Mississippi River Valley Division,
Regional Planning and Environment Division South

Draft Supplement No. 2

to the 1982 Yazoo Area Pump Project Final Environmental Impact Statement

October 2020

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DRAFT SUPPLEMENT NO. 2 TO THE 1982 YAZOO AREA PUMP PROJECT FINAL ENVIRONMENTAL IMPACT STATEMENT

The Yazoo Backwater Area is located in west-central Mississippi immediately north of Vicksburg, Mississippi. The Yazoo Backwater Area has historically been subject to flooding from backwater from the Mississippi River and is also subject to headwater flooding from the Yazoo River, Sunflower River, and Steele Bayou. The Yazoo Backwater Area is divided into five subareas (Yazoo Area: 926,000 acres; Satartia Area: 28,800 acres; Satartia Extension Area: 3,200 acres; Rocky Bayou Area: 14,080 acres; and Carter Area: 102,400 acres). This project is limited to the Yazoo area within the Yazoo Backwater Area, hereinafter referred to as the Yazoo Study Area.

This SEIS tiers of the Final Supplement No. 1 to the 1982 Yazoo Area Pump Project Final Environmental Impact Statement (FSEIS), hereinafter referred to as the 2007 FSEIS. This SEIS does not reexamine the broad array of alternatives formulated in the 2007 FSEIS. Conversely, the goal of this study is to reevaluate the recommended plan as described in the 2007 FSEIS considering new environmental data. The Proposed Plan is the remaining flood damage risk reduction feature of the Yazoo Basin, Yazoo Backwater, Mississippi Project, which includes both structural and nonstructural features.

The Proposed Plan is a 14,000 cubic feet per second pump station, with a year round pump elevation of 87.0 feet, National Geodetic Vertical Datum (NGVD), located near Deer Creek. The nonstructural flood damage reduction feature includes acquisition and reforestation/conservation features on up to 2,700 acres of agricultural lands at or near elevation 87.0 feet (NGVD) through perpetual easements from willing sellers only. Securing this conservation feature on lands below elevation 87.0 feet, NGVD, will remove these lands from future economic damages resulting from flooding. The Proposed Plan also includes a revised mitigation plan to compensate for unavoidable environmental impacts and a comprehensive monitoring and adaptive management plan presenting solutions to an array of environmental challenges with the Yazoo Study Area as well as the Yazoo Basin.

The Yazoo Study Area has experienced flooding in nine out of the last ten years. The combination of more frequent and significant flooding; substantial environmental, economic, and safety concerns; and new and improved environmental and hydraulic data prompted the initiation of an updated evaluation of the 2007 FSEIS recommended plan. New environmental data analyzed in this SEIS shows previously calculated adverse impacts overestimated the potential impacts given available data in 2007. An updated period of record and an improved digital elevation model improve calculations of impacts. Recent research demonstrates that out of channel flooding plays a smaller role in wetland hydrodynamics in the Yazoo Study Area than previously understood and that precipitation is the dominant driver of wetland hydrology in much of the Yazoo Basin. As a result, impacts to wetland functions are not anticipated to convert any wetlands into non-wetlands and the decreases in wetland functions may actually be less than is presented in this document. Upon completion of the Proposed Plan

approximately 200,000 acres of bottomland hardwood would be inundated prior to initiation of pumping.

The responsible lead agency for the preparation of this Supplemental Environmental Impact Statement (SEIS) is the U.S. Army Corps of Engineers Mississippi Valley Division, Vicksburg District. The responsible cooperating agencies are the U.S. Fish and Wildlife Service; U.S. Environmental Protection Agency, Region 4; U.S. Department of Agriculture, U.S. Forest Service; U.S. Department of Agriculture, Natural Resources Conservation Service; Mississippi Department of Environmental Quality; and Mississippi Department of Wildlife, Fisheries, and Parks. The non-federal sponsor is the Board of Mississippi Levee Commissioners for the Mississippi Levee District, a legally constituted body.

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Section 1
Introduction

The Yazoo Basin, Yazoo Backwater, Mississippi, Project was authorized by the Flood Control Act (FCA) of 18 August 1941 (House Document (HD) 359/77/1, as amended by the Act of 22 December 1944 and 27 October 1965 (HD 308/88/2) and the Water Resources Development Act (WRDA) of 1986 and 1996. As a result of the 1941 authorization and subsequent modifications, the authorized flood control features included levees, associated drainage channels, pump stations, and water control structures to provide flood protection to five subareas of the Yazoo Backwater Area (Yazoo Area: 926,000 acres; Satartia Area: 28,800 acres; Satartia Extension Area: 3,200 acres; Rocky Bayou Area: 14,080 acres; and Carter Area: 102,400 acres) (Figure 1.1). This supplemental environmental impact statement (SEIS) analysis will be limited to work within the Yazoo subarea of the Yazoo Basin, Mississippi, hereinafter referred to as the Yazoo Study Area, and will tier from and update the 2007 Final Supplement No. 1 to the 1982 Yazoo Area Pump Project Final Environmental Impact Statement (FSEIS), hereinafter referred to as the 2007 FSEIS.

Currently, authorized work in the Yazoo Backwater Area includes levees, water control structures, connecting channel, and pump stations. The levee, hereinafter referred to as the Yazoo Backwater levee, is an extension of the Mississippi River east bank levee, generally along the west bank of the Yazoo River to a connection with the Will M. Whittington (Lower) Auxiliary Channel levee in the vicinity of the mouth of the Big Sunflower River. The Yazoo Backwater levee was completed in 1978. The authorized water control structures are Steele Bayou, Little Sunflower River, and Muddy Bayou which were completed in 1969, 1975, and 1978 respectively. The connecting channel between the Little Sunflower and Steele Bayou water control structures was completed in 1978. Figure 1.2 shows the completed features of the Yazoo Basin, Yazoo Backwater, Mississippi, Project. This SEIS will focus on the remaining authorized, yet unconstructed flood damage reduction features, specifically the pump station, of the Yazoo Basin, Yazoo Backwater, Mississippi, Project.

Recent flooding and new environmental data from the Yazoo Backwater Area, and specifically the Yazoo Study Area, prompted the initiation of an updated evaluation of the recommended plan from the 2007 FSEIS. A combination of construction changes, negative effects of flooding on the environment, and new and previously unavailable data which indicate the environmental impacts, as a result of the pump station construction and operation, will be less than calculated in the 2007 FSEIS justify reevaluation of the Yazoo Backwater Area Reformulation Main Report, dated October 2007 recommended plan. The Yazoo Backwater Area Reformulation Main Report, dated October 2007 will hereinafter be referred to as the 2007 Main Report. This SEIS will not reformulate the broad array of alternatives examined in the 2007 FSEIS, but will analyze the Proposed Plan in light of new environmental and hydraulic data. The Proposed Plan addressed in this SEIS is the remaining flood damage reduction feature of the Yazoo Basin, Yazoo Backwater, Mississippi, Project, which will include both structural (construction and operation of the pump station) and nonstructural (flood

damage reduction features through acquisition and reforestation/conservation) features by updating the 2007 FSEIS recommended plan. The Proposed Plan will also include an updated mitigation feature to mitigate for all unavoidable environmental impacts. The same cooperating agencies from the 2007 FSEIS are cooperating agencies for this SEIS. The cooperating agencies are U.S. Fish and Wildlife Service (USFWS); U.S. Environmental Protection Agency, Region 4 (EPA); U.S. Department of Agriculture, U.S. Forest Service (USFS); U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS); Mississippi Department of Environmental Quality (MDEQ); and Mississippi Department of Wildlife, Fisheries, and Parks (MDWFP).

1.1 NON-FEDERAL SPONSOR

The non-federal sponsor for the project is the Board of Mississippi Levee Commissioners for the Mississippi Levee District, a legally constituted body. The Board of Mississippi Levee Commissioners maintains multiple existing projects, consisting of a major portion of the Yazoo Backwater Area, under a licensing agreement and has indicated they will continue the responsibilities as non-federal sponsor for the Proposed Plan and have demonstrated they can provide the necessary assurances as required. Implementation of the Proposed Plan, along with operation and maintenance requirements, will be the responsibility of the Federal government, however, the non-federal sponsor will perform minor maintenance on the completed project.

The Board of Mississippi Levee Commissioners believe the Yazoo Study Area has repeatedly been hurt by flooding and the area has been unfairly impacted because the pump station has not been built as outlined in the 1941 FCA to mitigate for the removal of the Eudora Floodway from the Mississippi Rivers and Tributaries (MR&T) project, which increased stages by six feet on the Vicksburg gage in the Yazoo Study Area. The Board of Mississippi Levee Commissioners feel the Proposed Plan responds to additional need for urban and agricultural flood protection for the Yazoo Study Area. Therefore, the Board of Mississippi Levee Commissioners, supports the Proposed Plan and believe the Proposed Plan balances the economic and environmental needs of the area. The Board of Mississippi Levee Commissioners have conducted numerous tours for Federal and state officials along with local officials and citizens to show their support for the project. They have also conducted landowner meetings to discuss the benefits from the Proposed Plan.

1.2 STUDY AREA

The Yazoo Study Area is located in west-central Mississippi immediately north of Vicksburg, Mississippi, and has historically been subject to flooding from backwater by the Mississippi River and headwater flooding from the Yazoo River, Sunflower River, and Steele Bayou. The triangular shaped study area extends northward about 65 miles to the latitude of Hollandale and Belzoni, Mississippi, and comprises about 1,446 square miles. Big Sunflower and Little Sunflower rivers, Deer Creek, and Steele Bayou flow through the study area. These streams drain 4,093 square miles of the Mississippi Alluvial Valley (MAV) and include a major portion of the Mississippi Delta (Figure 1.3). The drainage area extends from the confluence of Steele Bayou with the Yazoo River north to the vicinity of Clarksdale, Mississippi, and has an average

width of approximately 30 miles. The Mississippi Delta alluvial plain is generally flat with slopes averaging 0.3 to 0.9 foot per mile. Interior drainage of the area is accomplished by structures at Little Sunflower River (upper ponding area) and Steele Bayou (lower ponding area). Drainage areas of the four basins are shown in the Table 1.1.

The Yazoo Study Area contains approximately 926,000 acres of which approximately 500,000 acres are lands within the 100-year flood frequency. The Yazoo Study Area is bordered by the left descending bank of the mainline Mississippi River levee on the west, the west bank levees of the Whittington Auxiliary Channel and the Sunflower River and Steele Bayou connecting channel on the east, and the Yazoo River on the south (Figure 1.4). The study area includes all or portions of Humphreys, Issaquena, Sharkey, Warren, Washington, and Yazoo counties, Mississippi and part of Madison Parish, Louisiana.

The pump station will be located in Warren County, Mississippi, approximately eight miles northeast of the Steele Bayou water control structure near Deer Creek, between the Yazoo Backwater levee and the Yazoo River, and approximately three miles northeast of the intersection of Highway 465 and Highway 61. A borrow area will be located north of Highway 465 and the Yazoo Backwater levee, approximately eight miles southwest of the pump station, and approximately 0.5 mile northwest of the Steele Bayou water control structure. Thirty-four supplemental low flow groundwater wells will be located north of the Yazoo Study Area, in Washington, Bolivar, and Coahoma counties, Mississippi, and within the project drainage area (Figure 1.5). The supplemental low flow groundwater wells will be installed adjacent to the Mississippi River levee on the landside, upstream of the backwater area, in areas primarily utilized for agricultural production, and adjacent to headwater streams.

1.3 PRIOR REPORTS

The FCA of 1941 authorized the extension of the east bank mainline Mississippi River levee, generally upstream along the west bank of the Yazoo River for a distance of about 54 miles to a connection in the vicinity of Yazoo City, Mississippi, with the Yazoo River levee feature of the Yazoo Basin Headwater Project. A water control structure was included at Little Sunflower River, and a combination of water control structures and pump stations at Big Sunflower River, Deer Creek, and Steele Bayou with a total pumping capacity of 14,000 cubic feet per second (cfs) were planned. The capacities of the three pump stations were to be 11,000, 700, and 2,300 cfs for the Big Sunflower River, Deer Creek, and Steele Bayou, respectively. By closing the water control structures and operating the pumps when the Yazoo River reaches elevation 80.0 feet, National Geodetic Vertical Datum (NGVD), the pumping capacity of 14,000 cfs would prevent the elevation of water ponding behind the water control structures from rising above 90.0 feet, NGVD, more often than once in five years (i.e., the 5-year frequency event with pumps would be elevation 90.0 feet or less). The FCA provided for the enlargement of seven miles of levee in the Rocky Bayou Area, and the adjustment in the discretion of the Chief of Engineers of grades of existing levees on the east bank of the Yazoo River, all as contemplated in Plan C of the Corps of Engineers Mississippi River Commission (CEMRC) report, dated 07 March 1941. The FCA also provided that the Chief of Engineers should fix the grade of the extension levees so that their construction would give the maximum

practicable protection to the Yazoo Backwater Area without jeopardizing the safety of the mainline Mississippi River levees.

The FCA of 1944 extended the project, at the discretion of the Chief of Engineers, to include 38 miles of levees on the east bank of the Yazoo River (the Satartia and Satartia Extension Areas).

The Committee on Public Works of the U.S. Senate on 12 June 1954, adopted a resolution calling on the Chief of Engineers to "examine and review the project for flood control of the Mississippi River in its alluvial valley . . . as authorized by the FCA approved 15 May 1928, as amended by subsequent Acts of Congress, as one comprehensive whole and in its entirety, and to submit at the earliest practicable date recommendations for any modifications that are advisable with respect to the project or any feature of the project." In response, and in accordance with instructions from the Chief of Engineers, the Vicksburg District, U.S. Army Corps of Engineers (MVK) created a document that became Annex L to the Comprehensive Review. That Annex addressed the Yazoo Backwater Project, Mississippi, and put forward a plan to connect the Sunflower and Steele Bayou ponding areas by a connecting channel.

As a result of the Comprehensive Review of the MR&T Project Report dated 06 April 1962 (HD 308/88/2), the Chief of Engineers modified the authorized plan for the Yazoo Backwater Area to include a connecting channel between the Sunflower River and Steele Bayou, with all interior drainage evacuated through the Little Sunflower and Steele Bayou water control structures. The Chief of Engineers Report reads in part as follows.

> ". . . I believe that, at some future time, protection of some areas in the Yazoo Backwater by pumping may be warranted. Since the new plan developed by the Mississippi River Commission is proposed for construction under existing project authorization, selection of this plan does not affect those authorizations, which I consider sufficiently broad to permit selection of location and capacities of pump stations, or a combination of gravity and pumped drainage, as future developments dictate."

Included in the recommended alternative was the purchase in fee title of 70,000 acres of land in the ponding areas and the operation of the ponding areas to produce optimum flood control and fish and wildlife benefits. These modifications were recognized by the FCA of 1965.

A report on Muddy Bayou (Eagle Lake) was prepared in December 1969 in response to requests by the Warren County Board of Supervisors, the Mississippi Game and Fish Commission, and other local interests. The report presented results of studies to determine the impacts of completed and authorized flood control works on Eagle Lake and to determine the feasibility and advisability of providing structural features for fishery management practices and improvement of water quality in the lake. As a result, the Yazoo Backwater Project was modified to include the Muddy Bayou water control structure under the discretionary authority of the Chief of Engineers. The water control structure was approved in 1970. The Muddy Bayou water control structure allows manipulation of lake levels for improvement of water quality and fishery resources and also provides incidental flood protection for properties along Eagle Lake. This structure was completed in 1978.

