7	0.6	-0.4
TOTAL	Landside	4.8			+2.0	4.8			+2.0
TOTAL	Riverside	-4.2			-2.9	-3.3			-2.3
NET TOTAL		0.6			-0.9	1.5			-0.3
TOTAL	Landside	+530.4			+223	+419.1			+176
TOTAL	Riverside	+873.5			+611.1	+984.4			+688.7
GRAND TOTAL		+1403.9			+834.1	+1403.5			+864.7

HSI values were calculated for each alternative. The four habitat variables in the HSI model (VDI, maximum depth, percent area less than 5 feet, and turbidity) were estimated for each alternative and a HSI value calculated using equation 1 (see Section 3.2.7).

Equation 1:

$$HSI = \frac{31.2(VDI) + 2.2(\text{Maximum Depth}_{ft}) - 0.2(\text{Percent Area} > 5ft) - 0.1(\text{Turbidity}_{NTU})}{43} - 24.3$$

A HSI of 0.6 was calculated for both the traditional and avoid and minimize alternatives (Table 4-22). The VDI and percent area greater than 5 feet were based on a 1:3 slope with a maximum depth of 8 feet, which is the basic design criteria of borrow areas for both Alternatives 2 and 3. Alternative 3 would reduce placement of borrow areas in wetlands or BLH forests, but does not necessarily require a specific design of the borrow area itself.

Table 4-22. Habitat variable measurements and HSI calculations based off of basic borrow area design criteria for Alternatives 2 and 3.

Alternative	VDI	Max Depth	Area>5ft	Turbidity	HSI
Alternative 2 (traditional const.) and Alternative 3 (avoid and minimize)	1.5	8	50	22	0.6

Habitat Units

Overall, Alternative 2 would result in the creation of 530.4 acres landside and 873.5 acres riverside of open water habitat for fish, resulting in a HU gain of 221 and 614, respectively (Table 4-21). Lower gains in HUs for landside borrow areas was due to application of the RVI of

0.6 indicating reduced species diversity in borrow areas landside of the levee. Alternative 3 without environmental features would create 420.9 acres of landside open water habitat and 984.4 acres of riverside, resulting in a HU gain of 176 and 688.7, respectively (Table 4-21). Considering both gains and losses overall (Table 4-21), approximately 1,406 acres of open water would be created during the project and approximately 865 HUs gained for Alternative 3, the preferred alternative.

Additional Environmental Features Possible with Alternative 3

As described in Sections 1 and 2, landowner input was a central theme identified during public scoping. Additional environmental designs (e.g., irregular shorelines, islands, variable depths, reforestation, etc.) that could be incorporated into borrow areas to increase habitat value would be explored with willing landowners and non-Federal sponsors during detailed Work Item design with Alternative 3. Following construction, USACE would have no rights or responsibilities for these borrow areas; thus, these environmental benefits were not assumed to offset any impacts in calculations of compensatory mitigation; but they would provide ecological benefits when implemented. These potential features would include consideration of the model variables increasing the HSI to 1.0, including: higher VDI making the borrow area more cone shaped with deeper water, reducing percent area less than 5 feet, and reducing turbidity by creating riparian buffers around the borrow area to filter sediment runoff, provide additional windbreaks to reduce wave action, or implement some level of bank stabilization (Table 4-23). Other features not included in the model can also be incorporated to increase the heterogeneity of the borrow area including irregular shorelines and islands. Some percentage of the borrow area less than 5 feet would benefit spawning and rearing of fishes that typically reproduce in shallow-water habitats such as sunfishes, buffalo, and many species of minnows and shiners.

Table 4-23. Habitat variable measurements and HSI calculations associated with potential borrow area environmental design criteria to be explored with willing landowners and non-federal sponsors with Alternative 3.

Alternative	VDI	Max Depth	Area>5ft	Turbidity	HSI
Alternative 3 (avoid and minimize) with Environmental Features	1.7	10	25	10	1.0

Alternative 3 with environmental features would create the same acres of borrow areas but the HSI value will be 1.0 compared to 0.6 without environmental features. Although these features are unlikely to occur at all borrow locations, there is potential for habitat gains up to 249 and 988 HUs for landside and riverside borrow areas, respectively (Table 4-24). Field collections in borrow areas since 1981 confirms that incorporation of environmental design features would increase fish diversity, increase HUs gained, and benefit multiple ecological resources in the Lower Mississippi River.

Table 4-24. Avoid and Minimize Alternative with Environmental Features. Habitat Suitability Index values were calculated from equation 1, Part I. Habitat variables used in this analysis were VDI=1.7, maximum depth=10 ft, percent area > 5 feet=25, and average turbidity=10 NTU's resulting in an HSI of 1.0. Relative Value Index indicating reduced species diversity was applied to all landside borrow areas by multiplying Habitat Units by 0.6.

District	Location	Acres	HSI	RVI	Habitat Units
MVM	Landside	43.5	1	0.6	26
MVM	Riverside	513.1	1		513
MVK	Landside	147.6	1	0.6	89
MVK	Riverside	409.6	1		410
MVN	Landside	223.2	1	0.6	134
MVN	Riverside	65	1		65
TOTAL	Landside	414.3			249
TOTAL	Riverside	987.7			988
GRAND TOTAL		1402			1236

4.2.8 Water Quality

Alternative 1 - No Action

The historical *in situ* data presented for the Mississippi River in Section 3.2.8.1 and Appendix 12 shows that overall water quality is good and that it meets all aquatic life standards. The Mississippi River does carry excess nutrients, but this nutrient load does not have an adverse effect on aquatic life in the Mississippi River. With existing protections under the CWA, no significant changes to this trend are expected with the No Action Alternative. Existing borrow areas and other floodplain water bodies in the project area act as sinks for nutrients and sediments. Similarly, the existing water quality in borrow areas throughout the project area, as described in Section 3.2.8.2, are similarly not expected to change with the No Action Alternative. Existing borrow areas located riverside of the levee would continue to fill in over time, as described in Section 4.2.7 and Appendix 12.

Alternatives 2 (Traditional Construction) and Alternative 3 (Avoid and Minimize Alternative)

4.2.8.1 Mississippi River

Construction of the 143 MRL Work Items under Alternatives 2 and 3 would not have a noticeable impact on water quality of the Mississippi River. Construction of the features with Alternative 2 and 3 would have similar direct impacts of localized increases in turbidity and suspended solids. Implementation of BMPs for nonpoint pollution at construction sites would minimize these direct impacts to the water quality of the Mississippi River.

4.2.8.2 Borrow Areas

While the excavation of material from borrow areas is always done when the area is dry, seasonal flooding of the disturbed areas may contribute to localized increases in turbidity. These direct impacts would be minimized with BMPs for nonpoint pollution at construction sites. A SWPPP would be prepared in compliance with EPA and associated State regulations with each construction contract. The SWPPP would outline temporary erosion control measures such as silt fences, retention ponds, and dikes. The construction contract would include permanent erosion control measures, such as turfing and placement of riprap and filter material. As described in Section 2, Alternative 3 reduced impacts to BLH forest and vegetated wetlands from using a prioritization scheme in the siting of potential borrow areas. As shown in Table 4-1, Alternative 3 would impact 443 fewer acres of BLH forest and vegetated wetlands from borrow area placement than Alternative 2, resulting in fewer indirect impacts to water quality. Alternative 3, the preferred alternative, strikes a balance between the public safety associated with flood risks and the value of existing forested bottomland hardwood and non-forested wetlands, which provides functional enhancement to water quality within the project area.

4.2.8.3 Groundwater

Some land owners in Concordia Parish, Louisiana have expressed concern for the mixing of discharge from relief wells and precipitation runoff in surface waters used for irrigation within northeast Louisiana where salinity in the shallow aquifer is shown to be high. Work Item Nos. 341-R, 337-R, and 320-R are located in Concordia Parish and include proposed relief wells to address seepage problems for both Alternatives 2 and 3. Preliminary results do not show levels of SAR detrimental to agricultural production as described in Section 3.2.8.3 and Appendix 12. Additionally, the water quality from relief well discharge falls within acceptable limits for the National Recommended Water Quality Criteria for fresh water published by the EPA, as long as minimal time for re-aeration is available. USACE is continuing their monitoring efforts of relief well water to better understand the interactions with surface waters and to ensure the information is available to assist with future design of Work Items in the MRL system.

4.2.9 Air Quality

Alternative 1 - No Action

Under the No Action Alternative, there is no expected change from existing conditions.

Alternatives 2 (Traditional Construction) and Alternative 3 (Avoid and Minimize Alternative)

Air quality impacts would be the same with Alternatives 2 and 3. Most of the Work Items are located in areas classified as in attainment for air quality standards, and the equipment used is classified as a mobile source and exempt from permitting requirements. Best management practices would be used during construction to minimize air quality impacts. Overall, no direct or cumulative impacts are expected with either alternative. Impacts by District are discussed below with particular emphasis on those areas not in attainment for air quality standards.

4.2.9.1.0 Memphis District

All Work Items within the MVM are located within areas classified as in attainment for air quality standards, with the exception of those in Crittenden County, Arkansas. The Memphis metropolitan area that includes Crittenden County, Arkansas was designated as a maintenance area of the currently applicable 2008 8-hour O₃ standard with a marginal classification on 25 July 2016. An applicability determination for general conformity was conducted for construction of the seven proposed Work Items that are either partially or entirely within Crittenden County, Arkansas. Horsepower hours and total project emissions for each Work Item were calculated using EPA's NONROAD2010 emission inventory model (Appendix 13 - Attachment 1). The projected total amount of emissions for all Work Items in Crittenden County was calculated to be 3.55 tons of volatile organic compounds (VOC) and 67.01 tons of NO_x. Thus, even if all Work Items within Crittenden County were constructed within the same year, these levels are below the de minimis value of 100 tons/year for the county's marginal classification per 40 CFR 93.153(b)(1). Funding for construction of these Work Items would be received annually through congressional appropriations. Based on traditional funding allocations, no more than two Work Items are likely to be constructed within the same year in Crittenden County, resulting in emissions significantly lower than any annual threshold limits. Based on this applicability determination, the emissions for Work Items within the MVM are classified as de minimis, and no further action is required.

4.2.9.1.1 Vicksburg District

All Work Items within the MVK are within areas classified as in attainment for air quality standards. Equipment used is classified as a mobile source and exempt from permitting requirements.

4.2.9.1.2 New Orleans District

Most of the proposed Work Items in the MVN are located in areas that are in attainment status for NAAQS; however, there are several Work Items that are located in the Baton Rouge five-parish nonattainment area for O₃ or in the St. Bernard Parish nonattainment area for SO₂. The Baton Rouge metropolitan nonattainment area was designated by the EPA as a maintenance area for O₃ under the 8-hour standard effective December 15, 2016; and St. Bernard Parish was designated by the EPA as a nonattainment area for SO₂ under the 1-hour standard effective October 4, 2013.

An applicability determination for general conformity was conducted for the construction of the twenty Work Items that are in the Baton Rouge maintenance area for O₃ and for six Work Items that are in the St. Bernard nonattainment area for SO₂. EPA's NONROAD2010 emission inventory model (see Appendix 13 – Attachments 2, 3, 4, 5, and 6) was used to calculate the amount of VOC, NO_x, and SO₂ that may be created during construction of the Work Items. The projected total amount of VOC and NO_x emissions in the Baton Rouge maintenance area are 19.71 tons and 393.464 tons, respectively. Since the NO_x emissions could exceed the annual de minimis quantity if all Work Items were constructed within one year, MVN would ensure during detailed design that construction of the Work Items was scheduled so as to not allow the de minimis limits to be exceeded. This approach would allow MVN to remain in compliance with the State Implementation Plan.

The projected total amount of emissions for all Work Items in St. Bernard Parish was calculated to be 12.5872437 tons of SO₂. Thus, even if all Work Items were constructed within the same year, these levels are below the de minimis value of 100 tons/year for St. Bernard Parish's nonattainment classification.

4.2.10 Cultural Resources

Cultural resources/historic properties have been defined as important institutionally through the passage of various laws, technically through the funding and support of long term studies, and publicly through the call to visit and interpret important archaeological and historical sites. In terms of evaluating impacts or effects to them, the criteria of "adverse effect" is the standard of evaluation. The criteria says: "An adverse effect is found when an undertaking may alter, directly or indirectly, any of the characteristics of a historic property that qualify the property for inclusion in the National Register in a manner that would diminish the integrity of the property's location, design, setting, materials, workmanship, feeling, or association. Consideration shall be given to all qualifying characteristics of a historic property, including those that may have been identified subsequent to the original evaluation of the property's eligibility for the National Register. Adverse effects may include reasonably foreseeable effects caused by the undertaking that may occur later in time, be farther removed in distance or be cumulative" (36 CFR 800.5). Comparison between the No Action Alternative and the implementation of the Work Items form the basis of the impacts/effects determination.

Alternative 1 - No Action

Without implementation of the Work Items, existing trajectories of land use would likely persist. USACE anticipates that the various types of historic properties discussed in Section 3.9 would continue to be subjected to destruction by agricultural and development pressures. Additionally, NRHP-eligible buildings and archaeological sites would likely be damaged as a result of floodwaters potentially over-topping the MRL features. Historic properties that may be affected by federal undertakings (i.e. carried out, licensed, permitted, assisted, or permitted by federal agencies) would be subject to consideration under Section 106 of the NHPA. However, historic properties with no federal nexus would receive no consideration under federal laws and regulations, but may fall under other Federal, Tribal, or State stewardship programs. However,

USACE would have no impact to cultural resources or historic properties by implementing the No Action Alternative. Catastrophic flooding from any potential levee failure(s) could have adverse effects to cultural resources.

Alternatives 2 (Traditional Construction) and Alternative 3 (Avoid and Minimize Alternative)

Approximately 4,355 historic properties and other cultural resources items are located very near the Work Items (in the area of potential effects (APE)), with 143 sites, cemeteries, or historic buildings currently located within the Work Items (Hornum et al. 2020; Maymon and Kosack 2020; and Meaden et al 2020). These resources consist of African-American marked and unmarked cemeteries, prehistoric Native American archaeological sites, some with reported mounds within the levee profile, and national historic landmarks, such as the Vieux Carre in New Orleans. A summary per District is provided in Table 4-25.

Table 4-25. Summary of cultural sites recorded in the Work Items and in area of potential Effect.

District	# of Cultural Resources in Work Item	# of Cultural Resources in Vicinity (APE)
MVM	49	451
MVK	4	58
MVN	90	3,846
Total	143	4,355

Also, as documented in Appendix 14, a majority of the Work Items have the potential to contain unidentified historic properties. Therefore, USACE has determined that it is reasonably foreseeable that the Work Item impacts have the potential to adversely impact historic properties. Both the impacts and the processes for identification and evaluation of cultural resources for each individual Work Item are addressed in a PA governing USACE's Section 106 review process for these series of undertakings. Coordination and evaluation of cultural resources would not differ between alternatives and would apply to relocating borrow areas outside of environmentally sensitive areas. Thus, there would be no difference in impacts to cultural resources between Alternatives 2 and 3.

4.2.10.1.1 Development and Implementation of Programmatic Agreement

Consistent with regulatory guidance contained in 36 CFR 800.14(b)(1)(i) and (ii) that the impacts could potentially adversely affect historic properties and that there is a high potential for encountering additional cultural resources, USACE determined that the effects on historic properties could not be *fully* determined before congressional funding approval for each Work Item. Accordingly, USACE initiated the development of a PA in 2019. USACE notified the SHPO for the States of Arkansas, Illinois, Kentucky, Louisiana, Mississippi, Missouri, and Tennessee, 34 federally-recognized Tribes having an interest in the seven states, the Advisory Council on

Historic Preservation and the NPS (Table 7-1). Consultation was initiated by letter on September 11, 2019, followed by nine consultation meetings (Table 7-2) to discuss and develop the language of the a PA, entitled, *Programmatic Agreement, Among The U.S. Army Corps Of Engineers (USACE), Memphis, New Orleans, And Vicksburg Districts, The Chickasaw Nation, The Choctaw Nation Of Oklahoma, The Osage Nation, The Arkansas State Historic Preservation Officer, The Illinois State Historic Preservation Officer, The Kentucky State Historic Preservation Officer, The Louisiana State Historic Preservation Officer, The Mississippi State Historic Preservation Officer, The Missouri State Historic Preservation Officer, The Tennessee State Historic Preservation Officer, and The Advisory Council On Historic Preservation Regarding The Mississippi River And Tributaries Project: Mississippi River Levee Features (MRL SEIS II PA)*. While the MRL SEIS II PA is not yet executed, there is no reason to believe that the consulting parties would not come to agreement. A summary of the current draft agreement is in Appendix 14. The final executed document would replace the summary. All necessary additional identification of historic properties would follow the process outlined in the MRL SEIS II PA, as well as mitigating all identified effects/impacts per the terms of the agreement, keeping USACE compliant with the NHPA and accounting for cultural resources in each of the Work Items.

4.2.11 Socioeconomic Resources

The Mississippi River has made major contributions to the physical and economic growth of the MAV region and the main stem levee area. Regionally, it has provided tremendous potential for meeting water supply and water transportation needs for industrial and agricultural development. Also, comprising over 12,000 miles of inland waterways, the Mississippi River system has supported the ever-growing commerce of the Nation as the main stem of a major navigation network. The Mississippi River carries over 500 million tons of commerce annually. As the chief supplier of water for the many industries that have located along its banks, it is one of the Nation's greatest industrial attractions.

A significant portion of national prosperity is contributed by the MAV region. This area is the site of one of the oldest commercial agricultural regions in North America and lies in the heart of the most diverse hydrologic system in the Nation. In 1970, the lower region handled 1 of every 7 tons of waterborne commerce in the United States, supplied from one-fourth to one-third of the Nation's energy, made substantial contributions to national food and fiber requirements, and supported \$8 billion in industrial development along the lower reaches of the river.

Population projections are presented in Table 4-26 for existing (2018) and future conditions to the year 2060 for the project area. Population in the overall area is projected to increase from 4.8 million people in 2018 to approximately 6.5 million by the year 2060.

Table 4-26. Population projections for existing and future conditions to year 2060 for the project area.

	Population by Year					
	Existing	Projected				
Study Area by District	2018	2020	2030	2040	2050	2060
CEMVK - Vicksburg District	815,700	828,200	892,100	956,800	1,026,200	1,100,700
Arkansas Study Area	141,800	143,700	153,400	162,200	171,500	181,300
Louisiana Study Area	293,000	297,900	323,000	349,800	378,800	410,200
Mississippi Study Area	380,900	386,600	415,700	444,800	475,900	509,200
CEMVM Memphis District	1,967,600	1,998,200	2,153,600	2,301,200	2,459,200	2,628,000
Arkansas Study Area	340,800	347,900	384,200	412,600	443,100	475,800
Illinois Study Area	5,500	5,600	6,100	6,600	7,200	7,800
Kentucky Study Area	6,100	6,200	6,600	7,100	7,600	8,100
Mississippi Study Area	182,000	184,800	198,900	213,000	228,100	244,200
Missouri Study Area	252,600	257,600	283,200	308,800	336,700	367,100
Tennessee Study Area	1,180,600	1,196,600	1,247,600	1,353,100	1,436,500	1,525,000
CEMVN - New Orleans District	1,971,700	2,006,600	2,184,000	2,361,400	2,553,200	2,760,600
Louisiana Study Area	1,971,700	2,006,600	2,184,000	2,361,400	2,553,200	2,760,600
TOTAL MRL AREA	4,755,000	4,833,000	5,229,700	5,619,400	6,038,600	6,489,300
Historical data: Census Bureau; Projected data: Bureau of Labor Statistics.						

Income forecasts, which are presented in Table 4-27 for the project area, show per capita income (PCI) to increase substantially in all areas of the economic base area. Overall, PCI is projected to increase from \$21,700 in 2018 to \$27,500 by 2060, or approximately 21 percent. Income values in Table 4-27 are expressed in constant 2018 dollars.

Table 4-27. Per capita income forecasts through Year 2060 for the project area.

	Per Capita Income by Year (\$)					
	Existing	Projected				
Study Area by District	2018	2020	2030	2040	2050	2060
CEMVK - Vicksburg District	18,000	18,300	19,700	21,000	22,500	24,100
Arkansas Study Area	18,900	19,200	20,500	21,700	22,900	24,200
Louisiana Study Area	18,900	19,200	20,800	22,500	24,400	26,400
Mississippi Study Area	16,300	16,500	17,700	18,900	20,200	21,600
CEMVM Memphis District	21,500	24,300	26,400	28,400	30,600	32,900
Arkansas Study Area	20,300	20,700	22,900	24,600	26,400	28,400
Illinois Study Area	32,900	33,500	36,500	39,700	43,200	47,000
Kentucky Study Area	25,900	26,300	28,100	30,000	32,100	34,300
Mississippi Study Area	22,500	22,800	24,500	6,200	28,100	30,100
Missouri Study Area	20,300	20,700	22,800	24,900	27,200	29,700
Tennessee Study Area	21,700	22,000	23,400	24,800	26,300	27,900
CEMVN - New Orleans District	25,600	25,600	25,600	25,600	25,600	25,600
Louisiana Study Area	25,600	25,600	25,600	25,600	25,600	25,600
TOTAL MRL AREA	21,700	22,700	23,900	25,000	26,200	27,500
Historical data: Census Bureau; Projected data: Bureau of Labor Statistics						

Alternative 1 - No Action

Under the No Action Alternative, projections described above and conditions examined in Section 3 would be expected to persist. Throughout history, the Mississippi River has been the basis for the agricultural economies that have developed along its banks. However, commerce and industry have emerged over recent years, helping to diversify local and regional economies that have historically been rural in nature, with the exception of a few major metropolitan areas. Capitalizing on a market of available natural resources, investments have been made in the production, as well as the protection via flood risk reduction, of the region's resources. Failure of the MRLs during the time of a major flood event would allow the destruction of crops, homes, and industries, causing many billions of dollars in damages and businesses, and lives would be interrupted.