The 23 July 1976, Yazoo Basin, Yazoo Backwater Area, Fish and Wildlife Mitigation Plan report proposed the implementation of an increment of structural features to mitigate fish and wildlife losses resulting from the constructed flood control works in the Yazoo Backwater Area. The report was submitted for early action under the authority of the Yazoo Basin Comprehensive Study. The features proposed in the report were limited to only those mitigation features that might be implemented without acquiring additional lands because of then current U.S. Army Corps of Engineers (USACE) policy to use existing public lands. The alternative recommended the construction of nine greentree reservoirs and nine slough impoundments on lands of the Delta National Forest under the discretionary authority of the Chief of Engineers. The recommended improvements were approved by the Chief of Engineers on 03 December 1976. During preparation of Design Memorandum No. 15 entitled Fish and Wildlife Facilities, Structural Measures, Delta National Forest dated 19 April 1979, approved by CEMRC, 11 June 1979, and with concurrence of the USFS, the nine greentree reservoirs were reduced to four and the nine slough control structures were reduced to five. Four of the slough control structures and one of the greentree reservoirs were eliminated due to unsuitable site conditions. Due to problems with the existing easement, one additional greentree reservoir was deleted. The MVK eliminated three of the reservoirs because the USFS informally indicated that they did not want any more greentree reservoirs built in the Delta National Forest. Additionally, the MVK obtained approval by letter report dated 14 March 1979, approved by the CEMRC on 06 March 1980, to construct a boat-launching ramp on the Little Sunflower River mitigating the loss of access caused by construction of the Little Sunflower River drainage structure. The USFS agreed to operate and maintain the boat ramp in accordance with other features constructed in the Delta National Forest. Currently, the greentree reservoirs and the slough control structures are not being operated by the USFS, nor are they being maintained by the MVK. In summary, four greentree reservoirs, five slough control structures, and one boat ramp have been completed by the MVK. Prior to the construction of the greentree reservoirs by the MVK, the MDWFP constructed one greentree reservoir and continues to manage it. In recent years, Ducks Unlimited constructed several water control structures within the Delta National Forest.

A reevaluation of the economic feasibility of the pump station features of the backwater project was completed by the MVK in 1982. The results of the reevaluation are presented in the Yazoo Basin, Yazoo Backwater Area, The Yazoo Pump Project report dated July 1982 and revised November 1982 (https://www.mvk.usace.army.mil/missions/programs-and-project-management/project-management/yazoo-backwater-report/). The Yazoo Area Pump Project, Final Environmental Impact Statement, Flood Control, Mississippi River and Tributaries, Yazoo Basin, Mississippi was included in the report and the Record of Decision (ROD) was signed in July 1983. Construction was initiated in 1986 and the inlet and outlets channels along with the cofferdams were completed (Figure 1.6).

The WRDA of 1986 authorized the acquisition of perpetual easements on 40,000 acres of woodlands for mitigation of project induced fish and wildlife losses within the Yazoo Backwater Area as recommended by the MVK in the July 1982 Reevaluation Report. The WRDA of 1986 also changed the cost-sharing provisions of local interests for USACE projects nationwide. Under the new provisions, the local project sponsor would provide the lands, easements, right-

of-ways, relocations and disposal areas for the project or 25 percent of the construction cost whichever was greater. These new provisions were applicable to all projects or separable elements thereof, on which construction was initiated after 30 April 1986. The Rocky Bayou features, the Carter Area features, and the uncompleted features for the Yazoo Backwater Area were all deemed to be separable elements of the Yazoo Basin, Yazoo Backwater Project, and therefore, subject to the new cost-sharing provisions. Construction was halted in 1987 due to the inability of the non-Federal sponsor to provide financial capability.

In October 1989, MVK prepared the Yazoo Backwater Area, Mississippi, Yazoo Basin, Mississippi, Mitigation Plan. The report presented a proposal to implement mitigation through compensation for terrestrial wildlife losses that resulted from the construction and operation of the Yazoo Area and Satartia Area Backwater Levee Projects. Potential environmental impacts for the Yazoo Area pump station feature were not considered. Alternatives considered included:

a. Development of existing public lands.

b. Fee title acquisition and management of wooded lands.

c. Perpetual land use easement acquisition of wooded lands.

d. Fee title acquisition of cleared lands with reforestation/regeneration.

Fee title acquisition of 8,400 acres of frequently flooded cleared lands with reforestation was selected as the best alternative for mitigating the wildlife losses in lieu of the mitigation plan approved by the WRDA of 1986. The report recommended the acquisition of lands from willing sellers and identified several properties that were currently available. The recommendation was implemented with the acquisition of the 8,800 acres of frequently flooded cleared lands referred to as the Lake George Property in 1990. However, the entire 8,800 acres included some existing levees, channels, and roads, and therefore, did not fully offset the required mitigation. The MVK has continued mitigation acquisition intermittently as funding has been received from Congress. Currently, approximately 1,490 acres are required to fully offset the impacts from the construction of these projects.

In 1990 an Office of Management and Budget directive was received to reformulate the uncompleted projects within the Yazoo Basin. The reformulation of the Yazoo Backwater Project was initiated in 1993.

The WRDA of 1996, Section 102(a)(2) amended Section 103(e)(1) of the WRDA of 1986 by defining physical construction as the date of construction contract award (25 March 1986 for the authorized backwater pump station). Since a contract on the pump station was awarded before 30 April 1986, this modification in effect changed local cooperation requirements for the pump station to those of the original authorized project.

In October 2007, the Yazoo Backwater Area Reformulation Main Report and the Final Supplement No. 1 to the 1982 Yazoo Area Pump Project Final Environmental Impact Statement (FEIS) were completed (https://www.mvk.usace.army.mil/missions/programs-and-

project-management/project-management/yazoo-backwater-report/). No Record of Decision was signed due to the EPA vetoing the project in August 2008 under Section 404(c) of the Clean Water Act (CWA) citing “adverse impacts on wetlands and their associated fisheries and wildlife resources are unacceptable”.

Currently, the Yazoo Study Area has experienced flooding in nine out of the last ten years. In 2019 the Yazoo Study Area experienced record flooding when over 550,000 acres were inundated for over six months. The combination of more frequent and significant flooding; substantial environmental, economic, and safety concerns; and new and improved environmental data, analysis, and documentation concerning the Yazoo Study Area prompted the initiation of an updated evaluation of the 2007 FSEIS recommended plan and preparation of this SEIS which will serve as an update to the 2007 FSEIS, pursuant to the National Environmental Policy Act (NEPA) of 1969, as amended.

Section 2
Purpose and Need

The purpose of this SEIS is to evaluate the recommended plan from the 2007 Main Report. The Yazoo Study Area is still experiencing periodic damaging backwater floods and therefore produces a need to reduce flood impacts and restore balance to the ecosystem.

The primary purpose of the authorized Yazoo Basin, Yazoo Backwater, Mississippi, Project is to reduce flood damages from the Mississippi and Yazoo rivers to areas in the lower Mississippi Delta. When high water stages occur on the Mississippi and Yazoo rivers, the flood gates at two water control structures (Little Sunflower and Steele Bayou) in the Yazoo Backwater levee system are closed, keeping water from being able to get out of the system (Figure 1.7).

The Steele Bayou water control structure is the principal structure for the Yazoo Basin, Yazoo Backwater, Mississippi, Project. Any time the water on the landside of the Steele Bayou water control structure is higher than the riverside and above 70.0 feet, NGVD, the gates are open. The Little Sunflower water control structure generally remains closed but is opened during flood events when the riverside water surface elevation is less than the landside elevation. With the rising of the Mississippi and Yazoo rivers, the upper and lower ponding areas are allowed to rise to an elevation of 75.0 feet, NGVD. The water control structures are closed when the river elevations are higher than the interior ponding levels. Although the interior areas are protected from high stages of the Mississippi and Yazoo rivers, they are subject to flooding resulting from inflow from the 4,093 square mile drainage area of Steele Bayou, Deer Creek, Little Sunflower River, and Big Sunflower River. During low-flow periods, the Steele Bayou water control structure is operated to control water levels in Yazoo Study Area streams. The present operation of the Steele Bayou water control structure holds water levels between elevation 68.5 and 70.0 feet, NGVD. At these elevations, water is still in the river channels.

Inflow from the Yazoo Study Area drainage area into the ponding areas when the water control structures are closed causes interior flooding in the Yazoo Study Area that needs to be reduced. The flooding affects public roads and bridges; residential and nonresidential structures; other infrastructure; environmental resources; and agricultural, forested, and timber management lands. As a result, flooding has caused undue hardships and economic losses to residents of the area due to flooding of homes, disruption of sanitation facilities, lines of communications, and transportation. This flooding constitutes a major problem to residents and is a detriment to economic development of the Yazoo Study Area, therefore a definite need exists for the reduction of this flooding. A flood damage reduction project would benefit all sections of the economy and contribute to the well-being of all area residents.

The Proposed Plan would provide for the reduction in interior flooding during backwater flood events. When activated, the pumps will lower the water surface of floods greater than the 1-year frequency flood, which will reduce the extent and duration of the flood. Due to the limited pumps capacity, the changes to flood extent and duration would be slow and gradual with

actual changes in the water surface elevation being greatest near the pump station and less in the headwaters. Therefore, the Proposed Plan satisfies the overall purpose and need of the project while maintaining environmental and ecological balance within the Yazoo Study Area.

2.1 FEDERAL INTEREST

The Yazoo Backwater Area has historically been subject to flooding from backwater by the Mississippi River and headwater flooding from the Yazoo River, Sunflower River, and Steele Bayou. Such floods occur on the average of approximately 1.5 times a year with a duration in excess of 30 days. In 2019, the Yazoo Backwater Area experienced record flooding when over 550,000 acres were inundated for over six months, and the area has experienced flooding in nine out of the last ten years. Significant flood damage occurs to agricultural crops and infrastructure. Flood damages occur to residences and other non-agricultural properties causing social and health problems. Flooding also poses a threat to loss of life and requires residents to seek temporary housing.

If the recommended plan from the 2007 Main Report had been in place, the residential and nonresidential structures impacted by flooding would have been reduced by 68.5 percent and would have reduced all other damage categories by 75.2 percent. The 2007 Main Report recommended plan would also increase agricultural interest in the area while at the same time provide significant environmental benefits to the area.

2.2 PROBLEMS AND OPPORTUNITIES

The Yazoo Backwater Area experiences damaging floods from rainfall events when the Mississippi and Yazoo rivers reach certain flood stages. Once the Yazoo River reaches a certain flood stage, due to flooding along the Mississippi River, the Steele Bayou and Little Sunflower water control structures are closed to prevent flooding in the Yazoo Backwater Area. However, additional rainfall that falls into the Yazoo Backwater Area is trapped and cannot be released to the Yazoo River when these two water control structures are closed. This scenario creates damaging backwater floods that impact residential and nonresidential structures, commercial facilities, wildlife habitat, and agriculture production. See pages 39-40 of the 2007 Main Report for a full description of the problems and opportunities.

2.3 GOALS AND OBJECTIVES

The goal of this study is to update the recommended plan from the 2007 Main Report by continuing to reduce flood damages and maintain the ecosystem habitat in the area. No new study goals or objectives have been added to this validation study. A full description of the planning objectives can be viewed on pages 40- 41 of the 2007 Main Report. Below are a brief description of the objectives from the 2007 Main Report.

Objective 1: Reduce flood damage to urban and rural structures as well as agricultural properties resulting from prolonged flood stages on the Mississippi River when the Steele Bayou and Little Sunflower water control structures are closed and floodwaters pond landside of the structures.

Objective 2: Provide reduced levels of agricultural intensification.

Objective 3: Reduce adverse environmental impacts through design.

Objective 4: Compensate 100 percent for unavoidable environmental impacts.

2.4 PLANNING CONSIDERATION

The current study effort has not added any new planning considerations from those mentioned on page 41-42 of the 2007 Main Report. The Proposed Plan will still work congruently with other features in the Yazoo Study Area.

Section 3
Alternative Formulation

The Yazoo Backwater Area has been studied extensively over the years with the 1982 report laying the ground work for several projects in the system. The 2007 Main Report was produced to recommend the last piece to finish the flood risk reduction system. The 2007 Main Report had been finalized prior to 2008 when EPA indicated it would exercise a veto of the document citing concerns related to Section 404(c) of the CWA and unacceptable effects on fishery areas and wildlife. Since 2008, the Yazoo Backwater Area has continued to experience devastating floods. The most recent 2019 flood generated renewed public interest in the project.

The 2007 Main Report effort was reviewed and the overall results of that plan formulation were found to still be valid in identifying a final plan. The current study effort does not reformulate any new alternatives but will analyze the Proposed Plan based on the concerns indicated in 2008, new environmental data, and a new hydraulic period of record. The new Proposed Plan will be assessed using the same evaluation criteria used to select the recommended plan from the 2007 Main Report.

3.1 SCREENING AND EVALUATION CRITERIA

The screening and evaluation criteria remain the same for the current study effort. A full description of the screening and evaluation criteria can be viewed on pages 42 through 49 of the 2007 Main Report. The 2007 Main Report alternatives were formulated and evaluated in accordance with various technical, economic, environmental, and socioeconomic criteria (2007 Main Report). The Final array of alternatives were also evaluated on the four Principles and Guidelines criteria which are completeness, effectiveness, efficiency, and acceptability. The Principles and Guidelines Criteria will be covered under the plan accomplishments section. Table 3.1 provides a brief description of the evaluation criteria that were used in the 2007 Main Report.

3.2 DEVELOPMENT AND SCREENING OF ALTERNATIVE PLANS

Alternative development, screening of alternatives, and evaluation of alternatives can be found in the 2007 Main Report under the Alternatives section on pages 50 through 123. The 2007 Main Report starts out by discussing the different structural and nonstructural alternatives that could be generated. From this list of structural and nonstructural alternatives, the project delivery team forms the initial array. The study formulation went through a second, third, and fourth array (2000 Draft Report), as well as a Fifth and Final Array in the 2007 Main Report. Throughout the alternative development process, alternatives were added, screened out, or carried forward. The final array from the 2007 Main Report consisted of seven alternatives. The seven alternatives in the final array were then evaluated again to determine

a recommended plan. Alternative number five was identified as the recommended plan in 2007 Main Report and is described in the next section.

The recommended plan from the 2007 Main Report is now the plan currently being revised under this study effort. The development, screening, and evaluation criteria used for all alternatives remains unchanged for the Proposed Plan. The Proposed Plan will still include both structural (construction and operation of the pump station) and nonstructural (flood damage reduction features through acquisition and reforestation/conservation) features.

3.3 RECOMMENDED PLAN FROM 2007 MAIN REPORT

The recommended plan from the 2007 Main Report included structural and nonstructural features as discussed below.

Structural feature:

- A 14,000 cfs pump station with a year round pumping elevation of 87.0 feet, NGVD, located at the Steele Bayou water control structure.
- Operation of the Steele Bayou water control structure would be modified to maintain water elevations between 70.0 and 73.0 feet, NGVD, during low water periods. No additional real estate is required for this feature.
- The pump station would be operated according to a pump station operation manual. This operation alternative would address several factors. One factor would be that the diesel driven pumps could not be instantaneously turned on all at the same time nor would all the pumps be utilized every time stages were predicted to exceed elevation 87.0 feet, NGVD. Other factors that would have to be accounted for would be the forecast of inflows due to Mississippi River conditions, interior conditions (stages and ground conditions) and forecasted flood and weather conditions. A more detailed description of the pump operation is given in the Engineering Appendix, Appendix 6 of the 2007 Main Report and 2007 FSEIS.

Nonstructural feature:

- Acquisition and reforestation/conservation features on up to 55,600 acres of agricultural lands through perpetual easements from willing sellers only. Approximately 42,800 acres of cleared land are potentially available below elevation 87.0 feet, NGVD, (1-year floodplain at the Steele Bayou water control structure) and the remaining acreage needed to reach up to the 55,600 acres would be acquired between elevations 87.0 and 91.0 feet, NGVD (2-year floodplain at the Steele Bayou water control structure). Up to 10 percent of an acquired property could be in conservation features other than reforestation. Conservation features are practices implemented and maintained solely for wildlife management purposes. Conservation features include, but are not necessarily limited to (1) water management impoundments for waterfowl, wading birds, or other wildlife purposes; (2) food plots; (3) permanent openings maintained in early successional stages; (4) access trails, roads, and firebreaks; or (5) facilities and buildings necessary for property management (constructed above the

100-year floodplain elevation). While the MVK will provide the pipe for the waterfowl impoundment, landowners would be responsible for the cost of implementing and maintaining the waterfowl impoundment and any other conservation practices. Landowners also would be responsible for maintaining ditches used for agricultural operations on remaining portions of their properties or for agricultural operations on other properties dependent on those ditches.

3.4 PROPOSED PLAN

The Proposed Plan represents a balanced approach to addressing the flood damage reduction and environmental opportunities in the Yazoo Study Area. The Proposed Plan includes structural, nonstructural, and mitigation features as discussed below.

Structural feature:

- A 14,000-cfs pump station, consisting of twelve pumps, located near Deer Creek, with a year-round pump elevation of 87.0 feet, NGVD, when the riverside water elevation is greater than the landside water elevation at the Steele Bayou water control structure.
- Current operation of the Steele Bayou water control structure within the Yazoo Study Area will remain the same, maintaining the water levels in the Yazoo Study Area between 68.5 and 70.0 feet, NGVD, during low flow periods.
- The pump station would be operated according to a pump station operation manual. The pumps will be natural gas driven pumps could not be instantaneously turned on all at the same time nor would all the pumps be utilized every time stages were predicted to exceed elevation 87.0 feet, NGVD. Other factors that would have to be accounted for would be the forecast of inflows due to Mississippi River conditions, interior conditions (stages and ground conditions) and forecasted flood and weather conditions. The availability of natural gas as the power sources will help reduce the carbon footprint of operating the pump station and the initial capital cost of the project.

Nonstructural feature:

- Acquisition and reforestation/conservation features on up to 2,700 acres of agricultural lands through perpetual easements from willing sellers only. Approximately 2,100 acres of cleared land are potentially available below elevation 87.0 feet, NGVD, and the remaining acreage needed to reach up to the 2,700 acres will be acquired at or near 87.0 feet, NGVD. Securing this conservation feature on lands below elevation 87.0 feet, NGVD, will remove these lands from future economic damages resulting from flooding. Up to 10 percent of an acquired property could be in conservation features other than reforestation. Conservation features are practices implemented and maintained solely for wildlife management purposes. Conservation features include, but are not necessarily limited to (1) water management impoundments for waterfowl, wading birds, or other wildlife purposes; (2) food plots; (3) permanent openings maintained in early successional stages; (4) access trails, roads, and firebreaks; or (5) facilities and buildings necessary for property management (constructed above the 100-year floodplain elevation). While the MVK will provide the pipe for the waterfowl

impoundment, landowners would be responsible for the cost of implementing and maintaining the waterfowl impoundment and any other conservation practices. Landowners also would be responsible for maintaining ditches used for agricultural operations on remaining portions of their properties or for agricultural operations on other properties dependent on those ditches. For planning purposes, anticipatory ecological benefits were not included in the determination of compensatory mitigation. Nonstructural reforestation parcels likely differ from compensatory mitigation lands in several ways (e.g. smaller than the large parcels targeted for compensatory mitigation, may lack contiguous forested boundaries), wetland functional capacity units provided by the nonstructural feature would likely be lower when compared with the values for compensatory wetland mitigation areas described in Section 6.

Mitigation features:

- Installation of 34 supplemental low flow groundwater wells adjacent to the Mississippi River levee and upstream of the Yazoo Study Area which will deliver from 0.1 to 0.2 cfs per square mile during low flow periods and would not exceed 5 cfs per well. The supplemental low flow groundwater wells will mitigate for unavoidable losses to aquatic resources.
- Acquisition of 2,405 acres of frequently flooded agricultural lands in fee title and subsequent reforestation of these lands would be pursued to offset any unavoidable losses to wetlands, terrestrial, aquatic, and waterfowl resources.

3.5 COMPARISON OF THE 2007 RECOMMENDED PLAN AND THE PROPOSED PLAN

3.5.1 Similarities

Similarities between the Recommended Plan from the 2007 Main Report and the Proposed Plan.

- Total pumping capacity will remain at 14,000 cfs.
- The pump-on elevation will remain at 87.0 feet, NGVD, and the pump maximum discharge into the Yazoo River elevation will remain at 107 feet, NGVD.
- The pump station will reduce the maximum stage and the duration of backwater events, but will have little impact on headwater events in both plans.
- Both plans have associated conversion (clearing), hydrologic (pump station operation), and reforestation effects.
- The nonstructural flood damage reduction (reforestation) would be provided primarily at or below elevation 87.0 feet, NGVD, at the Steele Bayou water control structure, and structural flood damage reduction (operation of pump station) would be provided above elevation 87.0 feet, NGVD, for both plans.

3.5.2 Differences

Differences between the Recommended Plan from the 2007 Main Report and the Proposed Plan.

- The location of pump station is not the same. The recommended plan from the 2007 Main Report had the pump station located at the Steele Bayou water control structure. The Proposed Plan has the pump station located near Deer Creek (approximately eight miles northeast of the Steele Bayou water control structure).
- The recommended plan from the 2007 Main Report would modify the operation of the Steele Bayou water control structure to maintain water elevations between 70.0 and 73.0 feet, NGVD, during low water periods. The Proposed Plan would maintain the current operation of the Steele Bayou water control structure by maintaining water levels between 68.5 and 70.0 feet, NGVD, during low flow periods.
- The pump station in the recommended plan from the 2007 Main Report was diesel driven, and pump station in the Proposed Plan will be operated by natural gas. The availability of alternate power sources will help reduce the carbon footprint of operating the pump station and eliminates the need for a diesel storage area.
- The Proposed Plan will require construction of a pump station with all appurtenant structures, inlet and outlet channels, bridge and access roads, a borrow area and access roads, reforestation of nonstructural lands along with compensatory mitigation, and installation 34 supplemental low flow groundwater wells with associated features and access roads. Below is a brief description of the construction of each feature.

3.6 SELECTION RATIONALE FOR PROPOSED PLAN

The Proposed Plan was developed using the same criteria as was used to select the recommended plan from the 2007 Main Report. The evaluation criteria were discussed by the project delivery team to ensure the Proposed Plan still meets these criteria. The results were captured as either yes, no longer applicable, or no. The results of the evaluation are shown in Table 3.2.

The Proposed Plan resembles the recommended plan from the 2007 Main Report with a few updates to make the proposed plan a better and more effective plan. The key differences that helped make the Proposed Plan better than the old one are moving the pump site, not changing the operation of the Steel Bayou water control structure, using natural gas to power the pump station, and reducing unavoidable impacts to the environment. Therefore, the project delivery team recommends moving forward with the Proposed Plan and the no action plan to be further compared and evaluated. After further comparison and evaluations are made, the principles and guidelines criteria will be applied to see if the Proposed Plan is acceptable, effective, efficient, and complete.

3.7 PROPOSED PLAN DETAILED PROJECT DESCRIPTION

The Proposed Plan represents a balanced approach to addressing the flood damage reduction and environmental opportunities in the Yazoo Study Area. The Proposed Plan includes structural, nonstructural, and mitigation features as discussed below.

<u>Pump Station/Inlet Channel/Outlet Channel/Access Road/Utilities</u>

The pump station will be located in Warren County, Mississippi, approximately eight miles northeast of the Steele Bayou water control structure near Deer Creek, between the Yazoo Backwater levee and the Yazoo River, and approximately three miles northeast of the intersection of Highway 465 and Highway 61. The pump station right-of-way will be approximately 211.76 acres. Construction of the pump station, inlet channel, outlet channel, new levee associated with the pump station, along with removal of part of the existing levee for construction of the inlet channel and subsequent construction of a bridge over the inlet channel to connect the existing levee, will take place within the pump station right-of-way. Figure 1.8 shows a three dimensional model view of the completed pumping plant and associated features. Figure 1.9 shows the pump station, access road, and utilities right-of-ways.

The pump station will be constructed of reinforced concrete and will consist of wing walls, flood walls, retaining walls, intake structures, pump bay monoliths, a control room monolith, and a service bay monolith. Construction and permanent access to the new pump station will be accessed by traveling northwest on the existing Yazoo Backwater levee for approximately 2.3 miles from Highway 61. The existing Yazoo Backwater levee road will need to be widen to accommodate traffic, which will require the crown of the levee to be widened. The right-of-way for the access road and subsequent levee widening will be approximately 25.07 acres. The access road will enter the restricted facility by way of the new levee. The new levee and pump station are joined and tie into the existing backwater levee. The crown of the levees will be paved with asphalt to provide a smooth surface course. Utilities will be run parallel and approximately 80 feet to the southeast of the pump station access road. The utilities line right-of-way will be approximately 50 feet wide and approximately 10.54 acres. Utilities (both natural gas and electricity) are readily available and in close proximity to the pump station.

An inlet channel will be constructed to connect the pump station to the existing connecting channel. The inlet channel will be approximately 1,200 feet long and will require the excavation of approximately 500,000 cubic yards of material for construction. The inlet channel will be lined with riprap and filter stone to provide protection against erosion. An outlet channel will connect the pump station to the Yazoo River. The outlet channel will be approximately 1,800 feet long and will require the excavation of approximately 475,000 cubic yards of material for construction. The outlet channel will be lined with riprap and filter stone to provide protection against erosion. The inlet and outlet channel will form a secondary means of transferring floodwaters from the Yazoo Study Area into the Yazoo River via the pump station to reduce the damages resulting from Mississippi River backwater flooding.

Impervious material taken from the channel and structural excavation, if found suitable, will be used in construction of the new cofferdam and new levee and for structural backfill. If a shortage of impervious material from the channel and structural excavation occurs, borrow material will be hauled on-site from the borrow area location. The new levee will be constructed to finish grade elevation of 112 feet, NGVD, with 1 on 4 side slopes. A bridge will be constructed across the inlet channel to connect the existing Yazoo Backwater levee for continued public use, however access to the new pump station will be restricted. The new bridge will be pile founded and approximately 700 feet long. Construction will require the use

of a cofferdam that will be at an elevation of 112 feet, NGVD, and will have 1 on 4 side slopes. The cofferdam will require approximately 105,000 cubic yards of borrow material for construction. Construction will require a preload at the site which will have a crown elevation of 125 feet, NGVD, and a berm at elevation 107 feet, NGVD, which will be 690 feet wide and 450 feet long. The preload will be removed prior to construction and the cofferdam will be removed upon completion of construction. All excess and/or unused material removed for construction will be taken to a government approved disposal area or stockpiled for possible future use. All construction activities associated with constructing the new pump station will adhere to federal, state, and local laws.

Borrow Area

The proposed borrow area is located north of Highway 465 and north of the Yazoo Backwater levee, approximately eight miles southwest of the proposed pump station, and approximately 0.5 mile northwest of the Steele Bayou water control structure. The borrow area right-of-way is approximately 35.92 acres. An access road will be constructed to access the borrow area from Highway 465. From Highway 465, approximately 0.1 mile of site work will be required in order to construct an access road to tie into an existing coffer dam. The access road will be constructed on the coffer dam and continue for approximately 0.25 mile and intersect with the existing Yazoo Backwater levee road. The access road will then continue west along the Yazoo Backwater levee road for approximately 0.2 mile. From the Yazoo Backwater levee road, the access road construction will turn north for approximately 0.15 mile to the borrow area. The borrow area access road right-of-way is approximately 9.74 acres. Figure 1.10 shows the borrow area and access road right-of-ways.

If suitable, the material from the excavation of the inlet and outlet channels and corresponding cofferdam will be used to construct the new levee and cofferdam. If the excavated material is deemed unsuitable for construction, fill material and/or additional fill material will come from the borrow area. The borrow area will also be used as a disposal site for material deemed unsuitable from excavation at the pump station site.

Reforestation

The nonstructural feature of reforestation of agricultural lands primarily below 87.0 feet, NGVD, will provide significant long-term benefits to water quality and improve the functional capacity of the reforested wetlands. Additionally, the reforestation of agricultural lands below 87.0 feet, NGVD, will provide additional flood reduction benefits to the Proposed Plan, which will be in addition to those provided by the operation of the pump station. Flood reduction benefits will be gained by removing these lands from future economic damages resulting from flooding. The reforestation and conservation features will be monitored by the MVK. After planting, tree survival will be visually monitored to ensure success. Conservation structures will also be visually monitored to ensure proper installation at the designated location. Monitoring will continue after successful establishment of the trees and structures through remote-sensing techniques with occasional visual onsite inspection. Should this monitoring indicate a violation in the terms of the easement, the MVK will take the necessary action to regain voluntary compliance with the terms of the agreement or use legal action, if necessary.

NOTE: Blocking out. The reforestation/conservation features easement acquisition limits were established based upon flood frequency state elevations. However, based upon sound real estate practices and guidance as found in the USACE real estate regulations, blocking out will be utilized to address such items as access, the extent of severance damages, and avoidance of an uneconomic remainder. The blocking out will result in the acquisition of some lands outside a given flood event or elevation. The MVK Real Estate Division has vast experience in the acquisition of lands based upon elevation and typically uses a blocking factor of 30 percent. This figure was utilized for calculating the acreages to be acquired for the reforestation/conservation features easement for both the recommended plan from the 2007 Main Report and the Proposed Plan.

Mitigation

Thirty-four supplemental low flow groundwater wells, associated features, and access roads will be installed as a mitigation feature of the project to help alleviate the negative aquatic environmental impacts resulting during minimum flow conditions within the Big Sunflower and Steele Bayou watersheds of the Yazoo Basin. Base flows will be enhanced to levels that can better sustain aquatic life year-round and should reduce the effects of low dissolved oxygen levels within the Yazoo Study Area. The supplemental low flow groundwater wells will be located north of the Yazoo Study Area in Washington, Bolivar, and Coahoma counties, Mississippi within the project drainage area and will be installed adjacent to the Mississippi River levee, in areas primarily utilized for agricultural production, and adjacent to headwater streams. Figure 1.11 shows the locations of the 34 supplemental low flow groundwater wells in relation to the Yazoo Study Area. The right-of-ways for the 34 supplemental low flow groundwater wells, which includes associated features, and access roads will be approximately 30.9 acres and 12.19 acres respectively.

Discharge pumps will be electrically driven. The discharge pipe will be installed from each supplemental low flow groundwater well location to the bank of the receiving stream. The discharged water will flow down through a constructed reaeration trough to the channel. All disturbed areas will be stabilized with riprap to prevent erosion. The supplemental low flow groundwater wells will deliver from 0.1 to 0.2 cfs per square mile during traditionally low flow periods and will not exceed 5 cfs. The supplemental low flow groundwater wells will only be operated during periods of low flow (generally during the fall), and will not contribute to water levels during backwater flood events. Water levels in the Yazoo Study Area will be maintained between 68.5 and 70.0 feet, NGVD, during low flow periods by the Steele Bayou water control structure. This addition of water will increase the velocities in the streams of the headwaters of the Yazoo Study Area, therefore improving aquatic habitat and ultimately benefitting up to 650 stream miles within the Sunflower Basin.

Engineering studies will evaluate the geologic and hydrogeologic conditions at potential supplement low flow groundwater well sites. Installation of the supplemental low flow groundwater wells will disturb a minimal amount of land at each site and impacts to these disturbed areas shall be minimized with best management practices (BMPs). Necessary permits to operate the supplemental low flow groundwater wells will be obtained from the MDEQ prior to construction.

The supplemental low flow groundwater wells will improve environmental flows in 9,321 acres of streams, directly benefiting fish, mussels, and other ecological attributes of the Yazoo Study Area. Monitoring studies have documented extensive hypoxia in the Yazoo Study Area during flood inundation, questioning the value of reforestation to fully address aquatic impacts. Therefore, the alternative mitigation method of the installation of supplemental low flow groundwater wells will address a range of other habitat impairment in the Big Sunflower-Steele Bayou drainage negatively impacting the overall fish communities and aquatic habitat through environmental flow establishment during the low water season. Re-establishing perennial flows with supplemental low flow groundwater wells is anticipated to offset high mortality of larvae and juvenile fish in the spring from hypoxia and improve survival of juveniles and adults during autumn. This approach address the overall aquatic community during all life stages and improves a total of 9,321 acres of streams by improved environmental flows.

Additionally, the acquisition of 2,405 acres of frequently flooded agricultural lands in fee title and subsequent reforestation of these lands will be pursued to offset any unavoidable losses to wetlands, terrestrial, aquatic, and waterfowl resources. The 2,405 acre mitigation effort was calculated based on impacts from the entire calendar year, various flood frequencies, and variable flood depths associated with the Proposed Plan. The nonstructural flood damage feature (reforestation) will provide substantial environmental benefit and were not included in the determination of the 2,405 acre compensatory mitigation effort. Therefore, these anticipatory ecological benefits will be in addition to the 2,405 acre compensatory mitigation benefits. The mitigation plan for these lands is described in the Section 6. Mitigation for the Steele Bayou pump station site is being accomplished as part of the Yazoo Backwater levee mitigation. Acquisition and mitigation for the Yazoo Backwater levee is currently ongoing. Any mitigation from the Proposed Plan will be separate from the Yazoo Backwater levee mitigation.