Alternatives 2 (Traditional Construction) and Alternative 3 (Avoid and Minimize Alternative)

With implementation of either Alternative 2 or 3, projections described above and conditions examined in Section 3 would be expected to persist. However, with implementation of either alternative, the residents, businesses, agricultural land, and overall way of life associated with the Mississippi Delta and approximately 22 million acres of land in the States of Arkansas, Illinois, Kentucky, Louisiana, Mississippi, Missouri, and Tennessee would be provided the level of flood protection authorized by Congress in The Flood Control Act of 1928, as amended, and WRDA of 1986.

4.2.12 Environmental Justice

Alternative 1 - No Action

Under the No Action Alternative, construction of the proposed Work Items would not occur; as such, no EJ impacts from associated construction activities would occur. Low-income and minority populations would continue to be affected by and potentially adapt to changes in environmental conditions under the No Action Alternative in the short term. Continued risk of flooding to EJ communities in the assessment area could result in these communities suffering economic losses, loss of agricultural lands, impacts to urban structures and property, loss of crops, or damage to property, and reduction in land values.

The No Action Alternative could directly and indirectly affect other socioeconomic resources through increased flooding potential within the area. Potential EJ impacts could result to effects on employment, income, population (migration), and government revenues and expenses. Impacts to transportation infrastructure and water supply could occur under the No Action Alternative, thereby impacting EJ communities, and all communities.

Alternatives 2 (Traditional Construction) and Alternative 3 (Avoid and Minimize Alternative)

Alternative 2 (Traditional Construction) and Alternative 3 (Avoid and Minimize) are expected to have similar impacts to the human environment, including Environmental Justice. Both alternatives would have the same proportional impact from the 143 work items to EJ communities. Alternative 3 may avoid or minimize impacts to BLH, for instance, but the construction work will still take place at a new nearby location; the construction work will take place.

Each of the proposed 143 MRL Work Items contain numerous project features (e.g., intermittent segments of deficient levees or floodwalls, the associated borrow areas, etc.) to be assessed for potential EJ impacts. Across all of the 143 MRL Work Items, there are 421 segments that were assessed for adverse impacts to EJ communities. For these 421 segments, the impact area is determined as that population living within 0.5 miles of the proposed project. Normally, construction activities taking place for the types of MRL projects are experienced by communities directly adjacent to the site. Each site's impact area is assessed to determine if EJ communities may experience temporary or permanent direct or indirect impacts from construction of the levee or floodwall features. As discussed below, indirect impacts are primarily anticipated in portions of the MVN, MVK and MVM. These EJ impacts are temporary and are significantly offset by the long-term EJ benefits of the Work Items. The data is presented for each District and by parish or county, which were consequently determined to be the area of focus for this analysis.

Direct impacts to EJ communities from construction of the MRL projects are expected to be minimal. Direct impacts can occur when a Federal action, such as increasing the size of a levee for flood risk reduction, requires acquisition of land or other property to construct the

improvement. Detailed design is not yet completed for the 143 Work Items. Based off of the current design assumptions (Appendix 4), the need to acquire a substantial amount of land for the levee improvements is not anticipated. During detailed design, if it is determined that additional land is required to construct the improvement, re-engineering, including an analysis of the total height deficiency, can determine whether the levee lift can be a flood side shift, straddle or land side shift. In addition, a stability analysis would need to be conducted along with an evaluation of the height of the lift to determine the best solution and to raise the levee with the minimum impact. Direct impacts would be avoided and or minimized by incorporating design changes. During detailed design of the proposed Work Items, further analysis may be required to assess if land acquisition creates a disproportionate impact to EJ communities.

Positive, indirect impacts include a decrease in risk of damage from levee failure to minority or low-income populations in the assessment area. Assuming that the levee failures would be avoided, Alternatives 2 and 3 would reduce the adverse impacts to EJ communities - flood damages, loss of life, reduced economic activity, and potential out-migration. These positive impacts would be long term and would be likely to sustain the socioeconomic vitality of the project area, positively impacting EJ communities.

The more common type of adverse impact EJ communities may experience from the construction of the Work Items are considered indirect impacts, which for the Work Items would be short-term. The following is a description of the types of adverse, indirect impacts that may affect EJ communities within 0.5 miles of a project segment that are caused by the construction of the Work Items.

Transportation and Traffic Delays

In general, the overall MRL implementation may cause adverse temporary impacts on the road network near the work site due to increased congestion, accelerated roadway wear-and-tear, and traffic delays resulting from re-routing major and local access roads in the project area.

Temporary impacts on transportation due to increased congestion may occur and is dependent on road closures required to construct levee repairs. Road closures may not occur at every work site, and if closures are required, they would be for the short term. On those segments of roads that must close and traffic re-routed, minor to moderate delays, particularly during peak hours, may occur especially in more congested areas.

Several impact avoidance features are included as integral components of the proposed action to minimize impacts to vehicular transportation. Specific routes would be designated for construction-related traffic to minimize residential disturbance and traffic congestion. USACE contracts would designate specific routes for construction-related traffic to avoid residential areas, to the maximum extent practicable, and staging areas for construction equipment and personnel would be located away from heavily populated areas. Streets that would serve construction-related traffic would be resurfaced, if needed and as appropriate, prior to initiation of construction activities; and maintenance of those streets would be provided during the construction period. Appropriate detour signage would be placed to preserve access to local streets during construction activities. Off-street parking would be provided for construction

workers, and shuttle vans would be used to transport construction workers to the work sites, if necessary. Streets that are damaged by any and all construction activities would be repaired.

Minority and low-income populations near the levee or floodwall improvements in the MVN would experience minor to moderate, temporary, adverse impacts due to transportation delays during the approximately 6 – 60 month construction period, depending on the work. The Work Items would not start until fiscal year (FY) 2022, with most starting in FY2030 - FY2050. Transportation impacts from construction of MVK and MVM Work Items could also be possible, but is expected to be less of an impact to EJ communities than the MVN Work Items.

Noise

Noise along all segments of levee improvement existing ROWs would increase due to the temporary operation of equipment and vehicles used in the construction of the levee lifts and floodwall raises. While noise impacts may cause a temporary inconvenience to EJ residents and facilities in the immediate area, noise levels associated with construction activities would be temporary and monitored to ensure acceptable standards are maintained. No permanent noise impacts as a result of MRL construction are anticipated, and all noise emissions are expected to be short term, lasting only as long as construction activities. No long-term indirect effects on noise are anticipated with implementation of proposed actions. For more information on short-term noise impacts that may be avoided, minimized or mitigated by use of best management practices, please see the EJ section in Appendix 16.

Dust and Air Quality

Air Quality impacts to EJ communities are expected to be minor and short term. Temporary increases in air pollution could occur from the use of construction equipment (combustible emissions). As detailed in the air quality analyses in Section 4.2.9, all work would be conducted to ensure construction is below the annual de minimis quantities in areas of nonattainment and ensure the work remains in compliance with any State Implementation Plans.

Distribution of EJ Communities

See Appendix 16 for tables showing the MRL EJ communities in the impact area which is defined as the geographic area within 0.5 miles of a Work Item. According to CEQ's "Environmental Justice Guidance under the National Environmental Policy Act" released in December 1997, DOD's 1995 release of "Strategy on Environmental Justice" and EPA's "Promising Practices for EJ Methodologies in NEPA Reviews", prepared in March 2016, if the alternative impact is appreciably more severe or greater in magnitude on minority or low-income populations than the adverse effect suffered by the non-minority or non-low-income populations after taking offsetting benefits into account, then there may be a disproportionate finding.

EJ communities potentially impacted by Work Items in MVN

EJ communities are spread throughout the entire MVN project area. Impacts from the construction activities would be temporary (within a 6- to 60-month period). Fifty-six MVN

project segments are located within 0.5 miles of low-income or minority communities (EJ communities). Table 7 in Appendix 16 lists the EJ communities within 0.5 miles of 56 project segments (excluding borrow sites) in the MVN. Project segments that do not have an EJ community within 0.5 miles (78) are not listed in this table. EJ communities are defined as either at least 50 percent of population identifying as a minority or 20 percent or more of population living below poverty within a 0.5 miles buffer of the proposed work. Segments shown in the table have met or exceeded the minority or low-income threshold and therefore qualify as an EJ community. Well over half of the MVN projects are near non-EJ communities, while 42 percent of the projects are near EJ communities showing that the Work Items impact both communities and to a greater extent, non-EJ communities.

The parish is the reference community of which to compare the low-income and minority percentages of the impacted area and is one criterion to determine proportional or disproportionate effects. If the minority and low-income composition of the impacted area is similar to the reference community, the impact is not considered disproportionate in terms of this criteria. The demographics of many of the EJ communities around the project segments are similar to the parish they are within. Twenty-three of the 56 EJ communities are in EJ parishes, which shows that much of the population affected by the Work Item construction is similar to that of the parish. On the other hand, 32 EJ communities are in parishes that are not low income or minority as a whole.

As described in the EJ adverse impact section, many of the impacts are considered indirect and occur during construction, which would be temporary and are expected to last from 6 months to about five years, depending on complexity and size. Traffic re-routing causing delays, dust, noise, and air quality impacts would be the common indirect impacts for all of the Work Items. Depending on the duration of construction activities, impacts would vary. Once construction is completed, conditions would return to normal.

Because design changes would avoid direct impacts, mainly the acquisition of residential lands along the road adjacent to the levee, there are only minimal direct impacts anticipated from the construction of the Work Items. In situations where a design change cannot remove the need to acquire land for a ROW, which would be determined much later during detailed design, further analysis may be required to assess if the acquisition creates a disproportionate impact to EJ communities.

Work Item construction activities are minor to moderate, affecting both EJ and non-EJ communities throughout the entire MVN District and do not qualify as disproportionately high and adverse under EO 12898. BMP would be undertaken during construction to reduce or minimize the potential impacts. Additionally, MRL project benefits, including reduction in flood risk, would be felt by all residents in the assessment area, including those in EJ and non-EJ communities. Therefore, there are no direct, high adverse disproportionate impacts to EJ communities associated with MVN levee repairs.

EJ communities potentially impacted by Work Items in MVK

EJ communities within 0.5 miles of the MVK project segments are consolidated in Bolivar County, Mississippi. The focus of this analysis is four project sites and the minority or low-income communities within a 0.5 mile buffer of the construction activities. All of the other MVK project segments (58) are not located within 0.5 miles of an EJ community.

Impacts from the construction activities are expected to be short-term (within a 7- to 14-month period). Table 9 in Appendix 16 lists the low-income and minority communities within 0.5 miles of the four project sites (excluding borrow sites) in the MVK. Project segments that do not have an EJ community within 0.5 miles are not listed in this table. EJ communities are defined as either at least 50 percent of population identifying as a minority or 20 percent or more of population living below poverty within a 0.5 miles buffer of the proposed Work Items.

Bolivar County is the reference community of which to compare the low-income and minority percentages of the impacted area. The demographics of the EJ communities around the project segments are similar to the Bolivar County; that is, the county is also minority and low income.

As described in the EJ adverse impact section above, most of the construction impacts would be temporary and last from 7 months for the Deeson-Gunnison seepage remediation, to about 14 months for the Bolivar and Cessions seepage remediation Work Items, all in Bolivar County, Mississippi. Traffic re-routing causing delays, dust, noise and air quality would be the common indirect impacts for all of the Work Items. Depending on the duration of construction activities, impacts would vary. Conditions would return to normal once construction is completed.

Because design changes would avoid direct impacts, mainly the acquisition of residential lands along the road adjacent to the levee, there are no direct impacts anticipated from the construction of the Work Items. Construction activities are minor to moderate affecting both EJ and non EJ communities throughout the entire MVK and do not qualify as disproportionately high and adverse under EO 12898. BMP would be undertaken during construction to reduce or minimize the potential impacts. Additionally, MRL project benefits, including reduction in flood risk, would be felt by all residents in the assessment area, including those in EJ and non-EJ communities. Therefore, there are no direct, high adverse disproportionate impacts to EJ communities associated with MVK levee repairs.

EJ communities potentially impacted by Work Items in MVM

EJ communities within 0.5 miles of the MVM project segments are consolidated in Alexander and Pulaski Counties, Illinois; Mississippi and Scott Counties, Missouri; Fulton County, Kentucky; and Crittenden County, Arkansas. The focus of this analysis is on those minority or low-income communities within a 0.5 mile buffer of the construction activities.

Impacts from the construction activities would be short term (within a 7- to 21-month period). Table 11 in Appendix 16 lists the 23 low-income and minority communities within 0.5 miles of the project sites (excluding borrow sites) in the MVM. The 120 project segments that do not have an EJ community within 0.5 miles are not listed in this table. EJ communities are defined as

either at least 50 percent of population identifying as a minority or 20 percent or more of population living below poverty within a 0.5 miles buffer of the proposed Work Items.

The county is the reference community of which to compare the low-income and minority percentages of the impacted area. The demographics of the EJ communities around the project segments are similar to the county they are within; that is, the county is also minority or low income.

As described in the EJ adverse impact section above, most of the construction impacts would be temporary and are expected to last from 7 months to 21 months. Traffic delays due to temporary closures, or more permanent re-routing may take place throughout the construction activities, depending on the extent of the levee or floodwall work. Dust, noise and air quality would be the common indirect impacts for all of the Work Items. Depending on the duration of construction activities, impacts would vary. Once construction is completed, conditions would return to normal.

Because design changes would avoid direct impacts, mainly the acquisition of residential lands along the road adjacent to the levee, there are no direct impacts anticipated from the construction of the Work Items. In situations where a design change cannot remove the need to acquire land for a ROW, which would be determined at a much later phase of this project, further analysis may be required to assess if the acquisition creates a disproportionate impact to EJ communities.

Construction activities are minor to moderate affecting both EJ and non-EJ communities throughout the MVM and do not qualify as disproportionately high and adverse under EO 12898. BMP would be undertaken during construction to reduce or minimize the potential impacts. Additionally, MRL project benefits including reduction in flood risk would be felt by all residents in the assessment area, including those in EJ and non-EJ communities. Therefore, there are no direct, high adverse disproportionate impacts to EJ communities associated with MVM levee repairs.

MRL Borrow Sites

Seventy-four borrow sites are within the MVN. Table 8 in Appendix 16 shows 24 of these borrow sites that are adjacent to or within 0.5 miles of EJ communities. Another 50 borrow sites are not within 0.5 miles of EJ communities and are therefore not shown in this table.

Table 10 in Appendix 16 lists borrow sites having EJ communities within 0.5 miles that are within the MVK District. A total of 19 borrow sites are within MVK and four of them are near EJ communities (within 0.5 miles). The other 15 borrow sites are not within 0.5 miles of EJ communities.

Table 12 in Appendix 16 list borrow sites having EJ communities within 0.5 miles that are within the MVM. A total of 52 borrow sites are within MVM and seven of them are near EJ communities (within 0.5 miles). The other 45 borrow sites are within 0.5 miles of non-EJ communities.

Typical EJ indirect impacts to those within 0.5 miles of borrow excavation include noise and dust. Additionally, truck hauling may have adverse short-term impacts on vehicle traffic using the same route as the trucks delivering the borrow material needed for levee work. Both EJ and non-EJ communities could be impacted by construction activities at the MRL borrow sites. The distribution of impacts affecting both EJ and non-EJ communities are not high and adverse impacts nor are these impacts disproportionate. Additionally, MRL project benefits including reduction in flood risk would be felt by all residents in the assessment area, including those in EJ and non-EJ communities. Therefore, there are no direct, high adverse disproportionate impacts to EJ communities within 0.5 miles of the MRL borrow areas.

4.2.13 Agricultural Lands/Prime Farmland

Alternative 1 - No Action

No significant changes to the overall amount of prime farmland would be anticipated under the No Action Alternative. However, catastrophic flooding from potential levee failure(s) would adversely affect prime farmland.

Alternatives 2 (Traditional Construction) and Alternative 3 (Avoid and Minimize Alternative)

Overall, both Alternative 2 and 3 would reduce flood risk to the farmland landside of the MRL. It is estimated that Alternative 2 would directly impact 2,040 acres of total agricultural land in the project area due to construction (Table 4-28). Alternative 3, which was formulated to reduce impacts to wetlands and other resources by using agricultural property to acquire borrow material whenever practicable, would result in direct impacts to approximately 2,631 acres of agricultural lands (Table 4-29). Similarly, Alternative 2 would have fewer direct impacts (748 acres) to prime farmland compared to Alternative 3 (971 acres) (Table 3-23). However, the reduction of direct impacts to agricultural lands with Alternative 2 would be partially offset by the need to convert 326 additional acres of agricultural land to forest associated with the required compensatory mitigation. The flood risk reduction benefits provided to remaining farmland in the area outweigh the direct impacts from construction and mitigation efforts with either alternative. Therefore, the overall impact to agricultural land, and prime and unique farmland in particular, is not considered significant. Potential impacts to prime and unique farmland as a result of any project feature, including compensatory mitigation activities, would be coordinated with NRCS during the development of each tract-specific Work Item and/or mitigation plan. Farmland conversion impact rating forms would be coordinated with the NRCS at that time.

Table 4-28. Summary of acreage of agricultural crops within Work Item footprints for Alternative 2 (Traditional Construction) according to the 2018 USDA Cropscape spatial land cover layer.

Crop/Land Cover Type	Vicksburg		Memphis		New Orleans		All Districts	
	Total Acres	% Land Cover	Total Acres	% Land Cover	Total Acres	% Land Cover	Total Acres	% Land Cover
Corn	3.6	0.5	58.5	5.2	0.2	0.1	62.3	3.1
Cotton	7.6	1.1	154.9	13.8		0	162.5	8
Dbl Crop WinWht/Cotton		0	3	0.3		0	3	0.1
Dbl Crop WinWht/Soybeans	1.6	0.2	30.9	2.8		0	32.5	1.6
Fallow/Idle Cropland	5.7	0.8	33.9	3	6.6	2.7	46.2	2.3
Grass/Pasture	188.4	28	129	11.5	161.9	66.4	479.4	23.5
Other Hay/Non Alfalfa	80.9	12	20	1.8	4.2	1.7	105.1	5.2
Pecans	8.7	1.3	1.1	0.1		0	9.8	0.5
Rice	1.5	0.2	0.7	0.1	0.1	0.1	2.4	0.1
Sorghum	0.6	0.1	0.2	0		0	0.8	0
Soybeans	371.7	55.2	685.6	61.1	31.6	13	1088.9	53.4
Sugarcane	0.5	0.1		0	39.2	16.1	39.7	1.9
Winter Wheat	2	0.3	4.1	0.4	0.1	0	6.2	0.3
Grand Total	672.8	100	1123	100	244	100	2039.5	100

Table 4-29. Summary of acreage of agricultural crops within Work Item footprints for Alternative 3 (Avoid and Minimize) according to the 2018 USDA Cropscape spatial land cover layer.

Crop/Land Cover Type	Vicksburg		Memphis		New Orleans		All Districts	
	Total Acres	% Land Cover	Total Acres	% Land Cover	Total Acres	% Land Cover	Total Acres	% Land Cover
Corn	3.7	0%	60.4	4%	0.2	0%	64.3	2%
Cotton	8.8	1%	155.1	10%		0%	164	6%
Dbl Crop WinWht/Cotton		0%	3	0%		0%	3	0%
Dbl Crop WinWht/Soybeans	1.7	0%	283.2	18%		0%	285	11%
Fallow/Idle Cropland	6.6	1%	31	2%	6.6	3%	44.2	2%
Grass/Pasture	194.3	23%	129.2	8%	161.9	66%	485.4	18%
Other Hay/Non Alfalfa	112	13%	20.1	1%	4.2	2%	136.4	5%
Pecans	10.8	1%	1.2	0%		0%	12	0%
Rice	1.7	0%	0.3	0%	0.1	0%	2.2	0%
Sorghum	0.6	0%	0.2	0%		0%	0.8	0%
Soybeans	492.2	59%	860.3	56%	34.8	14%	1387.3	53%
Sugarcane	0.5	0%		0%	39.2	16%	39.7	2%
Winter Wheat	2	0%	4.3	0%	0.1	0%	6.4	0%
Grand Total	834.9	100%	1549	100%	247.1	100%	2631.4	100%

4.2.14 Hazardous, Toxic, and Radioactive Wastes

Alternative 1 - No Action

No significant changes to the overall existing HTRW environment would be anticipated under the No Action Alternative due to existing regulatory mechanisms. However, catastrophic flooding from potential levee failure(s) would increase the risk of HTRW impacts.

Alternatives 2 (Traditional Construction) and Alternative 3 (Avoid and Minimize Alternative)

4.2.14.1 General Information

As described in Section 3.2.14, an abridged Phase I ESA was conducted to assess the potential for HTRW materials within the proposed Work Item footprints for each of the Work Items included in the SEIS II, and the results of each are presented in an update memorandum (Appendix 19). Although record searches produced some sites of concern within one-mile of the proposed activities, none were listed within the proposed Work Item footprints. The record searches are on file with USACE. Based on the site assessments at the proposed 143 Work Items, the overall risk associated with HTRW for the project is low. District specific information is included below.

4.2.14.2 Memphis District

No evidence of recognized HTRW environmental conditions were observed with any of the proposed Work Items. Site reconnaissance revealed one site of concern with the following Work Item: 1) Fish Market Gate/High 51 Closure, Item 955-R. Immediately adjacent to the riverside levee toe were various small drums and containers and an old abandoned fish market in Cairo, Illinois. Initial observations did not reveal obvious discoloration of vegetation or soils, water sheens, or other evidence; however, further analysis will be conducted upon the approval of Congressional appropriations.