Compensatory mitigation for unavoidable impacts due to the construction of a project is determined after avoidance and minimization of impacts are considered. The primary method to achieve mitigation is the reforestation of frequently flooded agricultural lands. Loss of bottomland hardwoods wetlands is a major regional concern. Reforestation of the 1- and 2-year floodplain addresses this concern. Therefore, the MVK will focus mitigation on reforestation of bottomland hardwood on agricultural lands, which provides benefits to wetlands, terrestrial, aquatic, and waterfowl.

Maintenance

The MVK will be responsible for the majority of the operation and maintenance (O&M) of the Proposed Plan, which will include O&M of the pump station and all appurtenant structures, inlet and outlet channels, bridge and access roads, borrow area and access road, and supplemental low flow groundwater wells. The non-federal sponsor, Board of Mississippi Levee Commissioners, will be responsible for some minor maintenance of the inlet and outlet channels.

Maintenance over the project life will entail the periodic removal and deposition/disposal of sediment accumulations from the inlet and outlet channels and will be the responsibility of the MVK. The timing of maintenance dredging will depend upon hydrologic events and the rate

of deposition. Dredged material from the periodic maintenance dredging will be deposited in a government approved disposal area.

Best Management Practices

The majority of lands impacted by construction and deposition of fill material will be isolated from neighboring water bodies by dikes and existing levees. Any unavoidable impacts will be further minimized by the implementation of BMPs, such as silt screens, buffer zones, containment dikes, and erosion reduction techniques, in accordance with the State of Mississippi laws and regulations. A Stormwater Pollution Prevention Plan will be completed and submitted to MDEQ prior to initiation of construction. All required permits for construction and operation will be obtained prior to construction and all construction activities will adhere to state, federal, and local laws. The nonstructural and mitigation lands will be monitored for environmental success. Additional monitoring practices are discussed in the Monitoring and Adaptive Management Appendix.

For additional information on the Proposed Plan see the Engineering Appendix.

Section 4
Project Setting

Extending from Memphis, Tennessee, to Vicksburg, Mississippi, the Yazoo Basin covers 13,400 square miles. The surface of the Yazoo Basin consists mainly of an intricate network of meander belt (point bar, abandoned channel, abandoned course, and natural levee) deposits. The point bar deposits within the Yazoo Basin exhibit an undulating surface of ridges and swales partially covered by remnant natural levees. The Yazoo Basin also covers two physiographic subdivisions. One of these leveed alluvial plains is no longer subject to overbank flooding and is referred to as the "Delta". The other consists of rolling hills which drain into the Delta. The Yazoo Study Area is approximately 926,000 acres in the lower portion of the Delta and includes all or portions of Humphreys, Issaquena, Sharkey, Warren, Washington, and Yazoo counties, Mississippi, and a small part of Madison Parish, Louisiana.

The Yazoo Study Area lies within the Mississippi River alluvial plain and is comprised of forested lands and open fields. Area soils are alluvial and generally level. There is little to no topographic relief in the project area. In the immediate vicinity to the property, flora is dominated by deciduous hardwood trees, including species of oak (*Quercus* spp.), elm (*Ulmus* spp.), green ash (*Fraxinus pennslyvanica*), cottonwood (*Populus deltoides*), and sugarberry (*Celtis laevigata*) in the areas unaltered by modern agricultural production.

4.1 AFFECTED ENVIRONMENT

The Yazoo Study Area lies in the alluvial valley of the Mississippi River. The topography is characterized by relatively flat, poorly drained land with slopes of 0.3 to 0.9 foot per mile. Elevations range from 120.0 to 75.0 feet, NGVD, from north to south.

Geology

The alluvial valley was formed during the early Pleistocene epoch, or glacial period, at which time the Mississippi River became deeply incised in the coastal plain. The river gradually filled the valley with deposits of sand, silt, clay, and gravel during the Quaternary period. The deposits generally grade from coarse to fine, proceeding from deep to shallow with a clay cap typically found on the slopes. This material has been reworked as streams have meandered throughout the area. Depositional features resulting from this activity include abandoned course, abandoned channel, point bar, backswamp, braided stream, and natural levee.

Hydrology

The Yazoo Study Area ultimately drains into the Mississippi River through numerous rivers and streams. The Yazoo River traverses the area from the northeast to the southwest and enters the Mississippi River at Vicksburg, Mississippi. Deer Creek, Big Sunflower, and Yazoo rivers drain most of the area. The hydrology of the Yazoo Study Area is affected by both internal and external sources. Both sources have been altered by features of the MR&T Project. The frequency and duration of flooding due to the Mississippi River have been

reduced by the mainline levees and the channel cutoffs (external sources). The levees keep floodwaters of the Mississippi River out of the study area. The channel cutoffs lowered Mississippi River stages which in turn reduced backwater flooding. The maximum reduction of backwater flooding due to the channel cutoffs occurred in the 1950s. Aggradation of the Mississippi River channel bed has eliminated most of this reduction. Reservoirs constructed in the hill area of the Yazoo Basin and channel improvements to the Yazoo River also had an effect on stages within the Yazoo Backwater Area. The Yazoo Backwater Area has also benefited from other flood damage reduction features of the MR&T project that have been completed inside the study area (internal sources). These features are listed below.

a. Yazoo Backwater levee extends from the end of the east bank mainline Mississippi River levee to the downstream end of the west side of the Will M. Whittington Channel levee along the Yazoo River.

b. Water control structures at Steele Bayou and the Little Sunflower River allow interior runoff to be released when the ponding area stages are higher than the river stages and prevent backwater flooding from the Mississippi and Yazoo Rivers when the river is higher than the ponding areas.

c. A 200 foot bottom width connecting channel between the Big Sunflower and Little Sunflower rivers and an enlarged Little Sunflower River channel between this connecting channel and the Little Sunflower water control structure.

d. A 200 foot bottom width connecting channel between the Little Sunflower River and Steele Bayou, which also intercepts Deer Creek flow.

e. A water control structure in Muddy Bayou controls Eagle Lake inflows and outflows for environmental purposes.

f. The inlet-outlet channel and the cofferdam around the Steele Bayou water control structure site.

Climate

Climate in the Yazoo Study Area is mild, humid, and primarily subtropical with abundant precipitation. The summers are long and hot, and the winters are short and mild. The average annual temperature is 64 degrees Fahrenheit. Average monthly temperatures range from 44 degrees Fahrenheit in January to 82 degrees Fahrenheit in July. The normal length of the frost-free growing season is slightly longer than nine months. The average annual rainfall in the Yazoo Study Area is approximately 54.87 inches, and annual rainfall averages 4.57 inches per month. Normal monthly rainfall varies from 3.22 inches in August and September to 6.07 inches in December (https://usclimatedata.com). However, severe rainfall, producing locally intense runoff, can occur at any time during the year. Snowfall occurs about once a year with an average of less than two inches.

4.2 RELEVANT RESOURCES

For the purposes of this SEIS, relevant resources include those resources identified by institutional, public, or technical criteria. Institutional criteria are laws and formal government policies. Public recognition can include controversy, support, or opposition relative to utilization of resources. Technical recognition is based on scientific knowledge or judgment of resource characteristics. The significance may be recognized by more than one criterion. For example, the significance of bottomland hardwoods is recognized by Public Law 99-662 (requires in-kind mitigation to the extent possible) local communities for the consumptive and nonconsumptive recreational value, and the scientific community for the wetland functional value.

Table 4.1 contains a description of resources that may be impacted by the proposed action. The resources described in this section are those recognized by laws; executive orders; regulations; other standards of National, state, or regional agencies and organizations; technical or scientific agencies, groups, or individuals; and the general public.

The following sections are an explanation of the significant resources that could be impacted by the Proposed Plan. In addition to the above listed significant resources, the following were also evaluated for proposed action impacts: Environmental Justice; Prime and Unique Farmland; Hazardous, Toxic, and Radiological Wastes (HTRW); Hydraulics and Hydrology; Terrestrial (which will include Bottomland Hardwood Forest); and Waterfowl.

The following resources have been considered and determined to not be affected by any alternative under consideration: Soils and Water Bottoms; Essential Fish Habitat; and Navigation.

4.2.1 Human Environment

4.2.1.1 Socio-economics

This section outlines the social and economic environment of the Yazoo Study Area in Mississippi. In the last ten years this area has faced significant flooding events resulting in agricultural and structural damages. The purpose of this profile is to provide a picture of the demographic and economic conditions of the region of influence. The parameters of the socioeconomic profile are population, income per capita, housing, labor and employment, and agricultural activities. In addition to past and present conditions, this study will also address future economic and social conditions of the Yazoo Study Area for which the data is available.

The region of influence of (ROI) of this study encompasses Sharkey County and Issaquena County, Mississippi. This includes the following communities: Rolling Fork, Anguilla, Cary, Mayersville, Chotard, Fitler, Grace, Tullula, Valley Park, Delta City, Egremont, Lorenzen, Nitta Yuma, Onward, Panther Burn, and Patmos, Mississippi. The ROI consists of about 1,550 square miles situated near the Lower Yazoo Basin of the Mississippi River. The ROI extends from the Mississippi River on the west and the Yazoo River Levee on the east; it is located

about 15 miles south of Hellandale, Mississippi and about 50 miles north of Vicksburg, Mississippi.

4.2.1.1.1 Population

Historical population trends for the ROI and the state of Mississippi are illustrated in Figures 4.1 and 4.2. Unlike population trends for the entire state of Mississippi, the ROI has seen a steady decline in population over the past 50 years with the exception of a slight increase in population in Issaquena County between 1990 and 2000. The most significant decline occurred in Sharkey County between 2000 and 2010 when population went from 6,520 in 2000 to 4,880 in 2010. Projections show that that population trends will continue to trend downward over the next 50 years.

Population Centers

According to the 2010 census, Sharkey County and Issaquena County reported populations of 4,915 and 1,399 respectively. The largest population center, Rolling Fork, is located in Sharkey County, and reported a population of 2,130. The largest towns in the ROI are Rolling Fork, Anguilla, and Mayersville, Mississippi. The surrounding areas are sparsely populated with small towns and unincorporated communities.

4.2.1.1.2 Income per Capita

Income per capita serves as a proxy for the overall health of an economy making it important to include in a profile of the social and economic environment. Income per capita in the ROI, detailed in Figure 4.3, has increased significantly over the past 50 years. Income per capita in both counties in the ROI trend upwards over time following trends in inflation seen broadly across the U.S.. In general, income per capita in both counties closely mirror one another. Over the last five decades the income per capita in the ROI remains below that of the state of Mississippi. In the year 2020, Issaquena County's income per capita is expected to remain around the same while Sharkey County's income per capita is expected to rise, a gap between the two counties that is expected to continue over the next 20 years.

4.2.1.1.3 Housing

Housing trends describe the social environment that influences the economic activity of the area. Figure 4.4 illustrates the total number of households in the ROI over the past 50 years as well as estimates for the next 50 years. The number of households in the ROI remained relatively stable from the years 1970 to 2000 with the exception of a small dip in Sharkey County in the 1980s. Historically, the total number of households remained much more stable in Issaquena County over the past 50 years avoiding some of the dips seen in Sharkey County in the 1980s and 1990s. Between 2000 and 2020 the total number of households began to decline steadily in both counties, a trend that is projected to continue over the next 50 years. Declining housing trends in the ROI are consistent with the declining population trends.

4.2.1.1.4 Labor and Employment

Labor force and employment data illustrate level of economic activity in the ROI. In order to provide a full picture of the economic and social environment this study discusses labor force, total employment, unemployment rates, and non-farm employment by industry. The ROI is heavily dominated by the agricultural sector, however, the agricultural activities will be addressed in separate section.

Labor Force

Labor force is defined as any person in the working age population (age 16 and older). In the past 30 years the labor force in the ROI has been declining (Figure 4.5). The most significant drop was in Sharkey County in 2010 when the labor force decreased from 2,649 to 2,066 following trends in population decline during the same time period. Labor force is expected to decline steadily over the next 40 years.

Unemployment Rate

The unemployment rate is the rate of people actively seeking employment, but cannot find work. Unemployment rates serve as a proxy of the overall health of an economy, so it is integral to the study of the economic environment. In the last 30 years, the unemployment rate in the ROI was higher than that of the state of Mississippi. The ROI's unemployment rate consistently ranks 3-5% higher than the state unemployment rate. Projections estimate the gap between the state unemployment and Sharkey County's unemployment rate will remain around 3% while the gap between the state unemployment rate and Issaquena County's unemployment rate is expected to increase to almost 10% in the next 20 years. Total employment for the ROI can be found in Figure 4.6 and unemployment rate for the ROI and the State of Mississippi can be found in Figure 4.7.

The trends in unemployment in Sharkey County closely mirror those of the state as a whole. The trend in Issaquena County's unemployment rate is nearly identical to that of Sharkey County until 2010 in which the unemployment remains high but relatively stable over the following 10 years. Trends in unemployment rates are expected to remain stable over the next 20 years.

Employment by Industry – Non-Farm

Employment by industry gives us an idea of the type of economic activity in the ROI. This portion of the study focuses on non-farm employment. Non-farm payroll is the number of paid U.S. workers in all businesses, excluding those who work for farms, serve in the military, volunteer for nonprofit organizations, and perform unpaid work in their own household. Agricultural activities will be addressed in a later section.

Historically, the government, manufacturing, natural resources and mining, and trade, transportation, and utilities industries have provided the greatest number of non-farm payroll employment in the ROI (Figure 4.8). In the mid-1990s employment in the natural resources and mining industry sharply declined a trend seen broadly across the nation. Consequently,

by the year 2000 more people in the ROI were employed in education and health services than natural resources and mining. Employment in the manufacturing sector also declined over time. From 2000 onward the government and trade industries were the most dominant industries in the ROI mirroring a nationwide trend away from manufacturing and mining employment towards more service oriented jobs.

There is no projected data for non-farm employment in the ROI, but we can reasonably assume that trends in employment will continue over the next 50 years.

4.2.1.1.5 Agricultural Activities

Agriculture activities have been integral to the economic activity of the ROI so it is necessary to address this as part of the socioeconomic profile. This section includes a discussion of farm and non-farm proprietor profits, the market value of all agricultural goods sold, and the land in farms in the ROI.

Farm and Non-Farm Proprietor Profits

Non-farm proprietor profits represent the portion of the total income earned from current production that is accounted for by unincorporated nonfarm businesses in the United States. Conversely, farm proprietor profits represent the portion of total income earned from current production accounted for by unincorporated farm business in the United States. Farm and non-farm proprietor profits give us an estimation of the importance of agriculture to this region as well as how the trends in farm and non-farm profits have affected the economy of the ROI.

In general, Figure 4.9 shows that over the past five decades farm proprietor profits have remained well above non-farm proprietor profits in most instances demonstrating the importance of agriculture to this region. Non-farm proprietor profits in both Sharkey County and Issaquena County increased steadily throughout the last 50 years while trends in farm proprietor profits are much more volatile.

Farm proprietor profits in the ROI spiked in 1990 due to an increase in the demand for agricultural goods as widespread droughts in the late 1980s destroyed crops across the nation. Similarly, in 2010 farm proprietor profits spiked once again most likely due to similar weather patterns.

In the next 50 years projections predict that nonfarm profits will surpass farm profits slightly in both counties in the ROI.

Market Value of Agricultural Goods Sold

The market value of agricultural goods sold gives us an idea of the economic activity of agriculture industry in the ROI. Throughout the 1970s and 1980s Figure 4.10 shows relatively steady growth in the market value of agricultural goods sold followed by a slight decline in both counties in 2002. The market value of agricultural goods seemingly recovered between 2002 and 2012 with sharp increase from 47.89 million dollars in 2002 to 108.16 million dollars in 2012 in Sharkey County and from 22.31 million dollars in 2002 to 53.23 million dollars in

2012 in Issaquena County. This sharp uptick in the market value of agriculture good sold from 2002 to 2012 is likely due to severe drought across the nation making the price of agricultural goods shoot upwards.

There are no estimated projections for the market value of agricultural goods sold however, based on the data we have available we can assume that the market value of agricultural goods sold will continue to follow the trends seen in the rest of the state and country as a whole.

Land in Farms

The amount of acreage in farms is important to the social and economic environment as it demonstrates the importance of agriculture and the impact of agricultural damages caused by flooding in the ROI (Figure 4.11). In Issaquena County, the land in farms remained relatively the stable over the last 50 years, staying around the 110,000-120,000 acre range. Sharkey County saw a significant drop in acreage in 1987 when the land in farms went from 210,045 to 177,963 acres. This is likely due to national farm crisis of the 1980s leading many farmers to sell their land.