4.2.14.3 Vicksburg District

Record searches did not reveal sites of concern within one-mile of the proposed footprints of each Work Item. Site reconnaissance revealed five sites, which would warrant further attention during the initial design phase: 1) multiple drums of unknown contents adjacent to levee toe at Work Item 577-L Berm Construction; 2) residential structure within footprint of proposed seepage berm at Work Item 245-R; 3) petroleum tank battery at the toe of the levee at the southern end of the proposed relief well field (Work Item 341-R); 4) petroleum tank battery which appeared to bisect a string of existing relief wells where future work items are proposed at Work Item 337-R; and 5) agricultural chemical mixing station on the eastern limits of the proposed seepage berm at Work Item 333-R.

There were no obvious signs of discoloration of vegetation or soils and no observed water sheens found during the site reconnaissance.

4.2.14.4 New Orleans District

Based on land-use history, agency coordination, and field inspection, the risk of encountering HTRW throughout the MVN assessment area was determined to be low. Vegetation of the levee embankment and batture exhibits no visible signs of chemical spills or runoff, or aerial deposition of pollutants; therefore, levee soils were determined to be unlikely to contain contaminants. After extensive research, it was determined that the proposed alternative borrow pit sites have no HTRW problems.

Overall, it was determined that no HTRW issues currently exist within the proposed Work Item sites. Should the construction methods or Work Items designs change, the HTRW risk would require reevaluation. Additionally, the aforementioned guidance states a Phase I ESA is not valid beyond one year. When the final SEIS II is completed, record of decision (ROD) is signed, and funding allocated, then a final, full Phase I ESA would be executed on the Work Items prior to construction to secure “all appropriate inquiry” protection.

4.2.15 Recreation

Alternative 1 – No Action

Without intervention, communities within the project area would continue to be at risk from high water events induced by stormwater inputs. Recreational resources would continue to be influenced by existing conditions as a result of both land use trends and natural processes over the course of time. It is likely that catastrophic flooding from any potential levee failure(s) would have short term adverse impacts to recreation, while the long term effects would be uncertain as reconstruction of the surrounding areas occurred.

Alternatives 2-3

Alternatives 2 and 3 are expected to have similar impacts.

The Work Items would create some temporary negative impacts to recreational opportunities. Impacts to woodlands and grasslands would occur and some sites and areas would be temporarily disrupted by construction.

The Work Items would generate many direct positive impacts for recreation. Open areas would be reforested for compensatory mitigation which would provide additional wildlife habitat. Some of the proposed borrow areas would be designed for aquatic resources and environmental enhancements with Alternative 3 as described in Sections 2.3 and 4.2.7. Environmental features

(e.g., irregular shorelines, islands, variable depths, reforestation, etc.) that could be incorporated into borrow area designs to increase habitat value would be explored with willing landowners and non-federal sponsors during detailed design. Borrow areas would provide recreational fishing activities as the river inundates and replenishes the borrow areas.

Even though some fishery and wildlife habitat would be lost due to construction, Alternative 3 (avoid-and minimize) allows for creation of additional in-kind habitats. The proposed borrow areas, berms, and reforestation would eventually create more recreation opportunities. Work Items would protect existing habitat and prevent the displacement of wildlife in addition to reducing the risk to human life and property. This plan would substantially offset losses in recreational opportunities and have long-term benefits to meet the recreational needs. Overall impacts are expected to be relatively minor (See Appendix 17-Table 17.01: Recreation Resources by Work Item).

4.2.16 Aesthetics

Alternative 1 – No Action

The aesthetic impact of the No Action Alternative would be to increase the visual diversity and contrast in the assessment area as the proportion of cropland decreases and grassland and woodland increases.

Visual access, however, could decrease with overall access becoming limited due to flooding. Relics of the former built environment, abandoned due to flooding, would be aesthetically distressing in most cases (although some might be viewed as "ruins" and aesthetically pleasing). Examples of these relics could include abandoned water towers, buildings, and farm equipment as they yield to flood waters and vegetation.

Alternatives 2-3

Alternatives 2 and 3 are expected to have similar impacts.

Visual resources could be temporarily impacted by construction activities related to the Work Items and include: excavating existing and proposed borrow areas for work on existing levees and new seepage berms; installing new relief wells; replacing existing floodwalls; and transporting equipment and materials to and from the site. However, this temporary impact would most likely affect visual resources only from the immediate roadways. Active construction would have an adverse effect on natural aesthetic elements by stripping vegetation and excavating borrow, thereby exposing areas of bare sediment. Forested lands cleared for the Work Items would be mitigated by reforestation efforts in frequently flooded agricultural fields.

Most borrow areas would be deep enough to hold water year round and would be surrounded by vegetation once they naturalize. Over time and through natural succession, these borrow areas could be scenic and have good wildlife and fishery habitat. Some of the proposed borrow areas would be designed for aquatic resources and environmental enhancements with Alternative 3, as described in Sections 2.3 and 4.2.7. Environmental features (e.g., irregular shorelines, islands, variable depths, reforestation, etc.) that could be incorporated into borrow area designs to

increase habitat value would be explored with willing landowners and non-Federal sponsors during detailed design.

With the Work Items, new seepage berms and drainage improvements would be constructed on the main levee's landside. No trees would be planted on the seepage berms or improved levees to maintain their structural integrity. Proposed floodwall replacement would typically follow existing floodwall footprints and have insignificant impacts to existing viewsheds. For a detailed breakdown of aesthetic impacts by Work Item number, refer to the Appendix 18-Table 18.01: Aesthetic Resources by Work Item.

With the Work Items, the natural and culturally-influenced landscapes could provide greater visual diversity. While some features may constitute a negative aesthetic impact, the repair of the existing levee system is necessary and critical to protect existing habitat and prevent the displacement of wildlife in addition to reducing the risk to life and property from flooding. The proposed Work Items befit a landscape which has been contingent on similar river-training devices along the River since the Flood Control Act of 1928. In the long term, the proposed scenario does work to protect the overall visual character of the entire region by preventing excess water intrusion which could dramatically alter the scenic landscape.

4.2.17 Noise

This noise section addresses compliance for the following applicable environmental laws and regulations:

- Noise Control Act of 1972, as amended by Quiet Communities Act of 1978
- NEPA
- local noise ordinances

Impacts to noise would be considered significant if an alternative resulted in:

- substantial permanent increase in ambient noise levels for adjacent sensitive receptors
- exposure of persons to or generation of noise and vibration levels in excess of standards established by local/regional noise ordinances or applicable standards of other agencies

The project area includes residential, commercial, urban, and recreational areas with varying degrees of associated noise. Changes in noise are typically measured and reported in units of dBA, a weighted measure of sound level. The primary sources of noise within the area include everyday vehicular traffic along nearby roadways (typically between 50 and 60 dBA at 100 feet), maintenance of roadways, bridges, and the other structures (typically between 80 and 100 dBA at 50 feet), and the ongoing construction of various components of the existing floodwalls, pumping stations, and closure structures.

Noise effects to the residences and businesses within the project area are dominated by transportation sources such as trains, garbage and construction trucks, private vehicles, and emergency vehicles. Noise from occasional commercial aircraft crossing at high altitudes is typically indistinguishable from the natural background noise of the area. Noise ranging from

about 10 dBA for the rustling of leaves to as much as 115 dBA (the upper limit for unprotected hearing exposure established by the Occupational Safety and Health Administration) is common in areas where there are sources of industrial operations, construction activities, and vehicular traffic.

The U.S. Federal Transit Administration (FTA) has established noise impact criteria founded on well-documented research on community reaction to noise based on change in noise exposure using a sliding scale (FTA 1995). The FTA Noise Impact Criteria groups noise sensitive land uses and receptors into the following three categories:

- **Category 1:** Buildings or parks where quiet is an essential element of their purpose.
- **Category 2:** Residences and buildings where people normally sleep (e.g., residences, hospitals, and hotels with high nighttime sensitivity).
- **Category 3:** Institutional buildings with primarily daytime and evening use (e.g., schools, libraries, and churches).

Noise effects were evaluated on a general level for the project area by comparing the typical expected project generated construction noise levels with assumed existing noise levels while taking into account the locations of sensitive land use categories and receptors and the noise criteria and standards set forth in applicable laws and regulations. Because the average background noise level threshold being used is a DNL of 65 dBA, construction-related increase in noise to levels above 75 dBA would represent a significant effect. A reasonable worst-case assumption is that the three loudest pieces of equipment would operate simultaneously and continuously over at least a one-hour period.

Construction activity noise levels at and near the project areas would fluctuate depending on the particular type, number, and duration of uses of various pieces of construction equipment. Construction-related material haul trips would raise ambient noise levels along haul routes, depending on the number of haul trips made and types of vehicles used. In addition, certain types of construction equipment generate impulsive noises (such as pile driving or blasting), which can be particularly annoying. Table 4-30 shows typical noise levels during different construction stages. Table 4-31 shows typical noise levels produced by various types of construction equipment.

Table 4-30. Typical construction noise levels.

Construction Phase	Noise Level (dBA, Leq) ^a
Ground Clearing	84
Excavation	89
Foundations	78
Erection	85
Finishing	89

^a Average noise levels correspond to a distance of 50 feet from the noisiest piece of equipment associated with a given phase of construction and 200 feet from the rest of the equipment associated with that phase. Source: EPA, 1971.

Table 4-31. Noise emission levels typical for construction equipment.

Equipment	Typical Noise Level (dBA) 50 feet from the Source
Backhoe	80
Bulldozer	85
Compressor	81
Generator	75
Grader	85
Jackhammer	90
Loader	85
Roller	75
(cont.) Equipment	Typical Noise Level (dBA) 50 feet from the Source
Scraper	89
Crane	81
Pile Driver	91
Dump Truck	76

Source: FHWA 2007.

A reasonable worst-case assumption is that the three loudest pieces of equipment would operate simultaneously and continuously over at least a one-hour period. The combined sound level of three of the loudest pieces of equipment listed in Table 4-31 (pile driver, jackhammer, and scraper) is 94 dBA measured at 50 feet from the source. Table 4-32, which assumes this combined source level, summarizes predicted noise levels at various distances from an active construction site. The data shown in the table indicates that the DNL 75 dBA threshold would be exceeded up to approximately 200 feet from the point the noise is generated. These estimations of noise levels take into account distance attenuation, attenuation from molecular absorption, and anomalous excess attenuation (Hoover 1996).

Table 4-32. Expected construction noise levels in the Work Items.

Distance Attenuation	
Distance to Receptor (feet)	Sound level at Receptor (dBA)
50	94
100	88
200	82
400	73
600	72
800	69
1000	66
1500	62
2000	59
2500	56
3000	53
4000	49
5280	45
7500	38

*This calculation assumes simultaneous operation of one pile driver, jackhammer, and scraper.

The results in Table 4-32 above indicate the potential for residences within about 400 feet of active construction sites to be exposed to increases in noise, assuming a background DNL of 65 dBA.

Basis of Significance

Adverse effects on noise and vibration are considered significant if an alternative would result in any of the following:

- Exposure to, or generation of, noise levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies.
- Substantial (10 dB or greater) long-term increase in ambient noise levels in the project vicinity above levels existing without the project.
- A substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project.
- Exposure of sensitive receptors or structures to ground borne vibration that exceed local recommended standards or applicable standards of other agencies.

Alternative 1 – No Action

Noise impacts would be similar to those under existing conditions because there would be no direct or indirect impacts from construction equipment. Future maintenance activities could

result in a slight increase in noise levels from equipment and activities associated with maintenance activities but any increase in noise levels is anticipated to be temporary.

Existing borrow sites would be actively used by private individuals, non-Federal, and Federal entities seeking borrow. Noise levels would be expected to be similar to existing conditions of continued operation of borrow areas. These noise impacts related to borrow operation would continue until the borrow area is depleted.

Local and temporary noise typically associated with human activities and habitations such as car and truck traffic, operation of commercial and recreational boats, water vessels, airboats, and other recreational vehicles; operation of machinery and motors; and human residential-related noise (air conditioners, lawn mowers, etc.), would likely continue to affect humans and animals in the assessment area in the future. Noise levels may increase slightly with increasing population and industrialization in the assessment area. Changes in local noise ordinances may also increase or decrease future noise levels.

Alternatives 2-3

Alternatives 2 and 3 are expected to have identical impacts. Noise along the existing ROW would increase due to the temporary operation of equipment and vehicles used in the construction of the Work Item features. While noise impacts may cause a temporary inconvenience to residents and facilities in the immediate area, noise levels associated with construction activities would be temporary and monitored to ensure acceptable standards are maintained. No permanent noise impacts as a result of MRL construction is anticipated, and all noise emissions are expected to be short term, lasting only as long as construction activities. No long-term indirect effects on noise are anticipated with implementation of proposed actions.

Noise levels associated with construction activities have the potential to temporarily impact wildlife that may be present in the area, but would not be significantly different from noise associated with other human activities that occur on a daily basis. After completion of the proposed action, noise levels would be expected to return to pre-action levels. Future maintenance activities could result in a slight increase in noise levels from equipment and activities associated, but any increase in noise levels associated with maintenance activities is anticipated to be lower and of shorter duration.

Table 4-33 summarizes the sensitive noise receptors located in the three Districts, MVM, MVK, and MVN that would be exposed to noise emissions associated with the proposed action. Noise emissions would be expected throughout the construction period for each Work Item feature. Construction periods may range from 1 to 2 years. Construction would only occur during times allowed by applicable noise ordinances. While the noise emissions would create major impact to sensitive receptors during construction activities, they would be temporary and limited to active construction windows and sporadic (over 50 years). However, as noted in Table 4-32 nearby residential areas within about 400 feet of active construction sites would likely be exposed to increases in noise, assuming a background DNL of 65 dBA. Any structure listed in the current 65dBA data, and is within this major roadway buffer, could be exposed to noise levels just below

the threshold of 75dBA. A "major" roadway could be further defined as a U.S. interstate, U.S. highway, or State highway. Local streets would be exempt of 75dBA unless it would be designated as an access route. Temporary noise effects associated with the construction of this alternative are considered significant because of the close proximity. As such, potential implementation of best management practices and avoidance and minimization measures listed below would be required to reduce the significant effect, but not to a less than an adverse level.

Table 4-33. Number of sensitive noise receptors within the 65 DNL noise contours for MVM, MVK, and MVN.

MVM

Type of Noise Receptor	DNL 65 dB (number of receptors)
Single family homes	147
Multiple living units	8
Churches	2
Schools	2
Parks	6

Source: May 2020 USACE National Structure Inventory (NSI)

MVK

Type of Noise Receptor	DNL 65 dB (number of receptors)
Single family homes	88
Multiple living units	1
Churches	0
Schools	2
Parks	1

Source: May 2020 2019 USACE National Structure Inventory (NSI)

MVN

Type of Noise Receptor	DNL 65 dB (number of receptors)
Single family homes	4,141
Multiple living units	1,346
Churches	76
Schools	18
Parks	5

Source: May 2020 USACE National Structure Inventory (NSI)

Best Management Practices, Avoidance, and Minimization Measures

The following measures may be implemented to reduce the effects of construction noise:

- Placement of temporary noise barriers adjacent to construction activities.

- Inclusion of the following noise and vibration monitoring language in the contract specifications for specific MRL Work Items: monitoring of noise levels to verify adherence to contract specifications; limiting pile driving activities associated with pile founded T-walls to daylight hours; and vibration monitoring equipment measure surface velocity waves caused by equipment and monitor vibration up to a threshold value established and approved in writing by the USACE. Such measurements would only be taken near residences and occupied buildings that could be adversely affected by excessive ground vibrations.
- Construction equipment noise would be minimized during construction by muffling and shielding intakes and exhaust on construction equipment (per the manufacturer's specifications), and by shrouding or shielding impact tools.
- All equipment, haul trucks, and worker vehicles would be turned off when not in use for more than 30 minutes.
- Equipment warm up areas, water tanks, equipment storage areas, and staging areas would be located as far from existing residences as is feasible.

Borrow Areas

Temporary noise would occur during construction and hauling activities associated with equipment, such as bulldozers, excavators, and dump trucks. It is assumed that excavation and hauling would be limited to daylight hours (10 – 14 hours per day) seven days a week. However, this may change due to construction schedules, weather conditions, and Work Item borrow needs. Nearby residential areas may be impacted by elevated noise levels due to excavation and hauling. Actual noise impacts would depend on locations of borrow areas relative to sensitive receptors, construction schedules, which are dependent on weather conditions and specific borrow area characteristics, which are not known at this time.

All construction is anticipated during daytime hours. After completion of the proposed action, noise levels would be expected to return to pre-action levels. Future maintenance activities could result in a slight temporary increase in noise levels from maintenance equipment, such as mowers, but would be the same as existing conditions.

While no noise ordinances have been identified at the State(s) level, there are noise ordinances at the local level, which would be adhered to under each respective Work Item. While construction activities are temporary, best management practices, avoidance, and minimization measures would be implemented, though noise impacts would remain adverse and unavoidable because there would be a temporary increase in ambient noise levels in the Work Item vicinity above the levels existing without the project.

4.3 Cumulative Impacts

The CEQ's regulations (40 CFR 1500-1508) implementing the procedural provisions of the NEPA of 1969, as amended (42 U.S.C. 4321 et seq.) define cumulative effects as "the impact on the environment which results from the incremental impact of the action when added to other past, present, or reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions (40 CFR 1508.7)". Cumulative effects can result from individually minor, but collectively significant, actions taking place over a period of time.

Details on the effects from past and present actions for related projects, particularly activities associated with flood risk reduction that helped shape the land uses into the current form, are described in this section, Section 1.3 of this report, the 1976 EIS (USACE 1976), and the 1998 SEIS (USACE 1998), which are incorporated herein by reference. Individual levee construction to reduce risks of riverine flooding began along the Mississippi River in the 1700s and as settlements developed along the river, more local levees were built. Significant flood events occurred in 1849, 1850, 1882, 1912, 1913 and 1927, and therefore, raising and strengthening of the levees continued into the 1920's. The flood of 1927 was the most disastrous in the history of the MAV. This flood resulted in the failure of existing levees and caused extensive flooding of populated and agricultural areas; levees were breached, cities, towns and farms were laid to waste, crops were destroyed and industries and transportation were paralyzed.

Following the devastating flood of the Mississippi River Basin in 1927, Congress authorized the MR&T Project in 1928, which featured a system of levees, floodways, spillways and bank stabilization measures that direct floodwaters through the Mississippi River Valley to the Gulf of Mexico. (See 1928 Flood Control Act, Pub. L. No. 70-391, 45 Stat. 534; 33 U.S.C. §702a.) The MR&T project is congressionally authorized to provide comprehensive flood risk reduction from the PDF in the MAV. The Mississippi River mainline levees protect the MAV against the PDF by confining flow to the leveed channel, except where it enters backwater areas, overflows several levees designed to overtop and fill tributary basins, or is intentionally diverted into floodway areas. Although there have been large floods to date, the Mississippi River has not yet experienced a flood event equivalent to the PDF. Descriptions of major historical flood events from the time of early European explorers in the 1500s through 1997 can be found in Appendix 6 of the 1998 SEIS (USACE 1998). Additional information on flood events since 1997 can be found in the Hydraulics and Hydrology portion of Engineering Appendix 4. The MRL are designed to protect the alluvial valley from extreme flood events by confining flow to the leveed floodway, except where it enters the natural backwater areas or is diverted intentionally into the floodway areas. The mainline levee system, comprised of levees, floodwalls, and various control structures, is approximately 1,610 miles long. When major floods occur and the carrying capacity of the Mississippi River leveed channel is exceeded, additional conveyance through the Birds Point-New Madrid Floodway and relief outlets through the Atchafalaya Basin Floodway, Morganza Floodway, and Bonnet Carre Floodways are used, as well as the storage capacity of flat lowlands at the junctions of tributaries with the Mississippi River. These and other tributary areas, commonly referred to as backwater areas, are in effect mid-river reservoirs that store water during major floods. They may be protected from lesser floods by levee systems that are overtopped by the major floods. The backwater levees are designed to overtop prior to the

project flood peak such that the storage made available in a timely fashion would reduce the level of the PDF, thus resulting in lesser levee grades along the mainline levee. The MRL feature of the MR&T project is presently 83 percent complete. Approximately 500 miles of levees remain to be raised and strengthened. Continued assessment and maintenance would be required to ensure the integrity of the MRL after the project is completed. If additional work items are developed to address unforeseen problems, appropriate environmental analysis and documentation will be prepared at that time. The 1973 Refined Flowline, same as discussed in the 1998 SEIS (USACE 1998), is the standard basis for the design of the levee system under construction. The current water surface elevations would not be affected by the project.

The MR&T project features help to accommodate the tendency of the river to flood, while protecting and reducing financial instability for a population of more than 4.5 million people; numerous power plants, oil refineries, oil and gas wells, and natural gas transmission pipelines; an agricultural industry consisting of 22.5 million acres of cropland valued at \$51 billion; and manufacturing facilities that generate \$106 billion in revenues and employ 207,000 workers. Approximately \$16 billion has been invested for planning, construction, operation, and maintenance, approximately \$1 trillion in flood damages, and approximately \$5.7 billion is saved annually through transportation benefits.

While the region has received significant socioeconomic benefits from managing flood risks, construction of levees along the Mississippi River and many of its tributaries has severed the river from over 90 percent of its historic floodplain and allowed the clearing of floodplain forest and the area's conversion to agriculture. Approximately 80 percent of the original 22 million-acre forest in the MAV has been cleared. In more recent times, significant lands use changes have mostly subdued in the majority of the project area, as previously discussed in Sections 3.1-4.1. However, the Mississippi River Delta region is still predicted to undergo wetland to water land use changes continuing into the future (Karstensen and Sayler 2009, Gardiner 2015). Much of the coastal wetlands within the Mississippi River Delta region are decreasing in area ranging from 10.8 mi² per year to 32 mi² per year (trend analyses 1932-2016) (Couvillion et al. 2017) due to land loss and submergence caused by both natural and anthropogenic subsidence and altered surface water hydrology. Coastal and wetlands restoration and creation projects have provided some measures for combating the regional loss of wetlands, but the size of these projects has been small relative to the scale of projects that have contributed to wetland loss. Future large-scale restoration projects proposed by the state and Federal Governments would cumulatively provide a major benefit to wetlands in the region but are not likely to fully offset the cumulative adverse impacts of historic flood risk reduction projects on wetland loss.

After the conversion of the MAV from a dominantly forested landscape to a dominant agrarian landscape, the present dominant land uses/land covers in the MAV include agriculture (~50 percent or 17 million acres) followed by wetland (~20 percent or 6.8 million acres), water (~15 percent or 5.7 million acres), and forest (~10 percent or 3.4 million acres) (Karstensen and Sayler 2009). Within the project area specifically, defined as the lands and waters lying between the mainline MRL (and floodwalls), or bluffs where levees are absent, plus a zone extending approximately 3,000 feet landside of the levees. The area is similarly dominated by forest (BLH) (~38 percent or 1 million acres), cropland (26 percent or 700,000 acres), and open water (21 percent or 575,000 acres) (Table 3-1). The evolution of conservation compliance and incentive

programs in the 1980s (e.g., Wetland Reserve Program, Conservation Reserve Program, North American Waterfowl Management Plan, Lower Mississippi Valley Joint Venture programs, etc.) has resulted and is expected to continue to result in the conversion of marginal farmland to wetlands within the MAV (Mitchell et al. 2016, Oswalt 2013, Karstensen and Sayler 2009). From 1990 to 2010, there has been a slight gradual increase in overall forest cover in the MAV (Oswalt 2013).

Unavoidable environmental impacts from the Work Items addressed in the 1998 SEIS, after incorporating avoid and minimize measures, included 4,834 acres of BLH and 1,104 acres of tree plantations (mostly cottonwood) (USACE 1998). The impacts to environmental resources included a loss of 6,861 AAHUs of terrestrial wildlife, a loss of 25,035 average annual functional capacity units (AAFCUs) of wetlands, a loss of 334,432 DUD of waterfowl, and a gain of 27,381 AAHUs of aquatic habitat. The proposed compensatory mitigation for these unavoidable losses included active reforestation of 5,863 acres of frequently flooded agricultural lands providing for 17,296 AAHUs of terrestrial wildlife habitat, 25,035 AAFCUs of wetland habitat, and 334,432 DUD of waterfowl habitat. Since the 1998 SEIS, additional impacts from work on the MRL that were not anticipated at that time increased these compensatory mitigation requirements from 5,863 to 6,573 acres. To date, USACE has undertaken reforestation efforts on 5,672 acres, or approximately 86 percent of the total required acreage, that are under various stages of restoration (USACE 2020, Berkowitz et al. 2018). Construction, operation, and maintenance of Work Items and the associated acquisition of mitigation lands continue for activities described in the 1998 SEIS, as congressional funding is received.

Other significant projects related to flood risk reduction in the project area include the Greater New Orleans Hurricane and Storm Damage Risk Reduction System (HSDRRS). After the devastation of the 2005 hurricane season, the U.S. embarked on one of the largest civil works projects ever undertaken, at an estimated cost of \$14 billion, with restoration, accelerated construction, improvements, and enhancements of various risk reduction projects within southeastern Louisiana, including the Lake Pontchartrain and Vicinity, Louisiana Project (LPV) and the West Bank and Vicinity, Louisiana Project (WBV), jointly referred to as the Greater New Orleans HSDRRS (USACE 2013). The HSDRRS is comprised of 100-year level of risk reduction features in nine sub-basins within the Greater New Orleans metropolitan area. All of the sub-basins, except for the New Orleans East sub-basin, are located along the Mississippi River. Flood risk reduction from the Mississippi River flow is provided by the MR&T project. While the authorized purpose of the MR&T is not as a hurricane and storm damage risk reduction project, the MR&T does provide a Mississippi River boundary for the HSDRRS (LPV and WBV). Although the MR&T authorized design elevation does not meet the 100-year level of risk reduction in all areas, where the MR&T may be subject to hurricane storm surge and does not meet the 100-year design elevation, HSDRRS features are being added on top of, or over, the MR&T levee to meet the 100-year risk reduction requirements. Together, these HSDRRS, MR&T, and MR&T/HSDRRS co-located components form a closed loop around the entire area without breaks or openings, providing storm risk reduction to residents and businesses within the Greater New Orleans metropolitan area that meets National Flood Insurance Program (NFIP) certification requirements. Past unavoidable environmental impacts from the WBV (co-located project with the MRL) included 82 acres (99.06 AAHUs) of BLH (USACE 2012b). Mitigation efforts to fulfill these requirements are described in USACE (2016) and USACE (2019).

Subsidence and sea level rise have an impact on the project area known as the HSDRRS-MRL co-located project. This is the area along the MRL within the LPV and WBV project areas, where the 1 percent risk reduction elevations required for these projects are greater than the MRL authorized elevations for riverine flooding. Currently this area has been defined as RM 70 to 85.5 for the west bank, with no work presently required on the east bank. In future years, the RM at which 1 percent risk reduction elevations govern over the MRL authorized elevations moves upriver. Therefore, the project area increases, and additional levee reaches would require a lift to adequately provide 1 percent risk reduction. It is anticipated that by 2073 the LPV and WBV co-located levees would extend from RM 70 to 95.5 for the west bank and RM 81 to 90.5 for the east bank. Therefore, WBV and LPV would be required to expand and include additional levee elevation on top of MRL reaches for the HSDRRS project area to continue to sustain accreditation in the NFIP.

In addition to the direct and indirect impacts to forested and other wetland habitat described in Section 4.0 from construction of the Work Items in this SEIS II, any additional loss of forested lands and wetlands within the already fragmented MAV would contribute to the cumulative impacts experienced by the terrestrial wildlife and wetland species (including bats, migratory birds, waterfowl, and other wildlife species) and the associated resources supported by those habitats. While nearly all of the Work Item construction impacts to forested habitats would occur near the edge of adjacent open habitats (e.g., levee, cropland, etc.) of the MRL, and not in the middle of large blocks of forest, the cumulative impacts of habitat fragmentation within the MAV can alter species composition because biophysical conditions near the forest edge can significantly differ from those found in interior forest. As landscape features are altered, edge species could recruit to fragmented areas and species that occupy interior habitats could be displaced. The fragmentation of intact forests can have long-term adverse impacts on some wildlife species, such as forest interior birds. Alternative 3 avoids and minimizes impacts to BLH; however, some unavoidable impacts remain. As described in Section 5.0, reforestation of 1,447 acres of agricultural land, focusing on large contiguous blocks of land to extend forested corridors and in specific hydrologic zones (e.g., including those that receive a seasonal flood pulse), would mitigate those lost resources and functions. Additionally, USACE would avoid and minimize impacts by incorporating best management practices and altering construction schedules (e.g., fall and winter tree clearing to avoid direct impacts to migratory birds and bats, maintaining seasonal buffer restrictions for sensitive species,) when practical. Borrow areas created during construction would also provide habitat for some wetland species requiring shallow water for feeding and breeding. Invasive species also remain a threat to disturbed land from construction. Chinese tallowtree is prevalent in habitats near the Mississippi River in Louisiana, and colonization of this invasive plant into some borrow areas within Louisiana is likely. Similarly, any borrow area periodically connected to the river, would risk establishment of invasive carp from established populations in the Mississippi River. However, the benefits of maintaining a connection of floodplain water bodies to the Mississippi River, outweigh any potential impact due to invasive carp. USACE would coordinate with Federal and State regulatory agencies early during detailed design of each Work Item to identify additional measures that could be incorporated in the Work Item design and construction timeline to

minimize impacts, and increase connectivity and environmental gradients from the levee to the Mississippi River.

With the construction of the levee system along the Mississippi River and many of its tributaries over 90 percent of the historic floodplain and associated water bodies were severed from its floodplain, as previously discussed. Within the remaining active floodplain, borrow area lakes represent a substantial percentage of aquatic habitats in the active floodplain (mostly riverside of the levee) along the Mississippi River within the project area (Miranda et al. 2013). Baker et al. (1991) estimated that the combined surface areas of borrow areas approximately 38,000 acres was higher than that of oxbow lakes (~27,000 acres) and account for 6 percent of all aquatic habitats along the LMR active floodplain and 32 percent of all lentic aquatic habitats. Additionally, fish communities within these borrow areas are similar to those in natural floodplain lakes in the project area, including some fish species of special concern by state governments in the region (Miranda et al. 2013). The cumulative impact of the addition of approximately 1,000 acres of additional floodplain water bodies located riverside of the levee from borrow area construction with the preferred alternative, would be expected to have some minor cumulative beneficial impact on the aquatic fish community. These benefits would increase with any additional environmental features that are able to be incorporated into the borrow area designs, as described in Section 4.2.7.

Water quality values for the Mississippi River are described in Section 3.2.8 and shown in detail in Appendix 12. As described, nutrients originating from agricultural fertilizer, are the primary driver of hypoxic conditions observed in the Gulf of Mexico. Approximately 90 percent of the nitrate load in the Mississippi River originates from non-point sources within its Upper Basin and the Ohio River Valley (Section 3.2.8, Appendix 12, Aulenbach et al. 2005). While this project is not expected to add additional agricultural land or nutrient inputs to the Mississippi River, there would be short-term direct impacts due to construction of the 143 Work Items. Although these impacts would be minimized with BMPs and establishment of SWPPP, the cumulative direct and indirect impacts from this project combined with other regional projects with temporary degradation of water quality and loss of wetlands, combined with the current trend of water quality and habitat degradation in the MAV, would result in some cumulative minor impacts on water quality and associated aquatic habitats.

In addition to the impacts to fish and wildlife resources, construction of Work Items in this SEIS would convert ~2,000 acres of agricultural land into the levee footprint or associated borrow areas as well as another ~1,500 acres of agricultural land into forest due to compensatory mitigation. However, the levee would continue to reduce flood risks to the remaining agricultural land located landside of the levee. Thus, the cumulative impact of the loss of agricultural land due to the preferred alternative, other flood risk reduction projects previously discussed (e.g., work described in the 1998 SEIS, HSDRRS, etc.), including the associated mitigation, and ongoing Federal conservation program and other joint venture efforts is considered negligible.

As discussed in the individual resource assessments, project implementation would result in land use conversions on approximately 3,200 acres of lands and resources (including approximately 900 acres of BLH) for the project life into levee features and associated borrow areas as shown

in Table 4-1, in addition to losses from other flood risk reduction projects previously discussed (e.g., work described in the 1998 SEIS, HSDRRS, etc.). Approximately 1,447 acres of land would be committed to compensatory mitigation for unavoidable impacts to biological resources and ecological functions prior to or concurrent with construction, as shown in Table 5-3, for the Work Items in this SEIS. The cumulative loss of land and resources from this and other projects is not expected have an overall effect on current land use trends. From 1990 to 2010, there has been a slight gradual increase in overall forest cover in the MAV even with on-going projects (Oswalt 2013). This compensatory mitigation in addition to the on-going efforts from other mitigation activities would reduce the cumulative impacts on biological resources, but would not eliminate the impacts, especially the temporal cumulative loss of habitat fragmentation, rearing, resting, and foraging habitats. Although collectively the short-term and permanent cumulative impacts described throughout this document cannot be totally mitigated, the socio-economic benefits to the human environment that reside in the project area outweigh the cumulative adverse impacts.

4.4 Relationship of short-term uses and long-term productivity

40 CFR 1502.16 requires that an EIS include a discussion of the relationship between short-term uses of the environment and the maintenance and enhancement of long-term productivity. The intent of this analysis is to outline tradeoffs in the relationship between short-term uses of the environment and maintenance and enhancement of long-term productivity of resources. An important consideration when analyzing the effects of an action is whether it would result in short-term environmental effects to the detriment of achieving long-term productivity.

Socioeconomic benefits from managing flood risks and adverse environmental impacts represent tradeoffs between the local short-term use and the long-term stability and productivity of the environment. Protection from catastrophic floods would aid the continued existence of the agriculturally dominated economy and reduce the risk of fragmentation and financial and psychological hardships on individuals, families, and communities. However, these benefits would come at the expense of some adverse impacts that could not be avoided. Construction, operation, and maintenance of the Work Items from the preferred alternative would convert approximately 3,200 acres of various land uses and resources for the project life to levee features and associated borrow areas as shown in Table 4-1. These land conversions would have long-term adverse impacts to waterfowl (662,951 DUD), wetlands (49,293 FCUs/HSUs), and wildlife (1,606 AAHUs). However, these impacts would be compensated concurrently with project construction, as detailed in Section 5 (Mitigation Plan) and Appendix 20. Mitigation lands consisting of approximately 1,447 acres of actively reforested agricultural lands with long-term management plans and site protection instruments (e.g., land use restrictions, etc.) would contribute to the long-term stability and productivity of wildlife resources and society's environment.

4.5 Irreversible and irretrievable commitments of resources

40 CFR 1502.16 requires that an EIS include a discussion of the irreversible or irretrievable commitment of resources associated with an action. An irreversible or irretrievable commitment of resources refers to an adverse effect to the human environment which cannot be recovered or reversed. Irreversible impacts are those that cause, through direct or indirect effects, use or consumption of nonrenewable resources in such a way that they cannot be restored or returned to their original condition despite mitigation. Irretrievable impacts refers to the loss of production or use of natural resources for a period of time. The production or use of the resource could return in the future if the action is reversed, but the production lost is irretrievable.

As discussed in the individual resource assessments, the proposed action would cause the removal or consumption of resources. Project implementation would irreversibly and irretrievably commit approximately 3,200 acres of lands and resources for the project life to levee features and associated borrow areas as shown in Table 4-1. Approximately 1,447 acres of land would be committed to compensatory mitigation for unavoidable impacts to biological resources prior to or concurrent with construction, as shown in Table 5-3, for the Work Items in this SEIS. There may be minor irretrievable losses to environmental resources for a period of time due to the amount of time necessary for mitigation to become established; however, this is minimized with the transition periods that have been incorporated into the ecological modeling. If unknown historic or cultural resources were impacted by implementation of the Proposed Action, this would also be considered an irreversible effect. Irreversible commitments of resources would also include the fuel, labor, building material, planning, technical expertise, and monetary resources needed for construction and maintenance of the Work Items.

5.0 COMPENSATORY MITIGATION AND MONITORING

This section presents a proposed plan for mitigating and monitoring the foreseeable effects of the proposed action. The plan is the first part of a two phased mitigation approach. The approach entails plan development and implementation followed by monitoring and adaptive management (see Sections 5.10 and 5.11).

The information presented in this section serves as a compensatory mitigation plan prepared in accordance with Engineer Regulation 1105-2-100, Appendix C. Mitigation requirements were calculated using the same ecological models that were used to estimate project impacts. These ecological models were all certified or approved by the USACE Ecosystem Restoration National Planning Center of Expertise and used within their applicable ranges, in accordance with Engineer Circular EC 1105-2-412. Application of the models were also reviewed by the interagency team throughout the development of the SEIS. A list of these ecological models with their associated resources are included below.

- Wetlands:
 - 1) Regional Guidebook for Applying the Hydrogeomorphic Approach to Assessing Functions of Forested Wetlands in the Mississippi Alluvial Valley (Murray and Klimas 2013)

- 2) Wetland Value Assessment Bottomland Hardwoods Community Model for Civil Works, Version 1.2 (USACE 2018f)
 - 3) Wetland Value Assessment Coastal Marsh Community Models for Civil Works, Version 2.0 (USACE 2017)
- Waterfowl: Manual for Calculating Duck-Use-Days in the Mississippi Alluvial Valley (Heitmeyer 2010)
 - Terrestrial Habitat: Habitat evaluation procedures (HEP) (USFWS 1980) utilizing the following six HSI Models:
 - 1) Barred Owl (Allen 1987)
 - 2) Fox Squirrel (Allen 1982)
 - 3) Carolina Chickadee (Schroeder 1983a - modified per USFWS Memo dated October 29, 1989)
 - 4) Pileated Woodpecker (Schroeder 1983b)
 - 5) Wood Duck (Sousa and Farmer 1983c)
 - 6) Mink (Allen 1986)
 - Aquatics: Borrow Area Habitat Suitability Index Fish Diversity Model (USACE 2020 - on file with USACE)

Instead of a reforestation plan that solely bases mitigation on an overall acreage or location, a flexible mitigation strategy is recommended for a variety of reasons. First, a single mitigation measure does not compensate for all resources in which impacts were quantified. For example, land side reforestation may not provide compensatory benefits, as determined by ecological models, to waterfowl or aquatic resources. Second, specific mitigation tracts have not been identified. Once tracts are selected and acquired, decisions on the implementation of mitigation measures would be made based upon tract-specific parameters such as soil conditions, anticipated hydrology, elevation, etc. These tract-specific parameters would influence the overall mitigation credit determination and the appropriate types of vegetation that could be planted (*e.g.*, cypress trees are more flood tolerant than red oaks). Lastly, flexibility is required to address site-specific issues that may arise, such as whether or not the intended mitigation is functioning as designed, as well as to make future adaptive management decisions. Adaptive management is discussed in greater detail in Section 5.10.

The overall mitigation requirements are based on the impacts described in Section 4 and the anticipated gains from mitigation measures that are discussed below and in applicable environmental appendices. Many factors can influence the overall amount of mitigation credit that any one specific tract can provide. For example, areas that flood more frequently and for longer durations provide greater benefits to waterfowl. These areas generally occur at the lowest elevations within the project area. Therefore, the following approach defines the overall amount of mitigation based as habitat or functional units and not on overall acreages. Likewise, there are over sixty different soil types found in the project area. Different soil types provide varying mitigation opportunities, such as whether or not the site could hold water for long durations, which would influence the different types of vegetation that could be planted.

Once potential mitigation tracts are identified, a tract-specific, detailed mitigation plan comprising the mitigation measures recommended below would be developed in coordination with the interagency team consisting of the USFWS, EPA, respective State wildlife agency, and respective State water quality agency. Mitigation benefits would be quantified on a tract-by-tract basis, and mitigation would not be considered complete until all impacted habitat/functional units have been compensated. Mitigation sites would be monitored by USACE to verify mitigation benefits, and USACE is committed to adaptively managing the project should initial restoration efforts be determined unsuccessful.

5.1 Mitigation Plan Formulation

The preferred alternative incorporates environmental design features which reduce anticipated impacts to terrestrial, wetland, and waterfowl resources. However, unavoidable impacts to significant resources may occur. These impacts require the development of a compensatory mitigation plan. An array of mitigation alternatives were analyzed to determine a recommended mitigation plan as part of the overall preferred alternative. Appendix 20 provides details on the development of the mitigation plan.

For environmental planning, where traditional benefit-cost analysis is not possible because costs and benefits are expressed in different units (*e.g.*, AAHU, FCU, DUD) two analytical methods are used in the decision planning process. First, cost effectiveness analysis is conducted to identify the least cost solution for each possible level of environmental output. Subsequent incremental cost analysis of the cost effective solutions is then performed to identify changes in costs for increasing levels of environmental outputs.

Amongst the array of mitigation alternatives considered (*i.e.*, no-action, natural succession, active reforestation, and mitigation banks), active reforestation was identified as the most cost effective plan and a “Best Buy” plan. It was retained for further incremental cost analysis and mitigation planning purposes. Active reforestation of frequently and moderately flooded agricultural fields purchased in fee was determined as the recommended mitigation alternative. Additional information on mitigation plan formulation, cost effectiveness and incremental cost analysis of mitigation alternatives can be found in Appendix 20.

5.2 Compensatory Mitigation Measures

Constructing flood risk reduction improvements may affect a variety of resources, though the scope and scale of impact would depend on several factors including underlying land use, flood frequency, and flood duration. As some proposed flood risk reduction features have potential to affect multiple resources, some mitigation measures have potential to compensate for multiple resources. Mitigation that compensates for impacts to multiple resources is usually of greater incremental value than that which does not. However, not all mitigation measures compensate for impacts to multiple resources. Table 5-1 synthesizes the expected benefits from several mitigation measures.

Table 5-1. Compensatory mitigation benefits by restoration measure.

Restoration Measure	Wetlands	Terrestrial Wildlife	Waterfowl	Fisheries
Riverside Vegetated Wetland Restoration	X	X	X	X
Frequently Flooded/Hydrologically Connected Landside Vegetated Wetland Restoration	X	X	X	X
Moderately Flooded Landside Vegetated Wetland Restoration	X	X		
Mitigation Bank Credit	X	TBD	TBD	TBD

In addition to the measures depicted in Table 5-1, preserving high-value ecological resources may be appropriate on a case-by-case basis, such as in the following circumstances:

- the resources to be preserved provide important physical, chemical, or biological functions for the watershed;
- the resources to be preserved, as shown by the results of quantitative assessments, contribute significantly to the ecological sustainability of the watershed;
- preservation is appropriate and practicable;
- the resources are under threat of destruction or adverse modifications; and
- the preserved site would be permanently protected through an appropriate real estate or other legal instrument.

Mitigation tracts with potential to be preserved would be screened using these five criteria and would be based on the same ecological models that were used to determine project impacts. Should preservation be considered, the inter-agency team would be engaged in the site selection process and in determining the appropriate number of mitigation credits for each site.