There is no data concerning projections over the next 50 years, but trends are expected to continue.

4.2.1.2 Environmental Justice

Mississippi is one of the poorest states in America and has a sizeable minority population (Smith et al. 1999). The region of Mississippi known as the Delta is the poorest area of this already poor state and residents are known to experience low educational attainment and lack health insurance (Smith et al. 1999).

Issaquena and Sharkey County, Mississippi is the study area for the flood risk management Environmental Justice (EJ) analysis. Both counties are majority non-white with 60 percent of the population in Issaquena County identifying as minority while about 75 percent of the population in Sharkey County identifies as minority. The largest minority in both counties identifies as Black/African American. The largest city in Sharkey County is Rolling Fork which is home to about half of the County population. Hispanic ethnicity is about 1 percent of the population.

Nearly 42 percent of the population in Issaquena County and 26 percent of the population in Sharkey County live below the poverty threshold of $25,094 for a family of four. The smaller towns of Hollandale and Rolling Fork also have high percentages of population living below poverty. For comparison purposes, about 20 percent of the population in the state of Mississippi lives at or below poverty level.

For more details on the EJ communities in the study area, see the EJ Appendix.

4.2.1.3 Prime and Unique Farmland

Projects are subject to the Farmland Protection Policy Act (FPPA) if they may irreversibly convert farmland (directly or indirectly) to nonagricultural use and are completed by a federal agency or with assistance from a federal agency. For the purpose of FPPA, farmland includes prime farmland, unique farmland, and land of statewide or local importance. Farmland subject to FPPA requirements can be forest land, pastureland, cropland, or other land, but not water or urban built-up land.

A Farmland Conversion Impact Rating Form (AD-1006) was submitted to NRCS for further determination of FPPA requirements. This form evaluates the potential impacts on prime and unique farmlands. Prime farmland, as defined by FPPA, is land that has the best combination of physical and chemical characteristics for producing food, feed, fiber, forage, oilseed, and other agricultural crops with minimal inputs of fuel, fertilizers, pesticides, and labor without intolerable soil erosion. Unique farmlands are defined by FPPA as land other than prime farmland that is used for production of specific high-value food and fiber crops.

4.2.1.4 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 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 National Register of Historic Places (NRHP). Historic properties are identified by qualified agency representatives in consultation with the State Historic Preservation Officer (SHPO), Tribes, and other consulting parties.

USACE staff conducted a literature and records review to collect data pertaining to cultural resources identified within the Yazoo Study Area as well as within and adjacent to the proposed borrow area, pump, and supplemental low flow groundwater well locations (Tables 4.3 through 4.6). 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 the Yazoo Study Area as well as within or adjacent to the above listed areas. Records were examined generally in a 1-mile radius of the proposed borrow area, pump, and supplemental low flow groundwater well locations. Results of this cultural resources assessment were extensive due to the large geographic area. A summary of the report findings are contained in the Cultural Resources Appendix. In summary, approximately 1,110 cultural resources were identified in the Yazoo

Study Area (Tables 4.3 and 4.5), with an additional 179 cultural resources identified within a 1-mile radius of the proposed borrow area, pump, and supplemental low flow groundwater well locations (Tables 4.4 and 4.6). These resources were identified and recorded primarily as a result of Section 106 compliance studies in addition to private and avocational efforts (Tables 4.3 through 4.6).

These resources span the full range of occupation of the Yazoo Basin and are composed of buildings, structures, sites, Mississippi Landmarks, National Historic Landmarks, and a single historic district. They include pre-contact and contact period Native American mound sites, cemeteries related primarily to plantation development or historic church yards, historic archaeological sites, and several prominent national historic landmarks, namely Lake George/Holly Bluff and Fort St. Pierre sites in Yazoo County and Winterville Mounds in Washington County, Mississippi. There are 388 such resources within the Yazoo Study Area and near project locations in Washington County, 323 in Sharkey County, 159 in Humphreys County, 143 in Issaquena County, 122 in Yazoo County, 88 in Bolivar County, 33 in Warren County, and 32 in Coahoma County. 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 Yazoo Basin is presented below.

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) (Table 4.2).

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 Lower Mississippi River Valley (LMRV), 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, establish 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 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.

While agriculture industrialized along the Mississippi River, 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 LMRV 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 framing. 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.

4.2.1.5 Recreation Resources

The public lands of the Yazoo Study Area are regionally, nationally, and hemispherically important due to the habitat provided to a myriad of species (Nichols et al. 1983, Reinecke et al. 1989). Both game and nongame species, including resident and migratory songbirds,

waterfowl, deer, raccoon, woodpeckers, owls, rabbits, mice, wild turkey, squirrel, turtles, alligators, fish, and other species, rely on the bottomland hardwood forests and wetlands of the area for habitat and foraging (Glasgow and Noble 1971, Klimas et al. 1981). Historically, connections between the floodplain and the Mississippi River were frequent due to an unmodified hydrologic regime (Biedenharn et al. 2000). The 1927 flood spurred anthropogenic modifications of MAV hydrology through channelization and construction of levees and water control structures, which in turn altered the natural flood-pulse cycle delivering water, nutrients, and sediment to these floodplain ecosystems (Baker et al. 1991, Gore and Shields 1995). The functional capacity of these bottomland hardwood forests and wetlands benefit from short duration, periodic hydrologic connectivity (Ward 1989, King et al. 2009). Large-scale land conversion during the 20th century significantly changed the MAV landscape resulting in more than 75 percent loss of these habitats (Faulkner et al. 2011). The remaining natural areas provide a necessary refuge for wildlife (MacDonald et al. 1979**,** King and Keeland 1999). This area also draws a large number of recreational users for a variety of activities including hunting, which represent a significant regional economic driver (Grado et al. 2001, 2007, and 2011).

A vast array of recreational resources is available in the Yazoo Study Area which includes approximately 926,000 acres of which approximately 500,000 acres are lands within the 100-year flood frequency. There are 14 Federal and/or State-managed unique recreation areas within the Yazoo Study Area which include parks, natural areas, historic sites, fish and wildlife areas, scenic areas, and trails. Of the 14 unique public recreation areas listed, 29% are Federally-managed and 71% are State–managed. At least 36% of these areas provide one or more boat-launch access points. 31.9% of these areas offer consumptive recreation opportunities while 100% offer non-consumptive opportunities. These non-consumptive recreation opportunities include, but are not limited to trails, hiking, camping, wildlife observation, nature photography, boating, and environmental education (see Recreation Appendix, Table F-3.1: Federal and State Recreation Resources within the Study Area).

According to the U.S. Department of the Interior, National Park Service (NPS) Land and Water Conservation Fund (LWCF), nearly $30 million in funding has supported 33 public recreation projects within the seven counties and parishes that comprise the study area between 1965 and 2011 (see Recreation Appendix, Land & Water Conservation Fund Recreation Fund Table F-3.2 and Table F-3.3). 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. Table 4.9 illustrates the economic impact of recreation to the states of Mississippi and Louisiana.

4.2.1.6 Aesthetics (Visual)

Environmental assessments and impact statements for Corps planning studies are supposed to focus on significant environmental considerations as recognized by technical, institutional and public sources. The Visual Resources Assessment Procedure for USACE (VRAP)

provides a method to evaluate visual resources affected by Corps water resources projects. The following VRAP criteria identify significant visual resources in the study area:

- Important urban landscapes including visual corridors, monuments, sculptures, landscape plantings, and greenspace.
- Area is easily accessible by a major population center.
- Project is highly visible and/or requires major changes in the existing landscape.
- Areas with low scenic quality and limited visibility.
- Historic or archeological sites designated as such by the National Register or State Register of Historic places.
- Parkways, highways, or scenic overlooks and vistas designated as such by a Federal, State, or municipal government agency.
- Visual resources that are institutionally recognized by Federal, State or local policies.
- Tourism is important in the area's economy.
- Area contains parks, forest preserves, or municipal parks.
- Wild, scenic, or recreational water bodies designated by government agencies.
- Publically or privately operated recreation areas.

These significant visual resources are primarily described in the Cultural/Historic and Recreation Resources sections of this document. Specific examples include:

- The Delta National Forest.
- The Panther Swamp National Wildlife Refuge.
- The Holt Collier National Wildlife Refuge.
- The Yazoo National Wildlife Refuge.
- The Hillside National Swamp Area.
- Leroy Percy State Park.
- Mississippi State Sunflower Wildlife Management Area.
- The Mississippi Delta Great River Road Scenic Byway.
- The Lower Mississippi Historic Scenic Byway.

Significant roadways providing primary vehicular access into the Yazoo Study Area's visual landscape include Highways' 61, 1, and 16. Highway 61 and parts of Highway 1 are designated the Mississippi Delta Great River Road and Lower Mississippi Historic Scenic Byways. Highway 16 provides vehicular access to primary recreation features in the Delta National Forest. Historically, parts of these roads are impassable due to flooding for various durations.

4.2.1.7 Noise

Noise can be described as a sound or series of sounds that are intrusive, irritating, objectionable, or disruptive to daily life. Ambient noise refers to the all-encompassing noise associated with a given environment, typically being a composite of sounds from many sources near and far. Sound is produced by the vibration of sound pressure waves in the air. 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. 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 greater annoyance than do the same levels occurring 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). The DNL is the community noise metric recommended by the EPA. The U.S. Department of Housing and Urban Development established acceptable DNL noise levels for construction activities in residential areas (https://www.hud.gov/sites/documents/DOC_16415.PDF).

- 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.

The Yazoo Study Area is a rural area with a primary production working environment of noisy activities including vehicles, farm equipment and irrigation usage, animals, and some industry, but with key activities being agricultural production and forestry management. These activities can impact each other, but more commonly they impact rural residents. Surrounding trees and vegetation act as a noise barrier and as a practical method to reduce noise in rural environments.

Rural areas generally show decreases in noise levels during the evening and night times and seasonal variations show noise to be less prominent in the winter months. Evening and night time decreases are expected since people are less likely to be outdoors during these times and seasonal variations can be attributed to noisy rural activities being less prominent during the winter, wildlife such as birds and insects are less prominent in the winter, farming and forestry activities are less likely to occur in the winter, and people are less likely to be outdoors during the winter season.

No known noise issues or complaints currently occur within the Yazoo Study Area. Noise within the Yazoo Study Area is generally related to the working environment and is not known to be excessive in nature. The primary sources of noise for rural residences within the Yazoo Study Area include everyday vehicular traffic along nearby roadways which is typically between 50 and 60 dBA at 100 feet. Therefore, the noise level within the Yazoo Study Area is generally maintained at below an acceptable level.

4.2.1.8 Air Quality

The air quality of the Yazoo Study Area is in attainment of national air quality standards and is currently considered good. Except for odor, the ambient air quality standards for Mississippi are the Primary and Secondary Air Quality Standards promulgated by the EPA. The EPA has set air quality standards for six principal pollutants: nitrogen dioxide, ozone, sulfur dioxide, particulate matter, carbon dioxide, and lead. Currently, Mississippi meets all air quality standards. The surrounding counties of the Yazoo Study Area have air quality indices averaging around 44. Principal sources of air pollutants in the counties include industries, agricultural operations, and emissions from internal combustion engines (ICE).

4.2.1.9 Hazardous, Toxic, and Radioactive Waste

The general purpose of a Phase I Environmental Site Assessment (ESA) is to identify, to the extent feasible in the absence of sampling and analysis, the range of contaminants within the scope of the EPA Comprehensive Environmental Response, Compensation and Liability Act and petroleum products.

USACE Engineer Regulation (ER) 1165-2-132 and ER 200-2-3 require that procedures be established to facilitate early identification and appropriate consideration of potential HTRW in feasibility, preconstruction engineering and design, land acquisition, construction, operations and maintenance, repairs, replacement, and rehabilitation phases of water resources studies or projects by conducting HTRW Phase I ESAs. USACE specifies that these assessments follow the standard practices for conducting Phase I ESAs published by the American Society for Testing and Materials (ASTM). This HTRW assessment was prepared using the following ASTM Standard: E1527-13: Standard Practice for Environmental Site Assessments – Phase I Environmental Site Assessment Process. The USACE is obligated under 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 also states that HTRW policy is to avoid the use of project funds for HTRW removal and remediation activities.

The MVK conducted a preliminary, onsite HTRW assessment of the proposed major structural features of the Proposed Plan on 14, 17, 28, 29, and 30 July 2020 (see HTRW Appendix). These features included the proposed pump station area, the borrow area, and the supplemental low flow well sites. Additionally, a preliminary, online record search was conducted from 09-13 August 2020 on the areas associated with the Proposed Plan features using the online NEPAssist HTRW search tool, which is administered by the EPA. A one mile buffer was generated with the tool around each proposed project feature. The record search also included a query for Underground Storage Tanks using the online Groundwater Remediation and Assessment Division Tool administered by the MDEQ. A half mile buffer was projected around each feature.

4.2.2 Natural Environment

4.2.2.1 Hydraulics and Hydrology

The hydrology of the Yazoo Study Area is affected by both internal and external sources. Both sources have been altered by features of the MR&T Project. The frequency and duration of flooding due to the Mississippi River have been reduced by the mainline levees and the channel cutoffs (external sources). The levees keep floodwaters of the Mississippi River out of the Yazoo Study Area. The channel cutoffs lowered Mississippi River stages which in turn reduced backwater flooding. The maximum reduction of backwater flooding due to the channel cutoffs occurred in the 1950s. Aggradation of the Mississippi River channel bed has eliminated most of this reduction. Reservoirs constructed in the hill area of the Yazoo Basin and channel improvements to the Yazoo River also had an effect on stages within the Yazoo Backwater Area. The Yazoo Backwater Area has also benefited from other flood damage reduction features of the MR&T project that have been completed inside the Yazoo Study Area (internal sources). These features are shown in Figure 4.12. A more detailed description of the hydrologic setting is included in Engineering Appendix.

- Yazoo Backwater levee extending from the end of the east bank mainline Mississippi River levee to the downstream end of the west side of the Will M. Whittington Channel levee along the Yazoo River.
- Water control structures at Steele Bayou and the Little Sunflower River. These structures allow interior runoff to be released when the ponding area stages are higher than the river stages and prevent backwater flooding from the Mississippi and Yazoo Rivers when the river is higher than the ponding areas.
- A 200 foot bottom width connecting channel between the Big Sunflower and Little Sunflower Rivers and an enlarged Little Sunflower River channel between this connecting channel and the Little Sunflower drainage structure.
- A 200 foot bottom width connecting channel between the Little Sunflower River and Steele Bayou, which also intercepts Deer Creek flow.
- A water control structure in Muddy Bayou which controls Eagle Lake inflows and outflows for environmental purposes.
- The inlet-outlet channel and the cofferdam around the Steele Bayou water control structure site.

The mainline Mississippi River levees are designed to protect the alluvial valley from the Project Design Flood (PDF) by confining floodflows within the leveed floodway, except where it enters the backwater areas or is diverted intentionally into the floodway areas. The mainline levee system is comprised of levees, floodwalls, and various control structures. When major floods occur and the carrying capacity of the Mississippi River leveed channel is threatened, additional conveyance through the Bird's Point-New Madrid Floodway, and relief outlets through the Atchafalaya Basin, Morganza, and Bonnet Carre Floodways are utilized as well as the storage capacity of flat lowlands at the confluences of tributaries with the Mississippi River. These tributary areas are commonly referred to as "backwater areas." These areas are protected from lesser floods by backwater levee systems that are designed to be

overtopped near the crest of the PDF in order to reduce the peak flow of the PDF and allow safe passage within the mainline levee system. The system design which utilizes backwater storage at appropriate times in the PDF hydrograph has significantly reduced the need for even higher mainline levees. The Yazoo Backwater levees are designed to overtop by the PDF.

Ponding of runoff from the Big Sunflower River, Little Sunflower River, Deer Creek, and Steele Bayou is provided by two ponding areas connected by a 200 foot bottom width channel. The lower ponding area, formerly referred to as the Steele Bayou ponding area, lies in the lower end of the Steele Bayou Basin while the upper ponding area, formerly called the Sunflower River ponding area, is located in the lower portion of the Little Sunflower River Basin (Figure 1.7).