5.2.1 Vegetated Wetland Restoration

The vegetative restoration on agricultural tracts involves preparing the site, restoring site-specific hydrology (*e.g.*, plugging farm drains, plugging ditches, etc.) as needed, and reforesting cleared/agricultural areas with species that naturally occur or historically occurred within the project area. Tract-specific conditions are required to be known prior to determining specific details such as species of trees to be planted. However, these sites would exhibit hydric soils and would be planted with a mixture of hydrophytic saplings associated with high wetland habitat values described in Smith and Klimas (2002). This mixture would include a minimum of fifty percent hardwood species. Likewise, site-specific tracts are required to be known to refine compensatory mitigation benefits of any particular mitigation tract. Restoration includes the following:

- Reestablishment of micro/macrotopography – Project area lands have often been laser leveled/graded to promote drainage. Reestablishment of land heterogeneity is accomplished by excavating areas within the mitigation tract and side casting the material to create topographical variation, such as ridge and swale complexes. The overall topography restoration design depends on site specific conditions and geomorphological characteristics.
- Site-Specific Hydrologic Restoration – Farm fields within the project area have often undergone past hydrologic modifications to promote drainage. These modifications include but are not limited to ditches, culverts/farm drains, perimeter levees, water control structures, sluice gates, etc. These structures would receive hydrologic restoration including removal/capping to promote water detention/retention.
- Deep Disking/Sub-soiling – Depending on soil conditions, sites could be sub-soiled prior to tree planting to promote growth. Sub-soiling is necessary in some areas due to the results of decades of agricultural practices that have created a hard-pan layer that is problematic for root development.
- Tree Planting – Trees would be planted by the use of bare root seedlings. Natural regeneration may also be pursued in limited instances, such as, when there is a preferable seed bank nearby. The species of trees, as well as the appropriate planting method, would be described in the detailed tract-specific mitigation plans as approved by the interagency team. However, for the purposes of mitigation benefit determinations, a general assumption that all mitigation tracts would be composed of a minimum of fifty percent mast producing species was used.

Herbaceous wetlands could also be restored on a portion of some tracts to the extent practicable. For example, planting trees in restored topographical features may not be necessary due to expected flood durations; therefore, herbaceous wetlands would be allowed to regenerate naturally in these areas. Species beneficial to native pollinators, such as the Monarch butterfly, could also be restored on portions of some tracts, such as, along roads, parking areas, or other areas not conducive for trees.

Although unlikely to be implemented, preservation of bottomland hardwoods could also be considered for compensatory mitigation in certain exceptional circumstances, and in concert with the inter-agency team. However, mitigation determination assumptions discussed below assume no preservation credits would be provided in any District.

5.2.2 Mitigation Banks and In-Lieu-Fee Programs

Where appropriate, USACE considers purchase of credits from approved mitigation banks and in-lieu-fee programs in the impacted watershed to be a reasonable compensatory mitigation alternative.

5.3 Defining Watershed Mitigation Zones

A watershed approach to compensatory mitigation seeks to promote sustainable ecological resource functions throughout an entire watershed. Under a watershed approach mitigation measures are tailored to landscape positions and resource types.

Recalling Sections 3 and 4, and the applicable appendices, it should be remembered that the ecological resources landside of the MRL are in sub-optimal condition due to the general loss of BLH habitat and connection with the Mississippi River, with the exception of a few isolated, relatively small patches of BLH.

Based on the conditions found within project area watershed, the following assumptions were made regarding potential mitigation sites:

- Areas subject to Mississippi River flooding or those that receive a seasonal flood pulse are of significant value (Junk et al. 1989). Therefore, compensatory mitigation would focus on areas that remain connected to the Mississippi River (*e.g.*, batture land or hydrologically connected areas) and on areas in watershed basins that continue to experience seasonal flood pulses (*e.g.*, frequently flooded and impounded/backwater areas).
 - Areas within the batture, those that receive a seasonal flood pulse, or are hydrologically connected to the Mississippi River are considered to be connected wetlands (Junk et al. 1989).
- Areas adjacent to large tracts of high-value habitat are generally more desirable for mitigation than those that are not (Elliott et al. 2020, Murray and Klimas 2013).
- Areas that provide benefits to species listed as threatened or endangered under the ESA or areas that protect or are within their designated critical habitat are of significant value.
- Areas that provide benefits to at-risk species or Birds of Conservation Concern (<https://www.lmvjv.org/conservation-tools-summary>) are of significant value.
- Lands adjoining or in close proximity to lands held for conservation, especially public lands are of significant value.
- Although drainage ditches exist as a means to drain agricultural land for increased production, they provide aquatic habitat that supports residential populations of fish and freshwater mussels. Mitigation of areas adjacent to landside ditches would also be considered. Lands containing ditches with direct or frequent connection to the Mississippi River are of significant value.

The overall “ecological value” for any mitigation measure depends on the location of the tract within the watershed. For example, lands that are hydrologically connected to the Mississippi River and/or are subjected to frequent floods of high duration are generally more beneficial to

fish and waterfowl than hydrologically disconnected lands located at higher elevations. Therefore, to determine reasonable estimates of required mitigation, mitigation zones were established based on the assumptions listed above (Figure 5-1). Mitigation tracts would be identified and acquired within these zones. Since hydrology is likely the driving variable in determining the “ecological value” of a mitigation site, the following mitigation zones were established for planning purposes based upon hydrologic zones and location within the watershed:

- Mitigation Zone 1: Riverside frequently flooded Mississippi River connected lands (*e.g.*, batture lands).
- Mitigation Zone 2: Frequently flooded/hydrologically connected landside areas (*e.g.*, frequently flooded and impounded/backwater areas).
- Mitigation Zone 3: Moderately flooded landside areas (*e.g.*, low lying flooded areas landside of the MRL whose hydrologic conditions are dictated by precipitation and landscape position).
- Mitigation Zone 4: Mitigation Bank

In the event that mitigation lands cannot be identified and acquired in the following mitigation zones, a contingency plan would be established and submitted to the inter-agency team for review and comment. Supplemental NEPA documentation would also be prepared, if needed.

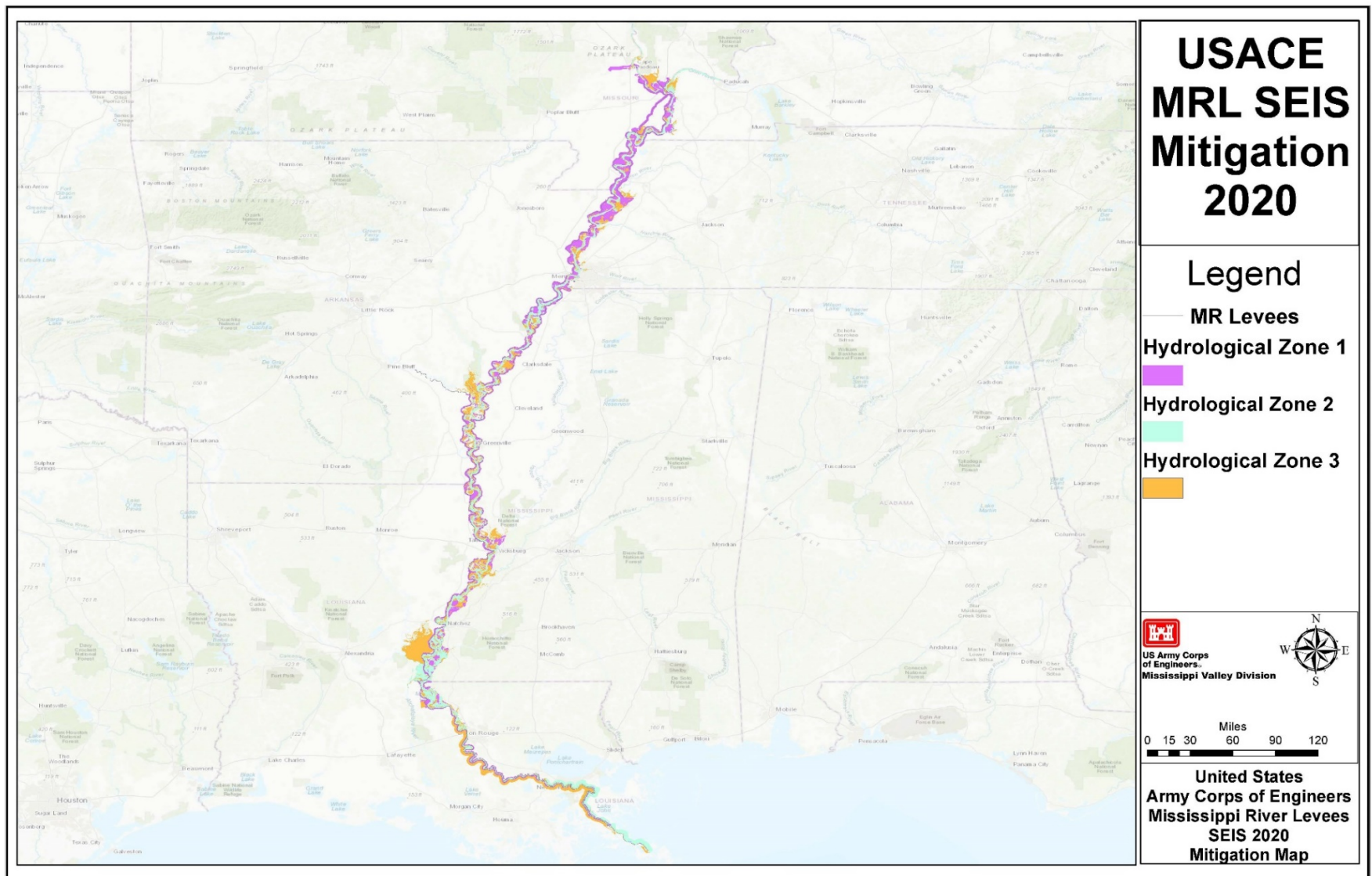


Figure 5-1. Proposed mitigation zones within the MRL SEIS II project area.

Mitigation Zone 1: Riverside frequently flooded Mississippi River connected lands (*e.g.*, batture lands)

Restoration of agricultural lands within the batture area and active floodplain in the project area to BLH/riverfront forests would provide significant compensatory mitigation benefits. Furthermore, it is anticipated that agriculture land in the batture and lands subjected to frequent backwater flooding would have a high likelihood of acquisition. Once restored through mitigation, flooded BLH/riverfront forests in the batture would benefit from the Mississippi River flood pulse and could provide quality wetland functions and habitat for many fish and wildlife resources (Junk et al. 1989). However, please note that restorable cropland within the batture area of MVK and MVN is limited due to the proximity of the MRL to the river proper, and/or extended flood durations that obstruct agricultural practices. However, should suitable mitigation land be identified in the batture within MVK and MVN, efforts would be made to acquire and restore such land, and overall mitigation adjusted accordingly.

Mitigation Zone 2: Frequently flooded/hydrologically connected landside areas (*e.g.*, frequently flooded and impounded/backwater areas).

Similar to the restoration of batture lands, the restoration of agricultural lands to BLH/riverfront forests within the active floodplain landside of the MRL within the project area would provide significant compensatory mitigation benefits. Furthermore, it is anticipated that land subjected to frequent backwater flooding would have a high likelihood of acquisition. Once restored through mitigation, flooded BLH/riverfront forests in areas hydrologically connected to the Mississippi River would benefit from the seasonal flood pulse and could provide quality wetland functions and habitat for many fish and wildlife resources (Junk et al. 1989). For reasons stated above, it is assumed that within both MVK and MVN, restoration of cropland within mitigation zone two would compensate for impacts to riverside wetlands.

Mitigation Zone 3: Moderately flooded landside areas (*e.g.*, low lying flooded areas landside of the MRL whose hydrologic conditions are dictated by precipitation and landscape position).

Depressional wetlands landside of the MRL provide important functions to many ecological resources. Although not directly linked hydrologically to the Mississippi River, these areas are often at the lowest lying elevations and are subject to precipitation run-off from large areas and pond water for long durations. Often these areas are adjacent to the MRL or existing tracts of BLH.

Mitigation Zone 4: Mitigation Bank Credits

In accordance with Engineer Regulation 1105-2-100, Appendix C, the purchase of credits from mitigation banks and in-lieu fee programs established by others shall be considered, where appropriate, when providing compensatory mitigation for environmental impacts to ecological resources resulting from construction of a Corps Civil Works project (Section 2036(c), WRDA 2007, as amended by Section 1163 of WRDA 2016). Therefore, although previously determined to not be the most cost effective means to mitigate project impacts, USACE would evaluate the potential to acquire appropriate compensatory mitigation bank credits for impacts to wetlands

and BLH habitat during the development of tract specific mitigation plans from an existing commercial mitigation bank and/or in-lieu fee program where available and appropriate. Additionally, a habitat assessment of the mitigation bank utilizing the same USACE certified habitat assessment model that was used to determine the functional impacts of the proposed action must be completed per Engineer Regulation 1105-2-100, Appendix C and Engineering Regulation 1105-2-412.

5.4 Mitigation Implementation

Following a project decision, USACE would acquire mitigation lands in accordance with Federal law. It is anticipated that lands would be acquired from willing sellers. Landowners would be queried in the project area regarding their willingness to sell. Once suitable tracts available to be acquired are identified, preliminary information (*e.g.*, landscape position, hydrology, soils, etc.) would be gathered to implement the most beneficial and practicable means of restoration. For example, based on the preliminary information, a determination would be made whether or not to restore micro-topography, plant a certain percentage of mast species, or develop the site to herbaceous marsh/riverfront forest mix.

Upon acquisition, a draft, tract-specific mitigation plan would be developed and disseminated for review to the inter-agency team, consisting of the USFWS, EPA, respective State wildlife agency, and respective state water quality agency, in accordance with the overall concepts described in this SEIS with tract-specific refinements. Applicable levee and drainage districts and other landowners would also be coordinated with during the completion of each tract-specific detailed mitigation plan. The tract-specific mitigation plans would contain baseline information, planned earthwork activities, hydrologic restoration features, and anticipated compensatory mitigation benefits quantified in a consistent manner in which impacts were quantified. Following an opportunity for the interagency team to comment and any issue resolution on the draft plan, a final plan for each tract would be formally submitted for purposes of any water quality certification requirements. Mitigation would progress prior to or concurrent with construction. USACE would develop and maintain a database of identifying its mitigation needs, approved mitigation plans, and construction-related impacts. In response to Section 2036(b) of the WRDA of 2007, as amended, USACE provides annual status reports on USACE construction projects requiring mitigation, including the MRL.

Avoidance, protection, or treatment of cultural resource sites in accordance with the PA, would be included in the development of tract-specific detailed mitigation plans. USACE would consult with federally recognized Tribes, SHPOs, and other interested parties following the provisions of the PA. As appropriate, mitigation sites would be surveyed to determine if historic properties are present in the proposed mitigation areas. Protection of cultural resources sites would be incorporated into the natural resources mitigation plan and long-term management of mitigation lands(s).

HTRW site assessments would also be conducted on any potential mitigation tract to gather and evaluate data regarding the existence or potential for encountering HTRW. USACE is obligated under Engineer Regulation (ER) 1165-2-132 to assume responsibility for the reasonable identification and evaluation of all HTRW contamination within the vicinity of proposed actions.

ER 1165-2-132 identifies that HTRW policy is to avoid the use of project funds for HTRW removal and remediation activities.

Additionally, mitigation bank or in-lieu-fee options would be pursued if applicable and as described above during detailed mitigation plan development for each Work Item. For the purposes of mitigation determinations described below, no mitigation banking credits are assumed. Should mitigation bank credits be purchased to offset project impacts, credit determination would be determined and overall project mitigation requirements adjusted accordingly.

5.5 Determination of Mitigation Credits

Assumptions and calculations regarding mitigation are discussed within the Significant Resources Assessments in Section 4.2 and their corresponding appendices. Tables 5-2 and 5-3, summarize impacts and required mitigation associated with Alternative 3 (preferred alternative). Please note that open water acreage gains from borrow area creation result in net HU gains for aquatic resources in all States and Districts. Therefore, additional mitigation benefits were not calculated for those resources and will not be discussed further. However, it is anticipated that vegetated wetland restoration of cropland riverside of the MRL would provide additional aquatic resource benefits. Additional information on aquatic resources can be found in Section 4.2.7 and Appendix 11.

Table 5-2. Summary of significant impacts for determining compensatory mitigation.

	Forested Acres Impacted ¹	Assumed Farmed Wetland Acres Impacted ¹	Memphis					Vicksburg					New Orleans				
			Wetlands (FCU/HSU)		Waterfowl (DUD)	Terrestrial Wildlife (AAHU) ²	Aquatic Resources (HU) ³	Wetlands (FCU/HSU)		Waterfowl (DUD)	Terrestrial Wildlife (AAHU) ²	Aquatic Resources (HU) ³	Wetlands (FCU/HSU)		Waterfowl (DUD)	Terrestrial Wildlife (AAHU) ²	Aquatic Resources (HU) ³
			Riverside	Landside				Riverside	Landside				Riverside	Landside			
Arkansas	155.7	432	-4,678	-6,411	-57,001	-394.3	379	0	0	0	0.0	347	0	0	0	0.0	140
Illinois	9.2	13	-488	-58	0	-1.1		0	0	0	0.0		0	0	0	0.0	
Kentucky	0.0	39	0	-6	-19	0.0		0	0	0	0.0		0	0	0	0.0	
Lousiana	535.5	390	0	0	0	0.0		-10,169	-1,453	-542,614	-678.0		-997	-3986*	-18,246	-197.8	
Mississippi	166.5	117	0	0	0	0.0		-5,354	-3,410	-3,062	-189.9		0	0	0	0.0	
Missouri	74.4	128	-3,120	-1,571	-41,512	-81.5		0	0	0	0.0		0	0	0	0.0	
Tennessee	65.0	527	-2,907	-4,685	-497	-63.4		0	0	0	0.0		0	0	0	0.0	
Total	1,006.3	1,646	-11,193	-12,731	-99,029	-540.3	379	-15,523	-4,863	-545,676	-867.9	347	-997	-3,986	-18,246	-197.8	140

¹ Impacted acreages shown here are from the Wetland Assessment (see Appendix 10), which is the controlling resource driving mitigation acreages. Forested acres impacted shown here include areas mapped as forested, tree plantations, shrub/scrub wetlands, sandbars, and non-forested wetlands. Assumed Farmed Wetlands impacted shown here include lands in row crop production, recently fallowed fields, pastures, old fields, and bare soil. A conservative assumption that all of these forested and farmed lands are wetlands was used for this level of analysis; no jurisdictional wetland delineations were completed. Impacted acreages differ across resource assessments, and the associated appendices should be referenced for the impacted acreages and associated assumptions with each resource. For example, all cropland and forested/non-developed lands were assessed for the wetland analyses; waterfowl assessment includes forested, non-developed lands, open water, and cropland other than cotton inundated 18 inches or less; terrestrial wildlife assessment includes forested areas with overstory canopy coverage, etc. for most HSIs but grouped forested, marsh, scrub/shrub, and non-forested wetland acreages for Wood Duck HSI; aquatic analysis include open water acreages).

*4.8 acres of brackish marsh impacts accounted for in the Wetland FCU/HSU totals.

² All AAHUs shown here use the assumption that suitable mink habitat results from creation of borrow pits (i.e., permanent hydrology) allowing forested tracts within 100m to contribute to positive habitat units. If using the assumption that borrow areas would provide NO benefits to mink, total AAHUs impacted for Memphis District = -934.0, Vicksburg District = -1,083.7, and New Orleans District = -262.9, respectively (total of -2,280.7 AAHUs impacted).

³ Increased open water acreage from borrow pit creation results in net habitat unit (HU) gains in all states and Districts.

Table 5-3. Summary of compensatory mitigation techniques.

Mitigation Zone and State Required Acreage			Memphis				Vicksburg				New Orleans						
			Wetlands (FCU/HSU)		Waterfowl (DUD)	Terrestrial Wildlife (AAHU) ¹	Aquatic Resources (HU) ²	Wetlands (FCU/HSU)		Waterfowl (DUD)	Terrestrial Wildlife (AAHU) ¹	Aquatic Resources (HU) ²	Wetlands (FCU/HSU)		Waterfowl (DUD)	Terrestrial Wildlife (AAHU) ¹	Aquatic Resources (HU) ²
			Riverside	Landside				Riverside	Landside				Riverside	Landside			
BLH/Wetland Reforestation (Zone 1)	Arkansas	130.0	4,678	0	304,370	356.7	Not Calculated	0	0	0	0.0	Not Calculated	0	0	0	0.0	Not Calculated
	Illinois	13.0	488	0	30,437	35.7		0	0	0	0.0		0	0	0	0.0	
	Kentucky	0.0	0	0	0	0.0		0	0	0	0.0		0	0	0	0.0	
	Louisiana (MVK/MVN)	(0 / 0)	0	0	0	0.0		0	0	0	0.0		0	0	0	0.0	
	Mississippi	0.0	0	0	0	0.0		0	0	0	0.0		0	0	0	0.0	
	Missouri	87.0	3,120	0	203,694	238.7		0	0	0	0.0		0	0	0	0.0	
	Tennessee	81.0	2,907	0	189,646	222.2		0	0	0	0.0		0	0	0	0.0	
Total		311.0	11,193	0	728,147	853.2	0	0	0	0.0	0	0	0	0.0			
BLH/Wetland Reforestation (Zone 2) ³	Arkansas	89.0	0	3,206	208,377	234.3	Not Calculated	0	0	0	0.0	Not Calculated	0	0	0	0.0	Not Calculated
	Illinois	1.0	0	29	2,341	2.6		0	0	0	0.0		0	0	0	0.0	
	Kentucky	4.0	0	3	9,365	10.5		0	0	0	0.0		0	0	0	0.0	
	Louisiana (MVK/MVN)	(325 / 32)	0	0	0	0.0		10,165	0	761,862	856.6		1,001	0	74,220	83.5	
	Mississippi	148.0	0	0	0	0.0		5,354	0	346,514	389.6		0	0	0	0.0	
	Missouri	22.0	0	786	51,509	57.9		0	0	0	0.0		0	0	0	0.0	
	Tennessee	65.0	0	2,343	152,185	171.1		0	0	0	0.0		0	0	0	0.0	
Total		686.0	0	6,366	423,777	476.5	15,519	0	1,108,376	1,246.2	1,001	0	74,220	83.5			
BLH/Wetland Reforestation (Zone 3) ⁴	Arkansas	89.0	0	3,206	0	138.8	Not Calculated	0	0	0	0.0	Not Calculated	0	0	0	0.0	Not Calculated
	Illinois	1.0	0	29	0	1.6		0	0	0	0.0		0	0	0	0.0	
	Kentucky	4.0	0	3	0	6.2		0	0	0	0.0		0	0	0	0.0	
	Louisiana (MVK/MVN)	(46 / 128)	0	0	0	0.0		0	1,438	0	72.7		0	4,001	0	199.1	
	Mississippi	95.0	0	0	0	0.0		0	3,410	0	148.2		0	0	0	0.0	
	Missouri	22.0	0	786	0	34.3		0	0	0	0.0		0	0	0	0.0	
	Tennessee	65.0	0	2,343	0	101.4		0	0	0	0.0		0	0	0	0.0	
Total		450.0	0	6,366	0	282.4	0	4,848	0	220.9	0	4,001	0	199.1			
Total Impacts ⁵			-11,193	-12,731	-99,029	-540.3	379	-15,523	-4,863	-545,676	-867.9	347	-997	-3,986	-18,246	-197.8	140
Net effects with mitigation	Arkansas	308	0	0	455,746	335.5	Not Calculated	0	0	0	0.0	Not Calculated	0	0	0	0.0	Not Calculated
	Illinois	15	0	0	32,778	38.8		0	0	0	0.0		0	0	0	0.0	
	Kentucky	8	0	0	9,346	16.8		0	0	0	0.0		0	0	0	0.0	
	Louisiana (MVK/MVN)	(371 / 160)	0	0	0	0.0		-4	-15	219,248	251.3		4	15	55,974	84.7	
	Mississippi	243	0	0	0	0.0		0	0	343,452	347.9		0	0	0	0.0	
	Missouri	131	0	0	213,691	249.4		0	0	0	0.0		0	0	0	0.0	
	Tennessee	211	0	0	341,334	431.3		0	0	0	0.0		0	0	0	0.0	
Total		1,447	0	0	1,052,896	1,071.8	379	-4	-15	562,700	599.2	347	4	15	55,974	84.7	140

¹ Management Plan 6 from Terrestrial Wildlife Appendix applied to Zone 1 (batture) Reforestation; Management Plan 5 applied to Zone 2 Reforestation; Management Plan 4 applied to Zone 3 Reforestation. For net effects, total gains of AAHUs for terrestrial wildlife are based off of assumption that suitable mink habitat results from creation of borrow pits (i.e., permanent hydrology) that permitted forested tracts within 100m to contribute to positive habitat units. If using the assumption that borrow areas would provide NO benefits to mink, total AAHUs gained for Memphis District = 678.1, Vicksburg District = 383.4, and New Orleans District = 19.6, respectively.