The interior area is protected from high stages of the Mississippi and Yazoo Rivers by levees; however, the area is subject to flooding resulting from inflow into the ponding areas from Steele Bayou, Deer Creek, and Big and Little Sunflower rivers. Under present conditions, the flooding in the Yazoo Study Area primarily results from interior ponding behind the Yazoo Backwater levee when the Steele Bayou and Little Sunflower water control structures are closed due to high Mississippi River stages. The interior ponding areas consist primarily of agricultural and forested lands with several developed areas. Interior flooding begins at approximately 80.0 feet, NGVD.

During the rising and falling stages of a flood hydrograph, the water surface elevations in the upper ponding area are generally higher than the water surface elevations in the lower ponding area. This difference is due to slope through the connecting channel and head losses across bridges and overbank openings along Deer Creek ridge and the divide between the two areas. Near the peak of the flood event, there is little difference in water surface elevations between the two ponding areas.

The Muddy Bayou water control structure was constructed as a means of controlling inflows to and discharge from Eagle Lake during non-flood conditions in order to enhance the lake's water quality. However, due to the topography surrounding the lake, some flood protection is provided as well.

During flood conditions, the Muddy Bayou water control structure is opened to allow water to pass from the lower ponding area into Eagle Lake only if it becomes apparent that this line of protection will be overtopped (about elevation 96.0 feet, NGVD).

Eagle Lake was formed from an abandoned Mississippi River channel. Although being cutoff from the Mississippi River by the Mississippi River levee, Eagle Lake provides numerous recreational benefits with numerous permanent and recreational homes located there. Without the two low-level levees (privately owned) in conjunction with the Muddy Bayou water control structure, the area would see significant backwater flooding.

The Steele Bayou water control structure is the principal drainage structure for the Yazoo Study Area. Any time the stage on the landside of the Steele Bayou and Little Sunflower water

control structures is higher than the riverside and above 70.0 feet, NGVD, the gates are opened. With a rising river, the interior ponding areas are normally allowed to rise to an elevation of 75.0 feet, NGVD. The floodgates are closed when the river elevation is higher than the interior ponding levels. The Little Sunflower structure generally remains closed. It is opened during flood events when the riverside water surface elevation is less than the landside elevation and the Steele Bayou water control structure is closed.

The Steele Bayou water control structure is operated to control minimum water levels in the Steele Bayou and Little Sunflower ponding areas. The current operation plan calls for holding minimum water levels in the ponding areas between 68.5 feet, NGVD, and 70.0 feet, NGVD.

The Yazoo Study Area was hydraulically modelled to estimate the effects of the pumps. The updated hydraulic modeling was developed using the HEC-RAS (Hydraulic Engineering Center- River Analysis System) computer program, version 5.1 Alpha 2019-11-22. The alpha version of HEC-RAS was used because this was the first version that allowed for the use of pumps connected to 2D flow areas, and this version was not available beyond the alpha edition. The HEC-RAS model utilizes a 2D flow area that extends from the Yazoo Backwater Levee System at the southern and eastern boundaries to Mississippi Highway 82 at the northernmost boundary, and it extends to the Mississippi River Mainline Levee System to the west. The unsteady flow model incorporates and routes the variable flows with adjustments for channel roughness, geometry and bathymetric data. The unsteady model's ability to simulate changes to the flow and water surface over time allows for a more accurate representation of hydraulic routing of water through the watershed. An existing model was updated by incorporating channels using surveyed bathymetric data, adding hydraulic structures to represent weirs, and revising channel roughness. The results of this model are only an estimate as there are several assumptions that are taken into account. The HEC-RAS model does not take hydraulic infiltration due to groundwater into account. The HEC-RAS model utilized results from the HEC-HMS (Hydraulic Engineering Center-Hydrologic Modeling System) model as inputs. Results were obtained from six different gages throughout the basin for comparison with historic observed data. The results showed that with the pumps the area would experience flooding with lower water surface elevation, and in cases where the water surface elevation was not significantly lowered the amount of time that the area was flooded could be shortened.

Flooding results from runoff from precipitation events. When the volume of runoff exceeds the channel capacity, the excess water moves into off channel ponding areas. Backwater flooding is also caused by excess runoff, but it involves more than one river. Backwater flooding in the lower Yazoo Basin is due to high waters in the Mississippi River at Vicksburg. The high waters act as a dam preventing runoff in the Yazoo River and its' tributaries from draining into the Mississippi River. During a backwater flood event, water from the Mississippi River backs up the Yazoo River channel to fill all areas of lower elevation. Prior to the completion of the Backwater Levee, these floodwaters would have filled the Steele Bayou and Big Sunflower ponding areas. After completion of the Yazoo Backwater Levee, Mississippi River floodwaters no longer enter the area, but internal runoff is trapped until the Mississippi River recedes. In 2011, the Mississippi River experienced a historic flood. The flood set

record high stages at many locations on the lower river. The Yazoo River backwater area riverside of the Yazoo Backwater levee reached an elevation of 107 feet, just a few inches below the top of the levee. The Steele Bayou structure had a differential of 18 feet between the riverside and the landside, but because the interior area received less than normal precipitation there was only a minor flood within the Yazoo Backwater area. However, prior to the Backwater Levees construction the area would have been inundated by 18 feet more. As was the landside water surface elevation exceeded 87 for 58 days, and the pump would have been in operation for that entire period. On the other hand not all flood events would require use of the pump. In 1991 the landside water surface exceeded 87 feet for 87 days. This was the result of three separate flood events. The first event in January was the only event where the riverside water surface exceeded the interior water surface and would have required pumping. The second and third events were strictly headwater events. The third event, in late April and May, set record stages in many locations within the Yazoo Basin, but would not have required use of the pump, since the Steele Bayou structure would have been open. 2019 is an example a worst case flood event. The Mississippi River experienced a long period of high stages and the interior area received above average precipitation. The interior water surface elevation at Steele Bayou exceeded 87 feet for 217 days, and the pump would have been in operation for 78 days (the pump would not have operated, when the Steele Bayou gates were open and draining the pooled flood waters). Flooding is an irregular occurrence. Using elevation 87 feet (NVGD) at the Steele Bayou Landside gage as an indication, this elevation is the 1-year flood elevation and the pump-on elevation. This elevation is equaled or exceeded on 1508 days of the 15320 days in the POR (9.8%). Of those 1508 days, the pumps would be used on 817 days (54.2%). The water surface exceeded 87 feet in 31 of the 42 years of the POR, but only 27 years would require pumping (64.2%). Four years have stages greater than 87 feet, but would not have pumping. The days per year, with stages at or above 87 feet per year, varies from 3 days in 1985 to 217 days in 2019, and the average duration of those periods with high stages is 48 days per year. The days with pumping per year varies from 1 in 1985 and 1989 to 78 in 2019. The percentage of the days above 87 that would require pumping varies from 0% (four years) to 100% (three years), and averages 54.2%. Overall, flooding in the Yazoo Backwater Area is complex. It is controlled by both internal and external precipitation events. The external events occur in one or more of the Missouri, Upper Mississippi and Ohio River basins or other major tributaries, and the internal events are caused by runoff from the 4093 square mile drainage area (2,620,000 acres).

4.2.2.2 Wetlands

Wetlands are an abundant and valuable resource within the Yazoo Study Area comprised of forested ecosystems adapted to soil saturation and flood inundation. Anthropogenic land use changes including logging, conversion of forested areas to agriculture, implementation of flood control projects, and reforestation have altered species composition and created a range of successional forest stands (see Wetlands Appendix). Dominant tree species include *Celtis laevigata* (Sugarberry), *Quercus lyrata* (Overcup Oak), *Fraxinus pennsylvanica* (Green Ash), *Liquidambar styraciflua* (Sweetgum), *Quercus texana* (Nuttall Oak), *Quercus phellos* (Willow Oak), *Carya illinoinensis* (Pecan), *Acer negundo* (Boxelder), *Ulmus Americana* (American

Elm), and *Populus deltoides* (Eastern Cottonwood). More frequently inundated areas and depressional features also feature a number of *Taxodium distichum* (Bald-Cypress), and *Nyssa aquatica* (Water Tupelo).

Soils in the Yazoo Study Area are pedagogically young and can support high rates of forest and agricultural productivity. Wetland soils in the study area are somewhat poorly to poorly drained, exhibit slopes <2%, and are characterized by seasonal high water tables in their unaltered states with fine soil textures found in commonly inundated areas. Field indicators of hydric soils observed within the Yazoo Study Area, include Depleted Matrix, Depleted Below Dark Surface, Redox Depressions, and Stratified Layers (USDA-NRCS 2018).

The USACE wetland delineation manual defines wetland hydrology as areas that are inundated or saturated to the surface continuously for at least 5.0% of the growing season in most years (50% probability of recurrence) (Environmental Laboratory 1987). Wetland hydrology has been further operationally defined using the technical standard described in USACE (2005) as occurring in those areas that are "inundated (flooded or ponded) or the water table is ≤12 inches below the soil surface for ≥14 consecutive days during the growing season at a minimum frequency of 5 years in 10 (≥50% probability)". Within the Yazoo Study Area, the 14 day duration of wetland hydrology corresponds to 5.0% of the growing season and the 2-year floodplain corresponds with the ≥50% probability of flood waters inducing wetland hydrology events which is required by the wetland hydrology threshold. As a result, wetlands in the Yazoo Study Area occurring within the 2-year floodplain (i.e., 50% recurrence interval) that display flood duration during ≥5.0% (i.e., ≥14 days) of the growing season were identified for analysis in this SEIS.

Historically, prolonged and extensive inundation occurred in the Yazoo Basin following precipitation during the winter wet season as precipitation and runoff discharged into the tributary network of the Yazoo River, which provides the only natural drainage feature to the Mississippi River at the southern end of the basin (Smith and Klimas 2002). Additionally, large flood events associated with the Mississippi River and tributary system inundated most of the Yazoo Basin in some years (Moore 1972). While the implementation of flood control measures has decreased flood frequency and duration in portions of the Yazoo Basin (Smith and Klimas 2002), development of the Mississippi River levee system in conjunction with incomplete flood control projects in the southern portion of the Yazoo Basin continue to create significant backwater flooding events. This typically occurs when high local precipitation occurs along with high Mississippi River stages that necessitate closure of multiple water control structures. These inundation events have increased the duration of wetland inundation in some portions of the Yazoo Study Area during some years **(**Stanturf et al. 2001). Currently, both precipitation and backwater flooding act as major hydrologic influences for wetlands in the Yazoo Study Area. Recent research documents precipitation provides the sole source of wetland hydrology at 67.9% of wetlands across 56 locations, with flooding providing supplemental sources of wetland hydrology in some areas during some years (Berkowitz et al. 2019).

4.2.2.3 Terrestrial

Terrestrial resources within the 926,000 acre Yazoo Study Area are comprised of agricultural land or woody wetlands, namely bottomland hardwoods. Agricultural lands provide limited utility habitat for a small number of species. As such, bottomland hardwoods containing Cottonwood *(Populus deltoides),* Sycamore *(Platanus occidentalis),* and Black Willow (*Salix nigra),* Pecan (Carya spp.), Green Ash *(Fraxinus pennsylvanica),* Sugarberry *(Celtis laevigata),* Hackberry *(C. occidentalis),* Oaks *(Quercus* spp.), and Elm *(Ulmus* spp.) are the most valuable terrestrial habitat and are most likely to be impacted by the construction and operation of the Proposed Plan. Herein, Habitat Evaluation Procedure (HEP) was used to evaluate direct and indirect impacts for four avian and two mammalian target species: Barred Owl (*Strix varia*), Carolina Chickadee (*Poecile carolinensis*), Pileated Woodpecker (*Dryocopus pileatus*), Wood Duck (*Aix sponsa*), Gray Squirrel (*Sciurus carolinensis*), and Mink (*Mustela vison*) (see Terrestrial Appendix). Oak and Pecan are the primary hard mast producing trees in the Yazoo Study Area and provide excellent habitat value for various wildlife species. Sycamores are prone to cavity formation which benefits species such as the Barred Owl, Wood Duck, Pileated Woodpecker, and Carolina Chickadee.

Barred Owls are large, stocky owls utilizing large, mature trees for nesting and forested areas as roosts during the day. Barred Owls are known to eat squirrels, chipmunks, mice, voles, rabbits, birds, amphibians, reptiles, and invertebrates.

Carolina Chickadees are small passerines with short bills; they consume mostly insects and spiders along with some plant material. This species utilizes a range of habitat types including bottomland hardwoods, swamps, and riparian areas in addition to open and urban areas.

Pileated Woodpeckers require large, standing dead trees and downed wood. They are large birds foraging on carpenter ants, other types of ants, beetle larvae, termites and other insects. They may also consume wild fruits and nuts including Hackberry fruit.

Wood Ducks are common in the Yazoo Study Area and nest in trees near water. Pairs of Wood Duck regularly produce two broods per year. Preferred Wood Duck brood-rearing habitat includes specific vegetated cover components that are inundated for varying intervals and depths across the landscape.

Gray Squirrels are omnivorous mammals weighing up to four pounds. They forage for nuts, seeds, buds, and flowers of trees. They can play an important role in seed dispersal and prefer mature continuous forested areas.

Mink are solitary, carnivorous, efficient predators that live in areas adjacent to waterbodies such as riverbanks and lakeshores. Mink feed on rodents, fish, crustaceans, amphibians, and birds with fish comprising the majority of their diet. Their elongated body allows entrance to prey burrows and enhances their swimming abilities.

4.2.2.4 Wildlife

Lands within the Yazoo Study Area are regionally, nationally, and hemispherically important due to the habitat provided to a myriad of species (Nichols et al. 1983, Reinecke et al. 1989). Both game and nongame species including resident and migratory songbirds, waterfowl, White-tailed Deer (*Odocoileus virginianus*), Raccoon (*Procyon lotor*), woodpeckers, owls, rabbits, mice, Wild Turkey (*Meleagris gallopavo*), squirrel, turtles, alligators, fish, and other species rely on the bottomland hardwood forests and wetlands of the area for habitat and foraging (Glasgow and Noble 1971, Klimas et al. 1981).

The utility of these lands to wildlife is largely dependent on hydrology. Historically, connections between the floodplain and the Mississippi River were frequent due to an unmodified hydrologic regime (Biedenharn et al. 2000). Adaptation of the subsidy-stress model in forested wetlands suggest the highest rates of production and benefit occur with periodic floods of short duration, while longer duration floods in which water becomes stagnant cause stress and result in lower production (Odum et al. 1979). Recent analysis of deer health over the period from 1988 to 2016 supports this paradigm and suggests floods of shorter durations can be a benefit to white tailed deer likely due to siltation fertilization in the batture and associated regeneration of forage material (Remo et al. 2018, Jones et al. 2019).

The 1927 flood spurred anthropogenic modifications of MAV hydrology through channelization and construction of levees and water control structures, which in turn altered the natural flood-pulse cycle delivering water, nutrients, and sediment to these floodplain ecosystems (Baker et al. 1991, Gore and Shields 1995). These modifications have induced more erratic flow regimes, more frequent major floods, and fewer years with stable water levels essential for moist-soil plants and aquatic vegetation growing in floodplains and backwater areas (Sparks et al. 1998). Inundation events of significant duration and magnitude are likely to exert significant negative effects (Choudhury 1998, MacDonald-Beyers and Labisky 2005, De Jager et al. 2012) including direct mortality, a reduction in available dry ground habitat, a reduction in available food resources and species replacement, a reduction in recruitment, and increased predation and disease transmission rates due to concentration of remaining wildlife populations (Choudhury 1998, Bodmer 1990, Chamberlain and Leopold 2003, Sorensen et al. 2014).

Finally, the relative effects of too much or too little water in the Yazoo Study Area must be considered both over the short- and long-term as the cumulative impacts of hydrologic regime will likely differ among species. For example, Warblers have been found to abandon areas affected by flooding due to changes in understory habitat (Klaus 2004, Benson and Bednarz 2010) but shorebirds may benefit from the creation of mudflats associated with flooding (Newcomb et al. 2014).