² Project results in open water habitat created due to borrow pits (no impacts requiring mitigation). No potential habitat unit gains were calculated for reforestation efforts within mitigation zones.

³ Frequently flooded/connected lands subjected to the Mississippi River flood pulse in Louisiana and Mississippi assumed to compensate for riverside wetlands as cropland within the batture is extremely limited. Assume half of landside BLH/wetland restoration would be split between Mitigation Zones 2 and 3 unless riverside FCU/HU impact requirements require additional Zone 2 acreage.

⁴ Zone 3 assumed not to meet waterfowl hydrologic criteria or frequently flooded wetland criteria. If excess, mitigation land available in Zone 2, connected, more frequently flooded land is assumed more valuable and would adjust in MVK and MVN.

⁵ Total impacts from all States taken from Table 5-2. Impacted acreages differ across resource assessments, and the associated appendices should be referenced for the impacted acreages and associated assumptions with each resource. For example, all cropland and forested/non-developed lands were assessed for the wetland analyses; waterfowl assessment includes forested, non-developed lands, open water, and cropland other than cotton inundated 18 inches or less; terrestrial wildlife assessment includes forested areas with actual canopy coverage, etc. for most HSIs but forested, marsh, scrub/shrub, and non-forested wetland acreages were grouped for Wood Duck HSI; aquatic analysis include open water acreages).

5.5.1 Section 404 of the Clean Water Act

The preferred alternative would impact 655 acres of riverside forested wetlands and 351 acres of landside forested wetlands, primarily through borrow source acquisition and levee improvement features, resulting in a loss of wetlands function (-27,713 and -21,580 riverside and landside FCU/HSU, respectively).

Three active reforestation measures are proposed to compensate for the impacts to wetlands.

- Restore vegetated wetlands on 311 acres of cropland riverside of the MRL (Mitigation Zone 1).
 - All assumed within MVM.
- Restore vegetated wetlands on 1,136 acres of cropland landside of the MRL (Mitigation Zones 2 and 3).
 - 673 acres (MVM), 614 (MVK), and 160 acres (MVN).

5.5.2 Fish and Wildlife Resources

Impacts to wildlife resources are discussed in Section 4.2.2 and Appendix 6. Actively restoring 1,447 acres (as described above) would more than compensate for unavoidable impacts to wildlife resources. Tables 5-2 and 5-3 show the foreseeable impacts and the compensatory mitigation benefits proposed in the preferred alternative. The proposed vegetated wetland restoration complies with 33 U.S.C. § 2283(d)(1), which requires in-kind mitigation for impacts to BLH forests. Additionally, since proposed mitigation benefits multiple resources, mitigation required to compensate for impacts pursuant to the CWA also compensated for impacts associated with fish and wildlife resources, as shown in Table 5-3.

Vegetated Wetland Restoration

Active restoration of vegetation on mitigation tracts involves preparing the site, restoring hydrology to the extent practical (based on projected future hydrology) and reforesting cleared and agricultural areas with naturally-occurring and historically-occurring species. Vegetated wetlands restoration would be accomplished in three areas: 1) in the batture area (Mitigation Zone 1); 2) frequently flooded areas, or those with a hydrologic connection to the Mississippi River landside of the MRL (Mitigation Zone 2); and 3) low lying flooded areas landside of the MRL whose hydrologic conditions are dictated by precipitation and landscape position (Mitigation Zone 3).

Mitigation Zone 1 – Batture Lands

There are areas in the batture within the MVM project area that could be restored. Active restoration includes BLH plantings and creating microtopography and other site-specific hydrologic restoration as needed. Taking 311 acres of cropland out of production and restoring BLH in Mitigation Zone 1 is estimated to provide:

- 11,193 wetland FCU/HSU
- 853 AAHU for terrestrial wildlife
- 728,147 DUD during the winter waterfowl period

Mitigation Zone 2 - Frequently Flooded/Hydrologically Connected Landside Areas

An estimated 686 acres of cropland that is frequently flooded and/or hydrologically connected to the Mississippi River flood pulse located landside of the MRL is to be obtained and actively reforested. Considering the projected future hydrology in these areas, a mixture of BLH vegetation would be planted according to site conditions, as well as creating microtopography, providing earthwork, and conducting other hydrologic restorative activities.

Restoring 686 acres of vegetated wetlands in Mitigation Zone 2 is estimated to provide:

- 22,886 wetland FCU/HSU
 - 6,366, 15,519, and 1,001 wetland FCU/HSU in MVM, MVK, and MVN, respectively
- 1,807 AAHU for terrestrial wildlife
 - Approximately 477, 1,246, and 84 AAHU in MVM, MVK, and MVN, respectively
- 1,505,135 DUD during the winter waterfowl period
 - 319,495, 1,111,420, and 74,220 DUD in MVM, MVK, and MVN, respectively

Mitigation Zone 3 - Moderately Flooded Landside Areas

An estimated 450 acres of restored wetlands would be created using cropland within low lying flooded areas landside of the MRL whose hydrologic conditions are dictated by precipitation and landscape position. For planning purposes, all sites were assumed to meet wetland hydrologic criteria, but not waterfowl habitat suitability hydrologic criteria. Additionally, it would be assumed mitigation land in zone 3 would also not be suitable for aquatic resource benefits.

Restoring 450 acres of vegetated wetlands in Mitigation Zone 3 is estimated to provide:

- 15,215 wetland FCU/HSU
 - 6,366, 4,848, and 4,001 wetland FCU/HSU in MVM, MVK, and MVN, respectively
- 702 AAHU for terrestrial wildlife
 - Approximately 282, 221, and 199 AAHU in MVM, MVK, and MVN, respectively

5.6 Mitigation Plan Elements

As suggested in the Fish and Wildlife Coordination Act Report (Appendix 2), this section specifically addresses the following twelve elements for mitigation planning: (1) objectives; (2) site selection criteria; (3) site protection instruments (*e.g.*, conservation easements); (4) baseline information (for impact and compensation sites); (5) credit determination methodology; (6) mitigation work plan; (7) maintenance plan; (8) ecological performance standards; (9) monitoring requirements; (10) long-term management plan; (11) adaptive management plan; and (12) financial assurances.

Each of the twelve criteria is discussed in order. Please note that if mitigation banks or in-lieu-fee credits are pursued during later phases, the mitigation plan only requires the baseline information and credit determination methodology for the purposes of purchasing credits.

5.6.1 Objective

The objective of mitigation is to avoid, minimize, and compensate environmental impacts. It is the policy of the USACE Civil Works program to avoid and minimize impacts to terrestrial and aquatic resources to the extent practicable, and that unavoidable impacts are compensated. A variety of measures to avoid and minimize impacts are described in Sections 2.4 and Section 4. Compensatory mitigation for unavoidable impacts is described in this section and the other resource-specific appendices. Although mitigation ratios are commonly used for USACE-permitted activities, a more rigorous function- and habitat-based assessment was used to determine what and how much mitigation would be appropriate in this case. Each ecological model used in this case underwent independent review; all were determined to be suitable. The models use a temporal lag that considers the amount of time necessary to achieve habitat and function replacement. In 33 C.F.R. § 332.2(f), it states:

If the district engineer determines that compensatory mitigation is necessary to offset unavoidable impact to aquatic resources, the amount of required compensatory mitigation must be, to the extent practicable, sufficient to replace lost aquatic resource functions. In cases where appropriate functional or condition assessment methods or other suitable metrics are available, these methods should be used where practicable to determine how much compensatory mitigation is required. If a functional or condition assessment or other suitable metric is not used, a minimum one-to-one acreage or linear foot compensation ratio must be used.

Table 5-4 shows the unavoidable impacts reasonably likely to occur if the preferred alternative is implemented.

Table 5-4. Summary of avoid and minimize project impacts with preferred alternative.

		Memphis	Vicksburg	New Orleans
Wetlands	Riverside FCU/HSU	-11,193	-15,523	-997
	Landside FCU/HSU	-12,731	-4,863	-3,986
Waterfowl	DUD	-99,029	-545,676	-18,246
Terrestrial Wildlife	AAHU	-540.3	-867.9	-197.8
Aquatic Resources	HU	+379	+347	+140

Thus, the overall objective of mitigation is to compensate for impacts provided in Table 5-4 using methods outlined in Table 5-3.

Within the overall framework of active reforestation through BLH planting, tract-specific objectives would be developed for each tract-specific mitigation plan containing species planting recommendations and densities. Since some mitigation measures benefit multiple resources, the mitigation objectives for each to-be-acquired tract would reflect this by clearly stating the anticipated benefits for each resource.

5.6.2 Site Selection Criteria

As previously stated, site-specific mitigation tracts have not yet been identified or acquired. Should a ROD be signed implementing the preferred alternative, landowners in the proposed mitigation zones (see Sections 5.3 and 5.5.2) would be surveyed to identify willing sellers. Preliminary information would then be gathered on each prospective tract including hydrological conditions, elevation, soil characteristics, habitat connectivity, compatibility with adjacent land uses, geomorphic setting, adjacent drainage patterns, and proximity and relation to other desirable tracts, and then each tract would be assessed for suitability and sustainability, and prioritized accordingly for acquisition. These tract-specific parameters would influence the specific types of vegetation that would be planted. It is reasonable to presume that this process would take several years before all needed lands are identified and purchased and all compensatory mitigation is satisfactorily accomplished. Because the undertaking would be long and complex and would be coordinated with the inter-agency team, USACE would build flexibility and adaptability into the process to, among other things, adjust to changes in the willingness of prospective sellers to convey property to the Government. Therefore, landowners would be periodically surveyed on their amenability to sell land.

5.6.3 Site Protection Instrument

Federal policy permits several different real estate acquisition methods for the Federal Government to procure interests in real estate. Interests that may be acquired, all of which are planned to be perpetual, include fee title, third-party conservation easements, and restrictive covenants.

All compensatory mitigation lands retained in private ownership, but subject to third-party conservation easements, would be inspected on an annual basis according to the terms and conditions of the easement. Supplemental or corrective action would be taken, as needed.

If it is determined that any proposed mitigation lands would be turned over to another public land managing agency for long-term protection and management, coordination with that agency would occur to ensure any specific requirements are met. Details on the real estate mechanism(s) needed for each site would be incorporated into each tract's site-specific mitigation plan.

5.6.4 Baseline Information

Baseline conditions across the project area are presented and analyzed in Sections 3 and 4. Information on the most recent conditions pertaining to each prospective mitigation site would be acquired and assessed as part of the process of preparing tract-specific detailed mitigation plans. This would include project future (without mitigation) hydrology, soil types, elevations, delineation of waters of the United States (if applicable), and geomorphologic characteristics. In addition, where practical, historic conditions (*i.e.*, prior to large-scale ditching) would also be described. Finally, any information on historical and cultural resources, as well as any hazardous contamination, would also be included.

5.6.5 Credit Determination Methodology

The amount of compensatory mitigation credits provided for each resource would be calculated for each specific compensatory mitigation tract using the same models and assumptions employed to determine impacts and conducted in coordination with the interagency team. Additional information regarding impact analyses, calculations, and units of measurement used in mitigation determinations are discussed in Section 4 and each resource-specific appendix.

5.6.6 Mitigation Work Plan

Mitigation features are discussed throughout the SEIS and each resource specific appendix. However, the mitigation work plan would be refined for each tract-specific mitigation plan. Each tract-specific work plan would include the following information:

- Geographic boundaries of the site.
- Landscape position of the site.
- Surrounding land use.
- Site soil mapping/verification of the site.
- Mitigation implementation methods, sequencing, and timing of implementation.
- Hydrologic sources including projected future flood frequency elevations and site specific additional sources (*e.g.*, plugging farm drains, perimeter levee degradation), connections, durations, depths, timing, and fish access measures.
- Detailed plantings (*e.g.*, natural regeneration, 10-12-foot center bare root seedling plantings).
- Proposed grading plans, including the establishment of micro-topography and sub-soiling.
- Plans to control invasive species.
- Soil management measures.
- Erosion control measures.

5.6.7 Maintenance Plan

In 33 C.F.R. § 332.7(b), it states the following: “mitigation projects should be designed, to the maximum extent practicable, to be self-sustaining once performance standards have been achieved. This includes minimization of active engineering features (e.g., pumps) and appropriate siting to ensure that natural hydrology and landscape context would support long-term sustainability. Where active long-term management and maintenance are necessary to ensure long-term sustainability (e.g., prescribed burning, invasive species control, maintenance of water control structures, easement enforcement), the responsible party must provide for such management and maintenance. This includes the provision of long-term financing mechanisms where necessary”.

The proposed reforestation sites (cypress-tupelo, BLH, riverfront/batture) are anticipated to be maintenance-free and self-sustaining once established. USACE would be responsible for any routine maintenance (e.g., mowing, minor repair of any water retention features, invasive species control). Routine maintenance would be identified in each tract-specific mitigation plan.

5.6.8 Ecological Performance Standards

The goal of mitigation is to compensate significant unavoidable impacts to the extent justified and mandated by law. Therefore, the ecological performance standards for the overall project are as follows:

- 44,204 wetland FCU/HSU
- 1,606 Terrestrial Wildlife AAHU
- 662,951 waterfowl DUD

As presented, these values would mitigate the impacts of the preferred alternative. However, to measure how effectively each site-specific tract is achieving the desired outcome through time, monitoring reports would be prepared at a frequency of 5 year intervals during the 0-20 year post-planting/site establishment period and at 10 year intervals during the 20-50 year post-planting/site establishment period to establish baseline conditions at mitigation locations and document changes in wetland function or habitat suitability over time.

These methods have proven effective for identifying shifts in wetland functional capacity and habitat over multiple time intervals including short- (e.g., 0-5 year), mid- (e.g., 5-10 year) and long (e.g., >20 year) and implementation of a multi-year WVA/HGM assessment protocol will document functional capacity changes over the period of analysis (Berkowitz 2019).

Success criteria, which are early indicators of meeting overall ecological performance standards, would be considered achieved when the monitoring parameters summarized in Table 5-5 have been met. However, as the project area is vast and contains a diverse array of hydrologic and ecological conditions, definitive and localized success criteria would be further refined during the completion of each tract-specific mitigation plan in coordination with the interagency team. Additionally, each tract-specific mitigation plan would provide the anticipated mitigation benefit to each modeled ecological resource. Therefore, the ecological success of mitigation is quantified in a consistent manner with the way impacts were quantified.

Table 5-5. Preliminary compensatory mitigation monitoring parameters.

Mitigation Type	Monitoring Parameter
Forested/Herbaceous Restoration Areas	<ul style="list-style-type: none"> • Vegetation Present (percent composition, diversity, percent coverage) • Success of Planted Vegetation • Hydrology functioning as designed (duration, depth, timing) • HGM/WVA variables (variables described in Appendix 10 and field data sheets/detailed success criteria shown in Appendix 20)

Vegetation

Vegetation would be monitored by visually inspecting each mitigation tract a minimum of 3 times within the first 10 years (typically at years 1, 5, and 10 post-planting). Parameters measured would include vegetation present (percent composition), success of planted vegetation, diversity, and percent coverage. Anticipation and desire are that, in addition to plantings, early successional species would colonize lower elevation mitigation sites, and that the established mitigation sites would be subject to self-design (*i.e.*, recipient of beneficial seasonal flood pulses) and not human desire (*i.e.*, minimal earthwork). Therefore, recommendations of percent survivorship of the newly planted vegetation are not recommended, but monitoring parameters would measure percent composition to be analyzed in accordance with each respective ecological model. Instead, the project plan assumes that micro/macro-topography and hydrology would influence both native plant communities as well as species to be planting at each respective mitigation site.

Hydrology

Hydrology could be monitored by a variety of methods. Gages could be installed to provide daily sump elevations which measure, and therefore monitor, hydrologic parameters (flood timing, duration, and depth) of the mitigation sites. Likewise, the existing Mississippi River gages could be used to determine hydrology for zone 1 reforestation sites. Please note, gages would only measure inundation, not saturation. Additionally, hydrology of the borrow areas could be measured utilizing aerial photography and GIS by determining surface acres that remain inundated. Therefore, tract-specific hydrologic performance standards would be determined and included during the completion of each tract-specific mitigation plan.

5.6.9 Mitigation Tract Monitoring Requirements

As previously noted, mitigation and monitoring would be conducted in two distinct phases. Regardless of phase, monitoring would continue until such time as success criteria have been met per WRDA 2007, as the focus on monitoring is to answer whether or not the mitigation tracts are providing the anticipated benefits. Therefore, monitoring would include the development of baseline conditions that are present pre-mitigation implementation. Post mitigation-implementation would be compared to pre-implementation to measure success. In Phase 1 of mitigation, each compensatory mitigation tract would be monitored by USACE a minimum of 3 times within the first 10 years (typically at years 1, 5, and 10 post-planting). A site-specific monitoring report would be prepared with each monitoring event and results furnished to the inter-agency team. In Phase 2 of mitigation, overall project impacts and benefits would also be monitored by USACE through the use of the same ecological models used to determine project impacts and compensatory mitigation requirements (*i.e.*, Duck-Use-Day, HEP, HGM, WVA) to determine ecological conditions over time.

5.6.10 Adaptive Management Plan

Phase 1 Adaptive Management Report

An adaptive management report would be completed for each mitigation tract following Phase 1 monitoring within the first 10 years of planting. The purpose of this report is to determine if mitigation implementation was successful or if changes are required (*i.e.*, adaptive management). Each report would provide details on the type of mitigation planned and anticipated habitat benefit (*i.e.*, what was stated in the detailed tract-specific management plan), as-built drawings (if applicable), and monitoring results. The following conclusions would be made as a result of monitoring:

Scenario A – Success

If the tract is functioning as designed (vegetation and hydrology established), or is achieving greater results than expected to each ecological resource (wetlands, waterfowl, etc.), ecological success is considered achieved and the site would enter long-term management (see Long-Term Management Plan).

Scenario B – Partial Success

There may be some instances in which one particular resource is being compensated at planned levels while others are not. An example is whether planted vegetation becomes established. Tree survivorship influences some models but not others. Likewise, some HGM functions require tree survivorship (*i.e.*, maintain plant communities) while other functions (*i.e.*, detain floodwater) do not. Therefore, in the event that no planted trees survive but the site has naturally vegetated with pioneer species, ecological success may be achieved for some resources and not others.

Each adaptive management report would discuss the reason for the success of any particular resource or wetland function in comparison to others. Since the project over-compensates some resources, remedial actions may not be warranted. Instead of immediately rectifying a deficiency, data from other monitoring sites would first be used to determine the overall resource category level of compensation. If results from other tracts determine that the resource has been compensated, ecological success would be considered achieved and the tract would enter long-term management (see Long-Term Management Plan).

If results from other tracts determine that the resource has not been compensated, remedial action would take place on the site (see Tract Specific Remedial Actions). Results would be furnished to the interagency team prior to making any adaptive management decision.

Scenario C – Mitigation Deficiency

One or more resources are not functioning, as anticipated under Scenario C, and mitigation is considered deficient. Therefore, remedial action is necessary (see Tract Specific Remedial Actions).

Tract-Specific Remedial Actions

Adaptive management remedial actions would first attempt to remedy the cause of the deficiency on the site-specific tract. A contingency has been added to the overall mitigation costs, as described in Appendix 4 and included in mitigation alternative plan formulation. Included in this contingency is the cost of real estate, mitigation planning, mitigation implementation, invasive species control, and monitoring. Therefore, potential remedial action costs such as replanting areas subject to poor survival, invasive species control, addressing erosion concerns, etc. are included in the cost estimate as a contingency cost.