4.2.2.5 Waterfowl

The Yazoo Study Area lies within the MAV and is part of the Mississippi Flyway, a bird migration route following the Mississippi, Missouri, and Lower Ohio from the south into Canada. Approximately 40% of the Mississippi Flyway's waterfowl and 60% of all U.S. bird

species either migrate through or winter in the MAV (LMVJV 2015). Furthermore, the bottomland hardwoods of the MAV fulfill special waterfowl habitat requirements not provided by open lands including production of nutritious foods for waterfowl, secure roosting areas, cover during inclement weather, loafing sites, protection from predators, and isolation for pair formation. Thus, this area serves as critical habitat for a number of species including Mallard (*Anas platyrhynchos*), Gadwall (*Mareca strepera*), Green-winged Teal (*Anas crecca*), Blue-winged Teal (*Spatula discors*), Northern Shoveler (*Spatula clypeata*), and Wood Duck (*Aix sponsa*).

Size of the migratory waterfowl population in the MAV are a function of three habitat requirements: availability, utilization, and suitability in meeting social behavioral requirements. A recent annual USFWS Waterfowl Breeding Population and Habitat Survey calculated a total abundance of 38.9 million birds within North America, an increase of 10 percent higher than the 1955-2018 average (USFWS 2019). Within the Mississippi Flyway, the midwinter waterfowl survey by the USFWS and the states, counted on average ~7.5 million ducks per year over the past decade (2011-2020), an increase of nearly 12% over the long-term average (1955-2018) (Fronczak 2019). While recent counts of waterfowl indicate rising population numbers, habitat destruction and climate change continue to present significant threats to waterfowl necessitating conservation of critical habitat.

For more details on waterfowl, see the Waterfowl Appendix.

4.2.2.6 Threatened and Endangered Species

The USFWS listed the following eleven federally-listed threatened and endangered species within the Yazoo Study Area that should be addressed in this SEIS. A copy of the USFWS coordination memo is located in Threatened and Endangered Species Appendix. This section provides a summary of each of the listed species below. A more detailed description of each species can be found in Threatened and Endangered Species Appendix.

Species	Status	Occurrence
Pondberry (*Lindera melissifolia*)	Endangered	Known
Wood Stork (*Mycteria americana)*	Threatened	Potentially
Northern Long-Eared Bat (*Myotis septentrionalis)*	Threatened	Likely in low numbers
Eastern Black Rail (*Laterallus jamaicensis)*	Proposed Threatened	Unlikely
Piping Plover (*Charadrius melodus)*	Threatened	Likely (transient)
Red Knot (*Calidris canutus)*	Threatened	Likely (transient)
Least Tern (*Sternula antillarum athalassos)*	Endangered	Likely
Pallid Sturgeon (*Scaphirhynchus albus)*	Endangered	Potentially
Fat Pocketbook (*Potamilus capax)*	Endangered	Potentially
Rabbitsfoot Mussel (*Theliderma cylindrical)*	Threatened	Potentially
Sheepnose Mussel (*Plethobasus cyphyus)*	Endangered	Potentially

Pondberry (*Lindera melissifolia*)

Surveys conducted for the 2007 FSEIS identified colonies of Pondberry present within the Yazoo Study Area. In July 2020 these sites were resurveyed for Pondberry and to determine to extent possible, effects, if any, to Pondberry attributed to the recent high water events within the Yazoo basin. Upon completion of the July surveys, USACE, in coordination with USFWS, decided it would be in the best interest to conduct additional surveys in September to collect additional data. ESA coordination on the pondberry is ongoing and the Record of Decision will not be signed until coordination is complete.

Wood Stork (*Mycteria americana*)

The USFWS listed the Wood Stork (Mycteria americana) as federally threatened in February 1984 (Federal Register 49:7335). The recovery plan was for the breeding population within the United States and was approved 9 September 1986. While a prior record of six Wood Storks engaged in breeding activity near Vicksburg, MS, was documented in the late 1990's (Mueller and McCabe 1997), the breeding attempts were not successful. The species has potential to be present in the Yazoo Study Area.

Northern Long-Eared Bat (*Myotis septentrionalis)*

The USFWS listed the Northern Long-Eared Bat (Myotis septentrionalis) as federally threatened in 2015. The endangered Northern Long-eared Bat utilizes forest and forested wetland habitats, where they are known to roost in tree cavities, exfoliated bark and snags. The species is likely to be present in the Yazoo Study Area but in very low numbers.

Eastern Black Rail (*Laterallus jamaicensis)*

The USFWS proposed the listing of the Black Rail (*Laterallus jamaicensis*) as federally threatened in 2018. The state of Mississippi designates the Black Rail as S2N, meaning it is imperiled (non-breeding only) because of rarity. The black rail utilize densely vegetated meadows and marshes and occasionally upland transition portions of these habitats. The species is also known to utilize impounded wetlands, wet prairies, meadows and hayfields. For this reason, the black rail has potential to be present in the Yazoo Study Area but is unlikely.

Piping Plover (*Charadrius melodus)*

The USFWS listed the Piping Plover (Charadrius melodus) as federally threatened in 1986. Piping plovers can be found on expansive coastal or riverine sandy beaches and gravel flats. This is a migrant species which migrates through the Mississippi Delta and has the likelihood of migrating through the Yazoo Study area during the fall and spring.

Red Knot (*Calidris canutus)*

The USFWS listed the Red Knot (*Calidris canutus*) as federally threatened in 2014.

There are two Red Knot subspecies in the conterminous United States. The eastern population (*C. c. rufa*) and the western population (*C. c. roselaari*). During the breeding season, Red Knots usually nest in tundra and glacial sand and gravel habitats. They may also utilize marsh habitats on foothill slopes near riparian ponds and streams (Baker et al. 2020). During the non-breeding seasons, these birds use coastal habitats in tidal inlets of bays and estuaries, and are rarely found inland. Such habitats include tidal mud and sand flats, where they are dependent upon an abundant and diverse benthic community as a food source. This is a migrant species which migrates through the Mississippi Delta and has the likelihood of migrating through the Yazoo Study area during the fall and spring.

Interior Least Tern (*Sternula antillarum athalassos)*

The USFWS listed the Interior Least Tern (Sternula antillarum athalassos) as federally endangered in 1985.

Least terns nest on riverine (shorelines and sandbars), marine or estuarine shores, and typically on sparsely vegetated to barren areas with gravel or sandy substrates. Bare, open sand islands in riverine or coastal settings, separated sufficient distance from shoreline, that limit access by mammalian predators, usually provide the best nesting habitat for this species (Thompson et al. 2020). In areas with limited nesting habitat, or in years when interior rivers are flooded, this species is known to nest on gravel roof tops (Thompson et al. 2020).

There are three distinct subspecies of Interior Least Tern in the conterminous United States. S. a. antillarum breeds along the Atlantic and Gulf Coasts, S. a. browni breeds along the Pacific Coast and Baja Mexico, and S. a. athalassos breeds along interior rivers within the conterminous United States (Thompson et al. 2020). The breeding interior subspecies, S. a. athalassos, currently is federally protected under ESA and is the subspecies that is likely occur within the Yazoo Study Area.

Pallid Sturgeon (*Scaphirhynchus albus)*

The Pallid sturgeon was listed as endangered by the U.S. Fish and Wildlife Service in 1990 (USFWS 1990). A recovery plan was released in 1993 with the most current revision approved in 2014 (USFWS 1993, 2014). Further protection was provided with the listing of the Shovelnose Sturgeon as threatened under the Similarity-of-Appearance Provisions of the Endangered Species Act in 2010 (USFWS 2010). This provision only provides a protective status in river system where both species co-occur.

The species is a benthic, riverine fish that occurs in the Mississippi River Basin, including the Mississippi and Missouri Rivers, and their major tributaries (i.e., Platte and Yellowstone Rivers), and the Mississippi's major distributary, the Atchafalaya River (USFWS 1990).

Within Mississippi, Pallid Sturgeon occur within the mainstem of the Mississippi River (Killgore et al. 2007). There is a single historic record (1987) from the Big Sunflower River in Sharkey County, 12 miles NW of Sataria (Ross 2001). Cook (1959) noted the occurrence of the Pallid Sturgeon in the Yazoo River was possible since Shovelnose Sturgeon were routinely caught in this river by commercial fishermen during the early 1900's. In addition, there are several

museum records for Shovelnose Sturgeon in the Yazoo drainage (MMNS 2434, 51673 and 55110) dating 1937, 2007 and 2009 (MMNS 2020). A recent capture (23 May 2020) by a fisherman was noted in the tailwaters of Sardis Reservoir, a flood control reservoir on the Little Tallahatchie River (Yazoo drainage) in Panola County (Figure 15) (M. Wagner, MDWFP pers. comm.). No recent specimens of Pallid Sturgeon have been reported from the Yazoo Study Area. However, the species could potentially be present.

To promote directed recovery efforts, Pallid Sturgeon populations were assigned to four management units (USFWS 2014). These areas were selected as areas of high importance for recovery task implementation based on population variation (i.e., morphological, genetic) and habitat differences (i.e., physiographic regions, impounded, unimpounded reaches) throughout the extensive range of the sturgeon (USFWS 1993). The unit of concern for this project is The Coastal Plain Management Unit (CPMU) which includes the Mississippi River from the confluence of the Ohio River, Illinois, to the Gulf of Mexico, Louisiana, and includes the Atchafalaya River distributary system, Louisiana.

Fat Pocketbook (*Potamilus capax)*

The fat pocketboot (*Potamilus capax*) was listed as endangered by the U.S. Fish and Wildlife Service in 1976, a recovery plan was developed in 1985, revised in 1989 (USFWS 1976, 1989), and status reviews were published in 1987, 1991, and 2012 with no proposed changes recommended (USFWS 2012a).

Within Mississippi, the species is restricted to the Mississippi River, particularly secondary channels and chutes, and the Yazoo drainage with relict specimens observed in Sharkey County on the Big Sunflower River. The largest population likely occurs in the St. Francis drainage in Arkansas (Miller and Payne 2005), although populations are expanding within the Ohio River (USFWS 2012a). Local populations in Mississippi are rarely encountered in high abundances; however, based on the number of fresh valves observed (e.g., fresh dead *sensu* Haag and Warren 1998) a large population exists at Gilliam Chute in Jefferson County, MS (Killgore et al. 2014) and may serve as a source for local recruitment in the Lower Mississippi River. Within the Yazoo Study Area, the Fat Pocketbook mussel is noted from a single location on the Big Sunflower River in Sharkey County. Two individuals were collected in 2004 above Cypress Bend and are represented by relict shells. A more detailed account for the species including the Lower Mississippi River population is included in Killgore et al. (2014). The species could potentially be present in the area.

Rabbitsfoot Mussel (*Theliderma cylindrical)*

The Rabbitsfoot mussel (*Theliderma cylindrical*) was listed as federally threatened by the U.S. Fish and Wildlife Service in 2013.

The Rabbitsfoot is a freshwater mussel occurring the Ohio, Cumberland and Tennessee River systems, western Lake Erie drainages and Lower Mississippi River drainages from Louisiana and Mississippi N to Missouri and W to Kansas (Parmalee and Bogan 1998, Williams et al. 2008, Watters et al. 2009).

In Mississippi, the species occurs in the Tennessee, Yazoo and Big Black drainages. The Rabbitsfoot was likely more widespread throughout the Yazoo drainage based on available archaeological material but the only extant population within the drainage occurs in the Big Sunflower River in the reach between Indianola and Ruleville (Sunflower County).

The current range represents a 66% reduction from its historic extent. No recent specimens have been reported from the Yazoo Study Area although archaeological material from along the periphery of the Yazoo Study Area indicates it once occurred within the region. The species has potential to be present in the area.

Sheepnose Mussel (*Plethobasus cyphyus)*

The Sheepnose mussel (*Plethobasus cyphyus*) was listed as federally endangered by the USFWS in 2012 (USFWS 2012b). A recovery plan has not been developed.

The Sheepnose is a freshwater mussel occurring in the Mississippi River basin from Minnesota and Wisconsin downstream to northern Mississippi (Williams et al. 2008). The Mississippi population lies at the most southern extent of the species range (Jones et al. 2005). Within the Ohio River basin, it is found in the Ohio, Tennessee and Cumberland River systems (Watters et al 2009). A status assessment was prepared in 2002 (Butler 2002) noting that extant populations were generally small and geographically isolated.

In Mississippi, the species is known only from the Yazoo and Big Black drainages (Figure 10, Jones et al. 2019). Currently the only extant population occurs in the Big Sunflower River in the reach between Indianola and Ruleville (Sunflower County). Variable sized individuals observed during past survey efforts within the reach along with a fresh dead shell of juvenile suggests some level of recruitment, but there is uncertainty on the size of the Big Sunflower population (Butler 2002, Jones et al. 2019). No recent specimens have been reported from the Yazoo Study Area although archaeological material from along the periphery of the Yazoo Study Area indicates it once occurred within the region. The species has potential to be present in the area.

Other Species of Concern

The area is known to support various protected species under the Migratory Bird Treaty Act (MBTA) of 1918 (16 U.S.C. §§703-712) as amended. The MBTA, prohibits the direct and intentional take (including killing, capturing, selling, trading, and transport) of protected migratory bird species without prior authorization by the Department of Interior U.S. Fish and Wildlife Service (USFWS).

A search on the USFWS Environmental Conservation Online System identified 29 protected species that regularly use or occupy habitats within the Yazoo Study Area. These include, but are not limited to, various species of shorebirds, raptors, warblers, and other migrant species. See Table 2 in the Migratory Birds Appendix for a complete list and detailed description of each.

The bald eagle is protected under the Bald and Golden Eagle Protection Act (1962). Bald Eagles are a rare and unlikely breeder in the Yazoo Study Area, though as populations continue to expand nationally and regionally, future Bald Eagle nesting in or near the Yazoo Study Area is possible.

4.2.2.7 Aquatic Resources/Fisheries

Within the 926,000 acre Yazoo Study Area, abundant water sources provide habitat for aquatic organisms and fish. Aquatic resources in the Yazoo Study Area include rivers, oxbow lakes, scatters, brakes, sloughs, and tributary mouths as well as wetlands associated with bottomland hardwood forests which support approximately 32 species of fish in addition to three federally listed mussel species (e.g., Fat Pocketbook, Rabbitsfoot, and Sheepnose). Over the past century, land use change has altered the spatial distribution and extent of aquatic habitat within the Yazoo Basin creating the current mosaic of agricultural and forested areas adjacent to aquatic resources. Today, low dissolved oxygen levels, a lack of riparian buffers and associated accretion of sediment, and reduced flows which impede fish passage create an array of challenges for aquatic organisms in this habitat.

A lack or insufficiency of dissolved oxygen (< 2.0 mg L^{-1}) limits the utility of this habitat to both mobile and sessile organisms. Seasonal patterns of flood-induced hypoxia occur during the spring and early summer which likely impacts successful spawning and rearing regardless of reforestation efforts.

Additionally, a lack of riparian buffers on streams, rivers, and ditches in the Yazoo Study area enable erosion increasing turbidity, reduce shading thereby magnifying the amplitude of the thermal regime, and reduce habitat complexity available for various fish reproduction strategies.

Finally, due to increased water withdrawals and diversions in the Yazoo Study Area over the last century, low to no flow conditions are observed typically in the fall. Low flow conditions can desiccate mussel beds, prevent periodic fish passage flows over weirs for spawning movements and recolonization, and reduce hydraulic connectivity between the flowing waters and low-elevation backwaters or tributary mouths (see Aquatic Resources Appendix).

4.2.2.8 Water Quality

A detailed analysis of the water quality conditions observed in the Yazoo Study Area over the last several decades can be found in the Water Quality Appendix. The following is a summary of the information provided in the Water Quality Appendix.

Across the world as farmers have increased production to meet the increasing demand for food, water quality has declined. Most of the major river basins supporting agricultural production, especially those in the upper Midwest have suffered from degraded water quality conditions for many years due to agricultural runoff. To a lesser extent, the Mississippi Yazoo Basin has also experienced a decline in water quality conditions over the last six decades.

<u>Nutrients and Solids</u>

Most water bodies in the Yazoo Backwater Study Area have been designated for the propagation of fish and wildlife by the State of Mississippi. Many of these waters have been determined to be only partially supporting their designated use and were determined to be impaired when compared to existing water quality criteria. Impairments are generally due to sediment/siltation, nutrients, or organic enrichment/low dissolved oxygen.