Examples of specific actions that would improve wetland functional outputs include: improved connectivity with sources of wetland hydrology (e.g., resizing culverts, maintenance of natural drainage features) to increase assessment variables related to hydrology (V_{FREQ} , V4 – Hydrology); expansion of adjacent forested tracts to increase landscape scale variables (V_{TRACT} , V6 – Suitability); planting of desirable flood tolerant vegetation species and select species management (e.g., invasive/nuisance species control) (V_{COMP} , V1 – Species composition); manipulation of ground conditions to increase ponding and storage of flood/rain water to (V_{POND}), selective thinning to improve conditions for tree growth to increase (V_{TBA} , V2 – Stand maturity); and the removal/incorporation of carbon sources into the system (V_{WD} , V_{LOG}). Each of these activities alone would increase the assessment value of wetlands. Implemented collectively have the potential to significantly improve wetland function/suitability within the compensatory mitigation tracts through adaptive management. However, the remedy selected should incorporate components which individually or collectively address the specific shortcomings identified in the monitoring phase described above. For example, if the mitigation tracts already display variable subindex score of 1.0 for variables related to tree species (V_{COMP} , V1 – Species composition), additional manipulation of vegetation species will not lead to additional increases in HU/FCUs. As a result, the adaptive management must 1) identify the factors or variables limiting habitat suitability/functional capacity and 2) target the adaptive

management activity to address those limitations. The major benefit of these ground-level adaptive management strategies is that they increase the generation of HUs/FCUs without requiring the acquisition of additional mitigation acres.

Following remedial actions, monitoring would continue until the initial success criteria have been met, and a subsequent adaptive management report would be prepared.

Phase 2 Adaptive Management

In addition to the monitoring required for each mitigation tract noted in Section 5.6.9, the overall project (*i.e.*, summary of all completed Work Items and associated mitigation amongst the three Districts) would be monitored to determine if assumptions made in the SEIS are valid and validate uncertainties (e.g., temporal gains and losses) identified through the course of inter-agency coordination and IEPR.

The objectives of Phase 2 adaptive management are:

- Determine the environmental response to the action implemented.
- Determine whether observed responses match expected ecological success outcomes.
- Provide continuous improvement to changed conditions and new information.

Accomplishment of these objectives would be determined by replicating the environmental modeling used to assess impacts in the SEIS at prescribed intervals over a 50-year period (*i.e.*, the expected project life of the flood risk reduction improvements proposed to be constructed). A repeated measures approach of data collected using the ecological models within mitigation sites will include data gathered upon site acquisition and at a minimum frequency of 5 year intervals during the first 20 year post mitigation construction period and at 10 year intervals during the 20-50 year post mitigation period. These methods have proven effective for identifying shifts in wetland functional capacity and habitat over multiple time intervals including short- (e.g., 0-5 year), mid- (e.g., 5-10 year) and long (e.g., >20 year) and implementation of a multi-year protocol will document functional capacity changes over the period of analysis (Berkowitz 2019). These adaptive management reports would be prepared relative to the time that the improvements become operational and thereafter, until the ecological success criteria have been met.

The project area would be monitored for changes in land use, mitigation measures, hydraulics, and hydrology using variables described above and contained within the ecological models used. Results of monitoring would be used to replicate the modeling conducted for this SEIS to quantify project impacts. Therefore, the same models (*i.e.*, Duck-Use-Day, HEP, HGM, WVA) that were used to quantify impacts would be used to monitor the project area. These results would be provided in the adaptive management reports.

5.6.11 Long-Term Management Plan

Under current authorities and policies, mitigation lands acquired in fee by the Federal Government could be managed by State agencies or Federal agencies once mitigation acquisition is completed and determined to meet ecological success criteria. It is the intent of USACE to turn over mitigation lands to a suitable third party for long-term management. However, USACE is ultimately responsible in ensuring that mitigation is achieved and maintained.

5.6.12 Financial Assurances

Financial assurances, including mitigation and monitoring requirements, are included in the project costs and would be subject to the Federal Government's annual appropriations.

6.0 PUBLIC INVOLVEMENT

6.1 Public Comments

6.1.1 Scoping

A NOI to prepare an EIS was published in the Federal Register on 13 July 2018 (Federal Register Volume 83, Number 135, pages 32642 – 32644) inviting full public participation in the scoping phase. An additional NOI was published in the Federal Register on 29 August 2018 (Federal Register Volume 83, Number 168, page 44035) announcing the meeting dates, times, and locations of four public scoping meetings and extending the public scoping comment period. A copy of the NOIs can be found in Appendix 21.

Four public scoping meetings were held from 10-13 September 2018, extending throughout the project area at the following locations:

10 September 2018 - Blytheville, Arkansas
11 September 2018 - Vicksburg, Mississippi
12 September 2018 - Baton Rouge, Louisiana
13 September 2018 - New Orleans, Louisiana

At each meeting, the public received an overview of the proposed project, the purpose of NEPA and scoping, and were invited to provide verbal or written comments. Information on the scoping process, including presentations/handouts from the meetings, comments received, and other relevant information can be found in Appendix 21. In addition to formal meetings, a project website was available to receive relevant information (<http://www.mvk.usace.army.mil/MRLSEIS/>).

6.1.2 Draft SEIS II

A Notice of Availability (NOA) for the Draft SEIS II was published in the Federal Register on 28 August 2020 (Federal Register Volume 85, Number 168, page 53366). The Draft SEIS II was

disseminated for review and comment to various agencies, organizations, and interested parties. The comments received and associated responses are included in Appendix 21. Two virtual public meetings were conducted during the comment period to present the findings of the Draft SEIS II on 30 September 2020 and 1 October 2020, respectively. Information presented at these meetings is also included in Appendix 21.

6.2 Cooperating Agencies and Participating Agencies

Cooperating agencies for this SEIS II include the USFWS, EPA, and the Osage Nation. Numerous meetings were held with the cooperating agencies and other Federal and State wildlife and cultural resources agencies and federally recognized Tribes throughout the development of the SEIS to discuss the environmental models used for impact analyses, update the interagency team on the progress of the SEIS, perform technical reviews, and develop the draft PA. An ArcGIS portal was created to allow the interagency team to review individual Work Items and provide feedback.

6.3 List of Agencies, Organizations, and Persons to Whom Copies of the Statement are Sent

Electronic copies or notices of availability of this report were sent to Federal, State, and local agencies, federally recognized Tribal Nations, newspapers, NGOs, and other interested parties. An electronic file of the complete distribution list is available by request.

Federally Recognized Consulting Tribes

Absentee-Shawnee Tribe of Indians of Oklahoma	Mississippi Band of Choctaw Indians
Alabama-Coushatta Tribe of Texas	Otoe-Missouria Tribe of Indians, Oklahoma
Alabama-Quassarte Tribal Town	Peoria Tribe of Indians of Oklahoma
Apache Tribe of Oklahoma	Poarch Band of Creeks
Caddo Nation of Oklahoma	Ponca Tribe of Indians of Oklahoma
Cherokee Nation	Sac & Fox Nation of Missouri in Kansas and Nebraska
Chitimacha Tribe of Louisiana	Sac & Fox Nation, Oklahoma
Coushatta Tribe of Louisiana	Seminole Tribe of Florida
Delaware Nation, Oklahoma	Shawnee Tribe

Delaware Tribe of Indians	The Chickasaw Nation
Eastern Band of Cherokee Indians	The Choctaw Nation of Oklahoma
Eastern Shawnee Tribe of Oklahoma	The Muscogee (Creek) Nation
Jena Band of Choctaw Indians	The Osage Nation of Oklahoma
Kaw Nation, Oklahoma	The Quapaw Nation of Oklahoma
Kialegee Tribal Town	The Seminole Nation of Oklahoma
Kickapoo Tribe of Indians of the Kickapoo Reservation in Kansas	Thlopthlocco Tribal Town
Menominee Indian Tribe of Wisconsin	Tunica-Biloxi Tribe of Louisiana (Tribes usage)
Miami Tribe of Oklahoma	United Keetowah Band of Cherokee Indians in Oklahoma

Federal Agencies

U.S. Department of Energy, Office of Environmental Compliance
 U.S. Department of the Interior, Office of Environmental Policy and Compliance
 U.S. Department of the Interior, Fish and Wildlife Service, IL, MO, KY, AR, TN, MS, LA
 U.S. Department of the Interior, National Park Service
 U.S. Department of the Interior, United States Geological Survey
 U.S. Department of Commerce, National Marine Fisheries Service, Habitat Conservation
 Division
 U.S. Department of Agriculture, Natural Resources Conservation Service, IL, MO, KY,
 AR, TN, MS, LA
 U.S. Department of Agriculture, Forest Service
 U.S. Department of Homeland Security, Federal Emergency Management Agency
 U.S. Department of Transportation, Federal Aviation Administration
 U.S. Coast Guard
 U.S. Advisory Council on Historic Preservation
 U.S. Environmental Protection Agency, Regions 4,5,6,7
 National Weather Service

State Agencies

Arkansas Commissioner of State Lands	Louisiana Department of Environmental Quality
Arkansas Department of Environmental Quality	Louisiana Department of Transportation

Arkansas Game and Fish Commission
Arkansas Historic Preservation Program and the
Arkansas Archeological Survey

Arkansas Natural Resources Commission
Illinois Department of Natural Resources -
Office of Water Resources

Illinois Department of Natural Resources -
Office of Realty and Capital Planning

Illinois Environmental Protection Agency
(ILEPA)

Illinois State Historic Preservation Office
(DNR)

Kentucky Heritage Council

Kentucky Department for Environmental
Protection - Division of Water

Kentucky Department of Fish and Wildlife
Resources

LA State Historic Preservation Officer

Louisiana Coastal Protection and Restoration
Authority

Louisiana Department of Agriculture and
Forestry

Louisiana Department of Wildlife and Fisheries

Mississippi Department of Archives and History

Mississippi Department of Environmental
Quality

Mississippi Department of Marine Resources

Mississippi Department of Transportation

Mississippi Department of Wildlife Fisheries
and Parks

Missouri Department of Conservation

Missouri Department of Natural Resources

MO State Historic Preservation Office

State Library of Louisiana

Tennessee Department of Environment and
Conservation, Division of Archeology and
Tennessee Historical Commission

Tennessee Department of Environment and
Conservation

Tennessee Wildlife Resources Agency

Levee Districts and Local Governments

Atchafalaya Basin Levee District, LA

Atchafalaya Basin Levee District, LA

Fifth Louisiana Levee District, LA

Lafourche Basin Levee District, LA

Pontchartrain Levee District, LA

Southeast Louisiana Flood Protection
Authority East, LA

Southeast Louisiana Flood Protection
Authority West, LA

Grand Prairie Levee District (Plaquemines
Parish Government), LA

Plaquemines Parish Government, LA

Alexander County, IL

City of Cairo, IL

City of Mounds, IL

Cairo Drainage District, IL

City of Mound City, IL

Fulton County Board of Levee Commissioners,
KY

City of Hickman, KY

Dyer County Levee and Drainage District, TN

Lake County Levee and Drainage District, TN

Little River Drainage District, MO
St. Johns Levee and Drainage District, MO
Levee District No. 3 of Mississippi County,
MO
Levee District No. 2 of Scott County, MO
St. Francis Levee District of Missouri, MO

St. Francis Levee District of Arkansas, AR
Helena Improvement District, AR

Southeast Arkansas Levee District, AR
Yazoo Mississippi Delta Levee Board, MS
Mississippi Levee Board, MS

NGOs

Agricultural Council of Arkansas
American Rivers
Arkansas Waterways Commission
Association of Levee Boards of Louisiana
Audubon Society
Big River Coalition
Delta Farm Press
Delta Wildlife Foundation
Ducks Unlimited
Gulf Restoration Network
Lake Pontchartrain Basin Foundation
Louisiana Audubon Council
Louisiana Cotton and Grain Association
Louisiana Farm Bureau
Louisiana Wildlife Federation

Mississippi Emergency Management
Mississippi Farm Bureau
Mississippi Forestry Commission
Mississippi Soil and Water
Mississippi Soil and Water
Mississippi State Department of Health
Mississippi Valley Flood Control Association
Mississippi Wildlife Federation
MS Forestry Association
National Mitigation Banking Association
National Wildlife Federation
NRI Group, The
Restore or Retreat (ROR)
Sierra Club
The Nature Conservancy
The Water Institute of the Gulf

Newspapers

AR Dem Gazette
Arkansas Times
Blytheville Courier News
Cabot Star-Herald
Commercial Appeal
East Arkansas News Leader
Forrest City Times-Herald
News Examiner

Paragould Daily Press
Piggott Times
Stuttgart Daily Leader
The Advocate
The Daily Citizen
The Daily World
The Evening Times
Times Picayune

Other interested parties

Lists on file with USACE.

7.0 ENVIRONMENTAL LAWS AND COMPLIANCE

The relationship of the preferred alternative to environmental protection statutes or other environmental requirements is summarized in Table 7-1 and discussed below.

Table 7-1. Relationship of preferred alternative to environmental protection statutes or other environmental compliance.

<u>FEDERAL STATUTES</u>	<u>Compliance</u>
<u><i>Archaeological and Historic Preservation Act of 1974, as amended.</i></u> <i>Compliance requires USACE to undertake recovery, protection, and preservation of significant cultural resources whenever its activities may cause irreparable loss or destruction of such resources.</i>	PC
<u><i>Archaeological Resources Protection Act of 1979, as amended.</i></u> <i>Compliance requires that a contractor, state or federal agency obtain a federal permit under the act from the appropriate federal land manager for all archaeological work occurring within federal and Indian lands in the United States for the removal and subsequent disposition of archaeological collections from that land.</i>	PC
<u><i>Clean Air Act of 1970, as amended.</i></u> <i>Compliance requires coordination with the U.S. Environmental Protection Agency and analysis of potential impacts on air quality.</i>	FC
<u><i>Clean Water Act of 1972, as amended.</i></u> <i>Compliance requires preparation of 404(b)(1) Evaluation and submission of such to Congress with the DEIS or procurement of state water quality certification. See Appendix 3 for the 404(b)(1) evaluation. Full compliance will be received on a site by site basis, as state water quality certifications will be coordinated during detailed designs.</i>	PC
<u><i>Coastal Zone Management Act of 1972, as amended.</i></u> <i>Compliance requires coordination with the Louisiana Department of Natural Resources (LDNR) for the protection of U.S. coastal zones from environmentally harmful over-development. Coordination with the Louisiana Department of Natural Resources on a Coastal Zone Consistency Determination for all Work Items was conducted with no objections; however, full compliance will be coordinated on a site by site basis during detailed designs.</i>	PC

<u>FEDERAL STATUTES</u>	<u>Compliance</u>
<u>Endangered Species Act of 1973, as amended.</u> <i>Compliance requires coordination with the U.S. Fish and Wildlife Service (USFWS) to determine if any endangered or threatened species or their critical habitat would be impacted by the project. Full compliance will be received on a site by site basis, as Section 7 Consultations will be coordinated during detailed designs.</i>	PC
<u>Federal Water Project Recreation Act of 1965, as amended.</u> <i>Compliance requires review by the Department of the Interior. Washington level review of the DEIS will bring the project into full compliance.</i>	NA
<u>Fish and Wildlife Coordination Act of 1934, as amended.</u> <i>Compliance requires coordination with the USFWS and the state wildlife agencies. Agency comments and recommendations are discussed in Appendix 2, which includes the Fish and Wildlife Coordination Act Report.</i>	FC
<u>Land and Water Conservation Fund Act of 1965, as amended.</u> <i>Compliance requires Secretary of the Interior approval of replacement property that would be acquired to mitigate converted property purchased with LWCFA funds.</i>	NA
<u>National Historic Preservation Act of 1966, as amended.</u> <i>Compliance requires USACE to take into account the impacts of project on any property included in or eligible for inclusion in the National Register of Historic Places. Full compliance will be received on a site by site basis with associated coordination during detailed designs.</i>	PC
<u>National Environmental Policy Act of 1969, as amended.</u> <i>Compliance requires preparation of this EIS, consideration of public comments, and preparation and public review of the final EIS. Signing of the Record of Decision would bring this project into full compliance.</i>	PC
<u>Rivers and Harbors Act of 1899, as amended.</u> <i>No requirements for USACE projects authorized by Congress.</i>	NA
<u>Farmland Protection Policy Act of 1981, as amended.</u> <i>Compliance requires coordination with the Natural Resources Conservation Service to determine if any designated prime or unique farmlands are affected by the project. Full compliance will be received on a site by site basis with associated coordination during detailed designs.</i>	PC
<u>Watershed Protection and Flood Prevention Act of 1954, as amended.</u> <i>No requirements for USACE projects.</i>	FC

<u>FEDERAL STATUTES</u>	<u>Compliance</u>
<u>Wild and Scenic River Act of 1968, as amended.</u> <i>Compliance requires coordination with Department of the Interior to determine if any designated or potential wild, scenic, or recreational rivers are affected by the project. Coordination has been accomplished and there are no such rivers in the project area.</i>	NA
<u>EXECUTIVE ORDER/MEMORANDA</u>	
<u>Executive Order 11988, Floodplain Management.</u> <i>Compliance requires an assessment and evaluation together with the other general implementation procedures to be incorporated into the EIS.</i>	FC
<u>Executive Order 11990, Protection of Wetlands.</u> <i>Compliance requires results of analysis and findings related to wetlands be incorporated into EIS.</i>	FC
<u>Executive Order 12898, Environmental Justice in Minority and Low-income Populations.</u> <i>Compliance requires assessment of project effects on minority and low-income populations.</i>	FC
<u>Executive Order 13112, Invasive Species.</u> <i>Compliance requires assessment of potential for the project to introduce invasive species to the project area.</i>	FC
<u>Executive Order 13175, Consultation and Coordination with Indian Tribal Governments.</u> <i>Compliance requires the Agency to conduct coordination and consultation with Federally-recognized Tribes to determine if Tribal Rights, Tribal lands, or protected tribal resources, would be significantly adversely affected by a proposed action. It is implemented though the USACE Tribal Consultation Policy, 1 Nov 2012.</i>	FC
<u>STATE AND LOCAL POLICIES</u>	
<u>State Water Quality Standards</u>	FC
<u>State Air Quality Standards</u>	FC

PC = Partial Compliance

FC = Full Compliance

NA = Not Applicable

7.1 Archaeological and Historic Preservation Act of 1974, as amended (Public Law 93-291; 16 U.S.C.469-469c)

This law augments provisions of the 1960 Reservoir Survey Act and requires USACE to undertake recovery, protection, and preservation of significant cultural resources whenever its activities may cause irreparable loss or destruction of such resources (Section 1). Compliance with this law is achieved by following the provisions of the MRL SEIS II PA, specifically implementing treatment measures where appropriate (see Section 4.2.10 Implementation of the PA, Section 7.10 NHPA of 1966, and Appendix 19). USACE would follow the further guidance for implementation of the AHPA contained in ER 1105-2-100 1, April 2019, Appendix C-6, regarding cost sharing beyond the 1% threshold for archaeological mitigation activities which are not specifically addressed in the MRL SEIS II PA.

7.2 Archaeological Resource Protection Act of 1979, as amended (Public Law 96-95; 16 U.S.C 470aa-II; 32 CFR 229)

This law requires a contractor, State or Federal agency to obtain a Federal permit under the act from the appropriate Federal land manager for all archaeological work occurring within Federal and Indian lands in the United States for the removal and subsequent disposition of archaeological collections from that land. Compliance would be achieved by securing permits from the NPS if archaeological work is necessary at the Chalmette Battlefield Unit of the Jean Lafitte National Park and Preserve, associated with either the Work Item 90-L at the Chalmette Slip for the levee/floodwall, or work Item 88.5-L at the Chalmette Battle Field (1), levee/floodwall. The determination of the nature and scope of the permit would be developed through the process outlined in the MRL SEIS II PA (see Section 4.2.10 Implementation of the PA, Section 7.10 NHPA of 1966, and Appendix 14).

7.3 Clean Air Act of 1970, as amended

The Clean Air Act sets goals and standards for the quality and purity of air. It requires the EPA to set NAAQS for pollutants considered harmful to public health and the environment. All proposed Work Items are within areas classified as in attainment for air quality standards with except: those in the Memphis metropolitan maintenance area (specifically, Crittenden County, Arkansas) for the 2008 8-hour O₃ standard, Baton Rouge five-parish nonattainment area for O₃, and the St. Bernard Parish nonattainment area for SO₂. With implementation of the proposed action, construction activity would generate regulated pollutants including O₃, CO and coarse particulate matter (PM₁₀), resulting in temporary, minor impacts to air quality, which would be localized to the project area. Applicability determination for general conformity was conducted for construction of the all proposed Work Items either partially or entirely within these nonattainment or maintenance areas. Horsepower hours and total project emissions for each Work Item were calculated using EPA's NONROAD2010 emission inventory model (Appendix 13). Funding for construction of these Work Items would be received annually through congressional appropriations. Based on traditional funding allocations, no more than two Work Items are likely to be constructed within the same year in any of these maintenance or nonattainment areas resulting in likely project-related emissions significantly lower than any

annual de-minimis threshold limits. However, under the small chance that several Work Items are scheduled to begin within any given year and forecasted to reach the de-minimis limits, a phased approach would be pursued, to ensure compliance with the State Implementation Plan.

7.4 Clean Water Act of 1972, as amended – Sections 401, 402, and 404(b)(1)

The CWA sets and maintains goals and standards for water quality and purity. USACE administers regulations under Section 404(b)(1) of the CWA, which establishes a program to regulate the discharge of dredged and fill material into waters of the U.S., including wetlands. Section 401 requires a Water Quality Certification from State water quality agencies that the proposed Work Items do not violate established effluent limitations and water quality standards. Section 402 establishes the National Pollutant Discharge Elimination System Program, which the States also administer, requiring a permit for storm water discharges from construction sites or other areas of soil disturbance. A SWPPP would be prepared in compliance with EPA and associated State regulations for each construction contract. The SWPPP would outline temporary erosion control measures such as silt fences, retention ponds, and dikes. The construction contract would include permanent erosion control measures such as turfing and placement of riprap and filter material. While the preferred alternative minimizes impacts to wetlands to the extent practical, there are unavoidable impacts adjacent to the MRL from increasing the levee footprints and associated borrow material. The Section 404 (b)(1) Evaluation is included in Appendix 3. As previously discussed, Section 401 State water quality certifications would be pursued programmatically with each Work Item, as scheduled according to annual Congressional appropriation funding, during the detailed design and construction of each Work Item, to account for the exact timing and relevant site-specific information.

7.5 Coastal Zone Management Act of 1972, as amended

The Coastal Zone Management Act of 1972 is a partnership structure allowing States and the Federal Government to work together for the protection of U.S. coastal zones from environmentally harmful over-development. The majority of Work Items and associated impacts are located outside of the coastal zone. However, coordination with the Louisiana Department of Natural Resources on a Coastal Zone Consistency Determination for all Work Items within the coastal zone is underway. In the New Orleans District, there are approximately 68 projects located within the Louisiana Coastal Zone Boundary. These projects consist of various levee enlargements, floodwall construction, and seepage remediation measures on both the existing east and west bank Mississippi River levees. Impacts in the coastal zone would produce a net loss of 59 AAHUs (using the WVA model), which in turn would require approximately 10 acres of compensatory mitigation on the riverside of the levees and 83 acres on the landside of the levees. Descriptions of these Work Items are included in Appendix 1. Additional details on the wetland assessment is included in Section 4.2.6. Information regarding wetland impacts associated with individual Work Items, including those in the coastal zone, can be found in Appendix W1 of Appendix 10. This phase of the project was found to be in compliance with the Louisiana Coastal Resources Program (LCRP) in accordance with Section 307(c) of the Federal Coastal Zone Management Act (see Appendix 21). Additional consistency determinations will be conducted during detailed designs.

7.6 Endangered Species Act of 1973, as amended

The ESA is designed to protect and recover threatened and endangered species of fish, wildlife and plants. USACE has coordinated with USFWS to ensure the protection of those threatened and endangered species under their respective jurisdictions. While significant impacts to threatened and endangered species are not anticipated with the overall project, USACE would consult with the local USFWS Ecological Services Field Office with each Work Item, pursuant to Section 7 of the ESA, after congressional appropriations are received and while detailed plans are being developed, as recommended in the draft Fish and Wildlife Coordination Act Report.

7.7 Farmland Protection Policy Act of 1981, as amended

The Farmland Protection Policy Act (FPPA) is intended to minimize the impact of Federal programs on the unnecessary and irreversible conversion of farmland to nonagricultural uses. Projects are subject to requirements if they may irreversibly convert farmland to nonagricultural use and are completed by a Federal agency or with assistance from a Federal agency. Overall, the preferred alternative would reduce flood risk to the remaining farmland within the overall assessment area. The expansion of the levee footprint due to construction, the associated borrow areas, and compensatory mitigation measures required for other resources could potentially reduce the acreage of prime farmland. However, the flood management benefits provided to remaining farmland outweigh the impacts from compensatory mitigation activities. Therefore, the overall impact to prime and unique farmland is not considered significant. Thus, mitigation is not proposed for impacts to prime and unique farmland. Potential impacts to prime and unique farmland as a result of any project feature, including compensatory mitigation activities would be coordinated with NRCS during the development of each tract-specific Work Item and/or mitigation plan. Farmland conversion impact rating forms would be sent to the NRCS at that time.

7.8 Fish and Wildlife Coordination Act of 1934, as amended

The Fish and Wildlife Coordination Act provides authority for USFWS involvement in evaluating impacts to fish and wildlife from proposed water resource development projects. It requires that fish and wildlife resources receive equal consideration to other project features. It requires Federal agencies that construct, license or permit water resource development projects to first consult with the USFWS and State resource agencies regarding the impacts on fish and wildlife resources and measures to mitigate these impacts. USFWS is a Cooperating Agency for this SEIS, and extensive coordination was conducted throughout its development. The draft Fish and Wildlife Coordination Act Report is included in Appendix 2.

7.9 Migratory Bird Treaty Act of 1918 & Migratory Bird Conservation Act of 1929, as amended

The MBTA (16 U.S.C. 703, et seq.) is the primary legislation in the United States established to conserve migratory birds. The MBTA prohibits taking, killing, or possessing of migratory birds unless permitted by regulations promulgated by the Secretary of the Interior. The USFWS and the Department of Justice are the federal agencies responsible for administering and enforcing the statute. In general, most species of birds identified by IPaC within the assessment area, as described in this SEIS, would experience low or no negative impacts with the preferred alternative. Species most likely to be impacted are those that extensively use bottomland and floodplain forests during the breeding or wintering seasons, and those with ranges largely overlapping the assessment area due to the loss of forested habitats with construction.

Alternative 3 (avoid and minimize) would result in fewer impacts to each of these bird species identified by IPaC due to the reduction in forested impacts compared to Alternative 2 (traditional construction). Because of the projected loss of forested wetland habitats, particularly mature forested areas at some borrow sites, mitigation lands would target as large of habitat blocks as possible. Mitigation sites determined through the terrestrial habitat, wetlands, and aquatic assessments as part of this project would significantly offset habitat losses for the majority of the avian species, as described in Section 5.0. Similar to the ESA consultation, USACE would consult with the local USFWS Ecological Services Field Office with each Work Item, pursuant to the MBTA, after congressional appropriations are received and while detailed plans are being developed. Applicable surveys would be conducted and USFWS recommendations and best management practices (e.g., species-specific seasonal buffer restrictions to colonial nesting waterbirds, tree clearing during fall or winter, etc.) would be followed to avoid impacts to any protected birds.

7.10 National Historic Preservation Act of 1966, as amended (Public Law 89-665; 54 U.S.C. 300101 et seq.; 36 CFR 800)

The consideration of impacts to historic and cultural resources is mandated under § 101(b)(4) of NEPA as implemented by 40 C.F.R. Parts 1501-1508. NEPA calls for the consideration of a broad range of historic and cultural resources, including sites of religious and cultural importance to federally-recognized Tribal governments. Compliance with Section 106 of the NHPA is specifically mandated, but its legal definitions focus more narrowly on historic properties. The Section 106 process, implemented by regulations of the Advisory Council on Historic Preservation, 36 CFR § 800, requires agencies to define a project's APE, identify historic properties in that area that may be directly or indirectly affected by the project, assess the potential for adverse effects, resolve those adverse effects, and provide the Advisory Council on Historic Preservation a reasonable opportunity to comment on the undertaking.

Cultural resources include historic properties, archeological resources, and Native American resources including sacred sites and traditional cultural properties. They are a broad pattern of material and non-material sites or objects that represent contemporary, historic, and pre-historic human life ways or practices. Common cultural resource sites include prehistoric Native American

archeological sites, historic archeological sites, shipwrecks, and structures such as bridges and buildings. Historic properties have a narrower meaning and are defined in § 101(a)(1)(A) of the NHPA; they include districts, sites (archaeological and religious/cultural), buildings, structures, and objects that are listed in or determined eligible for listing in the NRHP. Historic properties are identified by qualified agency representatives in consultation with SHPO, Tribes, and other consulting parties.

USACE has determined that the effects on historic properties cannot be fully determined before congressional funding approval; and in accord with ER 1105-2-100, paragraph C-4(d)(5)(d)(2), USACE has elected to fulfill its obligations under Section 106 of the NHPA through the execution and implementation of a PA. Pursuant to 36 CFR 800.4(b)(2), Phased Identification and Evaluation and 800.8, Coordination with NEPA, USACE has notified the State Historic Preservation Officers for the States of Arkansas, Illinois, Kentucky, Louisiana, Mississippi, Missouri, and Tennessee, 34 Federally-recognize Tribes having an interest in the seven states, the Advisory Council on Historic Preservation and the National Park Service (Table 7-2). Consultation was initiated by letter on September 11, 2019, followed by 7 consultation meetings (Table 7-3) to discuss and develop the language of the a PA, entitled, Programmatic Agreement, Among The U.S. Army Corps Of Engineers (USACE), Memphis, New Orleans, And Vicksburg Districts The Chickasaw Nation, The Choctaw Nation Of Oklahoma, The Osage Nation, The Arkansas State Historic Preservation Officer, The Illinois State Historic Preservation Officer, The Kentucky State Historic Preservation Officer, The Louisiana State Historic Preservation Officer, The Mississippi State Historic Preservation Officer, The Missouri State Historic Preservation Officer, The Tennessee State Historic Preservation Officer, and The Advisory Council On Historic Preservation Regarding The Mississippi River And Tributaries Project: Mississippi River Levee Features ¹ (MRL SEIS II PA). The MRL SEIS II PA has not been executed, a summary is in Appendix 14. Upon execution, a copy of the MRL SEIS II PA will be included in the appendix.

Table 7-2. Invited Consulting Parties to the MRL SEIS II PA

Federally Recognized Tribes	
1	Absentee-Shawnee Tribe of Indians of Oklahoma
2	Alabama-Coushatta Tribe of Texas
3	Alabama-Quassarte Tribal Town
4	Apache Tribe of Oklahoma
5	Caddo Nation of Oklahoma

¹ This PA is intended to support USACE's Supplement No. 2 (SEIS II) to the Final Environmental Impact Statement, Mississippi River and Tributaries (MR&T) Project, Mississippi River Mainline Levees and Channel Improvement of 1976 (1976 EIS) which will evaluate impacts on the quality of the human environment of constructing the remaining authorized work for the Mississippi River mainline levees (MRL) feature. Supplement No.1, Mississippi River and Tributaries Project, Mississippi River Mainline Levee Enlargement and Seepage Control was completed in 1998 (SEIS I).

6	Cherokee Nation
7	Chitimacha Tribe of Louisiana
8	Coushatta Tribe of Louisiana
9	Delaware Nation, Oklahoma
10	Delaware Tribe of Indians
11	Eastern Band of Cherokee Indians
12	Eastern Shawnee Tribe of Oklahoma
13	Jena Band of Choctaw Indians
14	Kaw Nation, Oklahoma
15	Kialegee Tribal Town
16	Kickapoo Tribe of Indians of the Kickapoo Reservation in Kansas
17	Menominee Indian Tribe of Wisconsin
18	Miami Tribe of Oklahoma
19	Mississippi Band of Choctaw Indians
20	Otoe-Missouria Tribe of Indians, Oklahoma
21	Peoria Tribe of Indians of Oklahoma
22	Poarch Band of Creeks
23	Ponca Tribe of Indians of Oklahoma
24	Sac & Fox Nation of Missouri in Kansas and Nebraska
25	Sac & Fox Nation, Oklahoma
26	Seminole Tribe of Florida
27	Shawnee Tribe
28	The Chickasaw Nation
29	The Choctaw Nation of Oklahoma
30	The Muscogee (Creek) Nation
31	The Osage Nation of Oklahoma

32	The Quapaw Nation of Oklahoma
33	The Seminole Nation of Oklahoma
34	Thlopthlocco Tribal Town
35	Tunica-Biloxi Tribe of Louisiana (Tribes usage)
36	United Keetowah Band of Cherokee Indians in Oklahoma
SHPOs	
37	Arkansas Historic Preservation Program and the Arkansas Archeological Survey
38	Illinois State Historic Preservation Office (DNR)
39	Kentucky Heritage Council
40	LA State Historic Preservation Officer
41	Mississippi Department of Archives and History
42	MO State Historic Preservation Office
43	Tennessee Department of Environment and Conservation, Division of Archeology and Tennessee Historical Commission
Federal Agencies	
44	Advisory Council on Historic Preservation, Office of Federal Agency Programs
45	National Park Service, National Trails Program

Table 7-3. MRL SEIS II PA consultation meeting dates

Meeting #	Meeting Date
1	October 7, 2019
2	November 13, 2019
3	December 17, 2020
4	January 15, 2020

5	February 3, 2020
6	March 3, 2020
7	March 24, 2020
8	May 27, 2020
9	June 16, 2020
10	August 18, 2020
11	September 14, 2020

USACE shall follow the provisions of the MRL SEIS II PA when implementing individual Work Items.

Over the course of the consultation meetings, parties have worked to resolve information relating to applicability, points of contact, consultation process, development of areas of potential effect, and treatment measures. The consultation is intended to culminate in an in-person meeting in the MVM office to finalize the agreement document and to engage the District Engineers from all three responsible USACE Districts. Due to the COVID-19 pandemic, this meeting is anticipated to be delayed until August. None of the consulting parties had objections to USACE resolving the effects/impacts from this undertaking through the development of the MRL SEIS II PA, while still offering specific comments to the language of the document.

7.11 National Environmental Policy Act, as amended

This SEIS II was prepared in accordance with the NEPA. The draft SEIS II was published prior to the September 14, 2020 effective date listed in the 2020 CEQ Update to the Regulations Implementing the Procedural Provisions of the National Environmental Policy Act (85 FR 43304). The SEIS II was prepared under the 1978 CEQ Regulations. The issuance of the ROD would bring the project into full compliance with this act.

7.12 Native American Graves Protection and Repatriation Act of 1990, as amended (Public Law 101-601; 25 U.S.C. 3001-3013)

This law requires Federal agencies to provide greater protection for Native American burial sites and more careful control over the removal of Native American human remains, funerary objects, sacred objects, and items of cultural patrimony on Federal and Tribal lands. USACE has extended this consultation with federally-recognized tribes regarding Native American human remains, funerary objects, sacred objects, and objects of cultural patrimony, referred to

collectively in the statute as cultural items, to all times they are encountered. After notification, USACE would follow various state laws, as applicable, when these cultural items are encountered off of federal lands. The disposition and lineal descendancy would be determined following the processes outlined in the MRL SEIS II PA (see Section 4.2.10.1 Development and Implementation of the PA, Section 7.10 NHPA of 1966, and Appendix 14). For further reading, see the NPS's website at: <https://www.nps.gov/archeology/tools/laws/NAGPRA.htm>.

7.13 Executive Order 11988, Floodplain Management

EO 11988 requires a Federal agency, when taking an action, to avoid short- and long-term adverse effects associated with the occupancy and the modification of a floodplain. The agency must avoid direct and indirect support of floodplain development whenever floodplain siting is involved. In addition, the agency must minimize potential harm to, or in, the floodplain and explain why the action is proposed. Additional floodplain management guidelines for EO 11988 were provided in 1978 by the Water Resources Council. Some project features would extend into floodplain near the MRL; however, the preferred alternative would not promote or result in future development within the floodplain. The project is compliant with the order.

7.14 Executive Order 11990, Protection of Wetlands

EO 11990, Protection of Wetlands, directs Federal agencies to avoid to the extent possible, long and short-term adverse impacts associated with the destruction or modification of wetlands, and to avoid direct or indirect support of new construction in wetlands wherever there is a practicable alternative. The preferred alternative was developed specifically to avoid and minimize impacts to wetlands where practicable, impacting 11,703 fewer FCUs compared to Alternative 2, as described in this SEIS. All unavoidable impacts would be mitigated for as described in Section 5.0.

7.15 Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations

EO 12898 requires agencies to make achieving EJ part of their missions by identifying and addressing disproportionately high and adverse human health or environmental effects of programs, policies and activities on minority and low-income populations. The 143 proposed Work Items associated with the preferred alternative have 421 segments of levee repair or floodwall replacement projects, which are assessed for adverse impacts to EJ communities. There would be both positive and negative indirect impacts anticipated in portions of MVN, MVK and MVM, as described in Section 4.2.12 and Appendix 16. Direct impacts to EJ communities from construction of the MRL projects are expected to be minimal. Overall, there are no disproportionately high and adverse human health or environmental effects from the proposed activities.

7.16 Executive Order 13112, Invasive Species

EO 13112 requires agencies to prevent the introduction of invasive species; provide for their control; and minimize their economic, ecological and human health impacts. The preferred alternative is consistent with the EO to the extent practicable and permitted by law and subject to the availability of appropriations, and within administration budgetary limits. Relevant programs and authorities to prevent invasive species introductions would be used during construction. USACE would not authorize, fund, or carry out actions likely to cause or promote the introduction or spread of invasive species unless it has determined and made public its determination that the benefits of such actions clearly outweigh the potential harm; and that all feasible and prudent measures to minimize risk of harm would be taken in conjunction with the actions.

7.17 Executive Order 13175, Consultation and Coordination with Indian Tribal Governments

It is the policy of the Federal Government to consult with federally-recognized Tribal Governments on a Government-to-Government basis as required in EO 13175 (“Consultation and Coordination with Indian Tribal Governments;” U.S. President 2000). The requirement to conduct coordination and consultation with federally-recognized Tribes on and off of Tribal lands for “any activity that has the potential to significantly affect protected tribal resources, tribal rights (including treaty rights), and Indian lands” finds its basis in the constitution, Supreme Court cases, and is clarified in later planning laws. The USACE Tribal Consultation Policy, 1 Nov 2012, specifically implemented this EO and later Presidential guidance. The 2012 USACE Tribal Consultation Policy and related documents provide definitions for key terms, such as protected tribal resources, tribal rights, Indian lands, consultation, as well as guidance on the specific trigger for consultation. Definitions for the three key resources are provided below:

- a. Protected tribal resources: Those natural resources and properties of traditional or customary religious or cultural importance, either on or off Tribal lands, retained by, or reserved by or for, federally-recognized Tribes through treaties, statutes, judicial decisions or executive orders.
- b. Tribal rights: Those rights legally accruing to a federally-recognized Tribe or tribes by virtue of inherent sovereign authority, unextinguished aboriginal title, treaties, statutes, judicial decisions, EOs or agreement and that give rise to legally enforceable remedies.
- c. Indian lands: Any lands title to which is: either held in trust by the United States for the benefit of any federally-recognized Indian Tribe or individual or held by any Federally-recognized Indian tribe or individual subject to restrictions by the United States against alienation.

The counties of Illinois, Kentucky, Missouri, Tennessee, Arkansas, and Mississippi, as well as the parishes of Louisiana that are positioned along the Mississippi River have a long history of occupation by Native American communities; see Section 3.2.10.1. There are currently no Tribal rights or Indian lands identified within the project Work Items.

Of the 143 resources identified in the Work Items, approximately 20% contain pre-contact archaeological deposits associated with mounds or village sites (roughly 29 sites), additionally, the NPS defined Trail of Tears removal route parallels and intersects several of the work items. These 30 resources would likely fit into the category of protected tribal resources as identified above. The three Districts are addressing impacts to these resources under the NHPA Section 106 process. As part of this, the three Districts have offered 36 federally-recognized Tribes, having an aboriginal/historic interest in the project area (see Table 7-1), the opportunity to participate in the development of a PA to govern the process for further identification, NRHP-evaluation, and mitigation of these resources (see Section 4.2.10.1 Implementation of the PA, Section 7.10 NHPA of 1966, and Appendix 14).

8.0 LIST OF PREPARERS

Name	Agency	Experience	Role
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Name	Agency	Experience	Role
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11.0 ACRONYMS

AAHU	Average Annual Habitat Unit
ACS	American Community Survey
ASTM	American Society for Testing Materials
BLH	Bottomland Hardwood
BMP	Best Management Practice
CEQ	Council on Environmental Quality
CITES	Committee on International Trade in Endangered Species
CO	Carbon Monoxide
dB	Decibel
dBA	A Weighted Decibel
DEE	Daily Existence Energy
DEIS	Draft Environmental Impact Statement
DNL	Day-Night Average Sound Level
DUD	Duck Use Days
EIS	Environmental Impact Statement
EJ	Environmental Justice
EO	Executive Order
EPA	Environmental Protection Agency
ER	Engineering Regulation
ESA	Endangered Species Act
FCI	Functional Capacity Index
FCU	Functional Capacity Unit
FPPA	Farmland Protection Policy Act
FTA	Federal Transit Administration
FY	Fiscal Year
HEP	Habitat Evaluation Procedures
HGM	Hydrogeomorphic Manual
HSDRRS	Hurricane and Storm Damage Risk Reduction System
HSI	Habitat Suitability Index
HSU	Habitat Suitability Unit
HTRW	Hazardous, Toxic, and Radioactive Waste
HU	Habitat Unit
HUD	U.S. Department of Housing and Urban Development

IPaC	Information for Planning and Consultation
LMR	Lower Mississippi River
LPV	Lake Pontchartrain and Vicinity
LWCF	Land and Water Conservation Fund
MARB	Mississippi/Atchafalaya River Basin
MAV	Mississippi Alluvial Valley
MBTA	Migratory Bird Treaty Act
MRL	Mississippi River Levee
MR&T	Mississippi River & Tributaries
MRVAA	Mississippi River Valley Alluvial Aquifer
MVD	Mississippi Valley Division
MVK	Mississippi Valley Vicksburg District
MVM	Mississippi Valley Memphis District
MVN	Mississippi Valley New Orleans District
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NFIP	National Flood Insurance Program
NHPA	National Historic Preservation Act
NLEB	Northern Long Eared Bat
NOI	Notice of Intent
NOx	Nitrogen Oxide
NPS	National Park Service
NRCS	Natural Resource Conservation Service
NRHP	National Register of Historic Places
NTU	Nephelometric Turbidity Units
NWIS	National Water Information System
O3	Ozone
PA	Programmatic Agreement
PCI	Per Capita Income
PDF	Project Design Flood
PM	Particulate Matter
REC	Recognized Environmental Conditions
RM	River Mile
ROD	Record of Decision
ROW	Right of Way
RVI	Relative Value Index
SAR	sodium adsorption ration
SAS	Statistical Analysis System
SDI	Shoreline Development Index
SEIS	Supplemental Environmental Impact Statement
SHM	Seasonal Herbaceous
SHPO	State Historic Preservation Office
SLR	Sea Level Rise
SO2	Sulfur Dioxide
SPARROW	Spatially Referenced Regression on Watershed
SWPPP	Storm Water Pollution Prevention Plan

TON	Total Organic Nitrogen
TP	Total Phosphorous
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
VDI	Volume Development Index
VOC	Volatile Organic Compound
WBV	West Bank and Vicinity
WRDA	Water Resources Development Act
WVA	Wetlands Value Assessment