The mean concentrations observed for nitrogen and phosphorous coming from the Yazoo Study Area fall far below the concentrations estimated from the Midwest Tributaries. This was detailed using the Mississippi and Atchafalaya River Basins (MARB) SPAtially Referenced Regression On Watershed (SPARROW) model. The Yazoo Study Area does not contribute a disproportionate load of nitrogen to the Gulf of Mexico and is generally in line with its proportionate contribution of phosphorus to the Gulf of Mexico hypoxic zone. The extensive erosion control measures employed by the USACE and its federal, state, and local sponsors have made significant strides to control the nutrient contributions from the Yazoo Basin to the Gulf of Mexico Hypoxic Zone.

The concentrations for total phosphorous (TP) observed in both the Steele Bayou and Little Sunflower Basins increased from the decade starting in 2000 to the following 2010 decade. However, the TP concentrations observed in the Lower Yazoo Basin at Long Lake were observed to be lower. The Long Lake location represents the most downstream point in the Yazoo River before it enters the Mississippi River. From this, one can assume that higher concentrations of TP observed in the upper Steele Bayou and Big Sunflower Basins were either reduced through in stream utilization, bound to sediment particles and removed from the system by virtue of deposition or diluted by downstream inflow.

Residual phosphorus that has been applied as a soil amendment that is not utilized in the uptake for plant growth is typically bound to the soil particles. Runoff during precipitation events, brings these soil particles and their attached phosphorus molecules to the stream where they slowly migrate downstream. A distinct positive relationship exists between the monthly averages of suspended solid concentrations and phosphorus concentrations in the Steele Bayou Basin. The concentration for the two constituents appears to decrease from an approximate average peak of 0.33 and 150.00 milligrams per liter (mg/L) for TP and total suspended solids (TSS), respectively in the winter when conditions are wet. The concentrations reach an approximate low during the dry summer months of 0.17 and 40.0 for TP and TSS, respectively. In the Big Sunflower Basin where agricultural activity is more prevalent, the concentrations for the two constituents appear to decrease at a greater rate from an approximate average peak of 0.47 and 400.00 mg/L for TP and TSS, respectively in the winter when conditions are wet. The concentrations Big Sunflower River reach an approximate low during the dry summer months of 0.17 and 50.0 for TP and TSS, respectively.

The total nitrogen (TN) concentrations in the Steele Bayou Basin follow a cyclical pattern similar to that observed for TP. The peak was observed to come during the spring months at a value of approximately 2.25 mg/L and then recede in the early fall to a value of approximately 1.00 mg/L. The annual trend over the last two decades of record for the Steele Bayou Basin shows an approximate high and low of 2.00 and 1.00 mg/L, respectively. The TN concentrations in the Big Sunflower Basin follow the same annual cyclical pattern as

previously mentioned with greater amplitudes of the high and low with approximate values of 4.00 and 1.25 mg/L, respectively. These high values can be attributed to the increase agricultural production found in the Big Sunflower Basin. The lower peak and valley value associated with the Dummy line Road input are attributed to values from the Little Sunflower River which receives runoff from a disproportionately smaller area invested in agriculture. The annual trend over the last two decades of record for the Big Sunflower Basin shows an approximate high and low of 2.50 and 2.00 mg/L, respectively. These values register far below the National Median Concentration published by USGS.

Through programs initiated by the MVK and other federal sponsors, the agricultural community in the Yazoo Study Area has been successful with implementing BMPs like land leveling, pads and pipes, buffer strips, surge valves, deficit irrigation techniques, vegetative buffer strips, and moisture meters, and drop pipe structures for routine farming practice. These measures act like sediment traps which help to reduce sediment runoff and nutrient contribution into the watershed. These water management BMPs, which also affect water quality, consequently, reduce the amount of bound phosphorous that can enter the aquatic system and eventually the Mississippi River. The aforementioned BMPs have been instrumental in slowing the rate of runoff and helping control the sediment and nutrient loading into the Yazoo Watershed. The data also show that an overall decrease in TSS has been observed in the Steele Bayou Basin. The concentrations were reduced by approximately by 50% from the early 1990s to the early 2000s from concentrations in excess of 200 mg/L to average concentrations of 100 mg/L. Similar reductions in TSS concentrations are expected from the construction of future erosion control structures built in the Big Sunflower Basin.

Dissolved Oxygen

Water quality data was collected by the MVK and USGS starting in the 1970s through 2016 from multiple stations in the Steele Bayou, Deer Creek, and Big Sunflower basins. Surface water conditions were assessed through laboratory analysis of monthly grab samples and measurements made with in-situ water quality sondes. The mean monthly surface water temperatures in the Yazoo Study Area reached or exceeded 20^{o} Celsius in the period of April through October. These warmer conditions have a significant impact on the maximum oxygen concentration that can be dissolved into a stream. The dissolved oxygen saturation concentration monitored in the Steele Bayou Basin (Main Canal, Black Bayou, Grace, Low Water Bridge) rarely reached 50% from April to November.

When warm weather is combined with conditions of minimal dissolved oxygen saturation, aquatic life typically suffers from long periods of low dissolved oxygen. The published EPA requirement, for minimal dissolved oxygen concentration of 5.0 mg/L for early life stages of fish, was not met in most years. Streams in the Steele Bayou Basin fell below these minimal dissolved oxygen concentrations during the period of April to November. Similar conditions were observed for streams in the Big Sunflower Basin which extended from April to October. These depleted dissolved oxygen conditions for over half of the year in the Yazoo Study Area impose a severe impact on the overall health of the aquatic ecosystem.

Depleted dissolved oxygen concentrations were observed during many of the recent Yazoo Study Area floods. During the backwater flood events of 2008 and 2009, a decrease in dissolved oxygen concentrations appeared to coincide with increased water levels corresponding to higher flood stages. During the latter half of the Yazoo Study Area flood event of 2015, dissolved oxygen concentrations decreased below 5.0 mg/L with depths below 7 and 10 feet at the upper, middle, and lower portions of the Steele Bayou and Big Sunflower Basins. During the Yazoo Study Area flood of 2019, hourly measurements were collected in a flooded wooded area adjacent to Steele Bayou, approximately 15 miles upstream of the Steele Bayou Structure. During the last half of the flood event, the dissolved oxygen concentrations were measured at 0.00 mg/L and remained below 0.20 mg/L until the end of June. These data further reiterate the depletion of dissolved oxygen in the Yazoo Study Area during extended flood events.

Turbidity

During the flood event of 2011, turbidity concentrations measured from the Steele Bayou Channel showed a decrease from over 150 to less than 10 nephelometric turbidity units as the flood event progressed. The backwater pooling effect provides optimal conditions for settling. This settling of solids from the water column over the first few weeks of the flood allowed for better light transmission and consequently increased primary productivity. The production of oxygen from an increase in phytoplankton activity, along with the diffusion of oxygen from the surface, increased dissolved oxygen concentrations in the surface layer during the latter weeks of the flood event. This phenomenon was observed at multiple stations in the Yazoo Basin.

The data show that turbidity is greatest during the first few weeks of a Yazoo Backwater flood. As the backwater pools grow deeper and sustain prolonged periods of stagnation, the suspended solids have an opportunity to settle out of the water column. This process makes way for increased light transmission through the surface layer and the increased production of phytoplankton. As a result, dissolved oxygen concentrations begin to recover within the first 5 to 10 feet from the surface. This turnaround typically comes too late to provide habitat for aquatic species because they have either left the region or died from the extended period of low dissolved oxygen.

Water Flow

The main tributaries of the Steele Bayou and Big Sunflower Basins have suffered from decreasing annual minimum flows over the last 50 years. An adequate volume of water in riverine systems is fundamental to maintaining healthy water quality parameters for aquatic life. The annual 5% minimum return flow observed in the Big Sunflower River at Sunflower, Mississippi from the 1930s was 170 cfs and has decreased to a low of 26 cfs for the 1990s. The flow representing the 5% duration for the 2000s was increased to approximately 50 cfs as a result of the flow augmentation implemented by Yazoo Mississippi Delta Join Water Management District in 1998.

The minimum flow of the Big Sunflower River at Sunflower was recorded to be around 200 cfs in the 1930s through the 1940s but diminished to just under 100 cfs over the next three decades. By the 1980s and 1990s, the minimum flow (one percent duration) had diminished to around 20 cfs, which is a 90% reduction from when it was first measured in the mid-1930s. The observed flow depletion is most severe during the fall months, which historically receive less rainfall. The summer flow duration profile is quite different. During the summer, the more recent periods showed increased flow instead of decreased flow. This increase is due to irrigation return flow.

Section 5
Environmental Impacts

This section describes the impacts of the alternatives on the same significant resources that were previously discussed in the "Affected Environment" section. The results of quantified and qualitative evaluations are presented that evaluate both beneficial and adverse effects to these resources. The same quantified environmental methodologies that are described in the "Affected Environment" section have been used to determine the environmental impacts of the alternatives.

5.1 HUMAN ENVIRONMENT

5.1.1 Socio-economics

Impacts to the socioeconomic resources would be considered significant if socioeconomic impacts resulted in a substantial shift in population trends or adversely affected regional spending and earning patterns.

No Action Alternative

With the no action alternative the current trends in the socioeconomic categories are expected to continue as the future without project presented in section 4.2.1.1.

Proposed Plan

The direct impacts to the socioeconomic resources are negligible, are primarily beneficial, and include flood risk reduction for agricultural activities. Indirect impacts include temporary, minor inconveniences from construction activities to those living near the project area. There would be negligible indirect impacts to the socioeconomic resources in the Yazoo Study Area.

5.1.2 Environmental Justice

No Action Alternative

The no action alternative would not provide flood risk reduction. Direct impacts to EJ communities include continued flood risk. Indirect impacts under the no action alterative include a higher potential for temporary displacement of minority and/or low-income populations because residents within the Yazoo Study Area would remain vulnerable to flooding and may be forced to relocate to areas with risk reduction features in place. The flooding affects public roads and bridges, residential and nonresidential structures, other infrastructure, environmental resources, and agricultural, forested, and timber management lands. As a result, flooding has caused undue hardships and economic losses to residents of the area due to flooding of homes, disruption of sanitation facilities, lines of communications, and transportation and subsistence fishing. This flooding constitutes a major problem to residents and is a detriment to economic development of the Yazoo Study Area.

Proposed Plan

The USACE concludes, consistent with Executive Order No.12898, 3 CFR 59-32, (2004), that the Proposed Plan as designed would benefit low-income and minority populations far more than it would cause harm. The vast majority of structures and homes would be better protected from flooding, there would be a discernible benefit to structures, automobiles and agricultural crops, and the negative effects of extended duration backwater flooding on aquatic resources, wildlife, and recreational resources would be dampened. The addition and placement of 34 supplemental low flow groundwater wells in the upper extent of the basin will allow maximum benefit to the affected aquatic systems compared to placement lower in the drainage near the Yazoo Study Area. In all, improvement of environmental flows would benefit a total of 9,321 acres of streams within the Yazoo Study Area. EJ communities can expect improved aquatic conditions and a higher likelihood of more opportunities for subsistence fishing and hunting once the 34 supplemental low flow groundwater wells are operational.

Direct impacts to EJ communities within the Yazoo Study Area are generally positive and include a lower risk of flooding to: structures and automobiles, roads and agricultural crops, and improvements in subsistence fishing and hunting. Three positive, direct impacts to EJ communities, from the Proposed Plan condition, are presented in detail in the EJ Appendix and include: 1) reduction in flood risk to structures and automobiles, 2) reduction in flood risk to agricultural crops, and 3) improvement in subsistence fishing and hunting opportunities.

Indirect impacts to EJ communities may occur resulting from construction activities associated with installation of the pumps and other associated improvements of the Proposed Plan. EJ population groups residing or working near the construction site itself may experience minor, adverse indirect impacts due to the added traffic congestion and construction noise and dust. Truck traffic and noise along roads, highways and streets during project construction would cease following completion of construction activities. There may also be a degradation of the transportation infrastructure, primarily local roads and highways, as a result of the wear and tear from transporting construction materials. Indirect impacts related to construction activities are expected to be short-term and minor. BMPs will be utilized to avoid, reduce, and contain temporary impacts to human health and safety.

Positive cumulative impacts to minority and/or low-income populations, including lower flood risk, are expected to occur as a result of the pumps. If these projects and other federal, state and local projects encourage regional economic growth, any additional jobs created may benefit minority and/or low-income groups living within the study/proposed project area.

5.1.3 Prime and Unique Farmland

No Action Alternative

Without implementation of the Proposed Plan, no direct, indirect, or cumulative impacts to prime and unique farmland would occur.

Proposed Plan

Approximately 336 acres of land would be directly converted for construction and operation of the Proposed Plan and approximately 64,827 acres would be indirectly converted. The NRCS returned the Form AD 1006 after completing their portion of the form which identified and quantified the prime and unique farmland within the Yazoo Study Area assessment of 88 points. The MVK compiled their portion of the form and concluded that the total site assessment was 118 points (see the Prime and Unique Farmland Appendix).

Based on NRCS guidance, if the value of total assessment points is equal to or exceeds 160 points, consideration of alternative actions, as appropriate, that could reduce adverse impacts is required. The Proposed Plan has been previously evaluated with an array of alternatives. The Proposed Plan was selected as the alternative which maximizes net benefits, both economically and environmentally. Based on this evaluation, it was determined that the Proposed Plan is exempt from the addition rules and regulations of the FPPA. Therefore, the Proposed Plan is not anticipated to have any significant direct or indirect impacts on prime and unique farmland, therefore the direct and indirect impacts are considered negligible.

Since the direct and indirect impacts are considered negligible, prime and unique farmland impacts associated with the implementation of the Proposed Plan are not deemed cumulatively considerable. Therefore, no cumulative impacts on prime and unique farmland are anticipated as a result of the implementation of the Proposed Plan.

The project will achieve Section 106 compliance through the development of a programmatic agreement with the interested Tribes and SHPO.

5.1.4 Cultural Resources

No Action Alternative

Data pertaining to cultural resources identified within the Yazoo Study Area as well as within and adjacent to the proposed borrow area, pump, and supplemental low flow groundwater well locations was incorporated into a GIS platform in order to analyze the spatial distribution of cultural resources against plotted flood coverage models across 1-, 2-, 5-, 10-, 20, 50-, and 100-year intervals for existing conditions and with project conditions. For the purposes of this analysis, the no action alternative equals the “Without,” while the Proposed Plan equals the “With” (Tables 4.7 and 4.8). Below are brief discussions of the varying impacts the alternatives poses to cultural resources based upon direct, indirect, and cumulative effects.

Direct Impacts. Direct impacts refer to the causation of the effect to a particular resource (King 2013). In the case of the no action alternative, there is an expected increase in the number of cultural resources directly or physically impacted by ever-growing flooding events. As the amount of acreage increases between each of the named flood intervals, there is a corresponding increase in the number of cultural resources impacted, for the purposes of this study meaning a presence/absence of flood waters. Generally speaking the numbers are virtually identical between the 1- and 2-year flood events, with a slight increase in the total number of cultural resources impacted by flooding noted between the 2-and 5-year intervals, the exceptions being in Issaquena and Warren counties (west/southwestern quarter of the

Yazoo Study Area adjacent the Mississippi River and its confluence with the Yazoo River), where the numbers nearly doubled in size (Tables 4.7 and 4.8). A similar increase in the overall numbers was also observed between the 5-and 10-year intervals, with the largest increases observed in Sharkey and Yazoo counties (the south/southeastern quarters of the Yazoo Study Area adjacent the Yazoo River). There were no differences observed between the 10-, 20-, 50-, and 100-year intervals; all are unchanged over these intervals, which suggests that the 10-year flood frequency represents the maximum extent of cultural resources impacted by flooding within the Yazoo Study Area.

Physical impacts from flooding are numerous and impact cultural resources to varying degrees depending on the type of resource. For archaeological sites, this includes but is not limited to the following: direct physical damage from floating materials; destruction/loss of artifacts during flooding; soil destabilization/ shifting (ground heave, landslide, etc.); damage to unexcavated artifacts and site integrity from direct force of water; and erosion to site deposits from overflow and development of new flood channels over the site surface. Impacts to historic properties include but are not limited to the following: structural collapse from moving force of floodwaters particularly during flash floods; sewage backup and overflow leading to saturation, and related flooding contamination and damage; walls “implode” from hydrostatic force of standing water; and damage to utilities, generators and electrical systems (Morgan et al. 2016).

Indirect Impacts. Post-flood impacts have the potential to result in impacts to cultural resources beyond the direct effects of flooding and the movement of water. All types of cultural resource would be subject to damage inflicted from post-flood clean up and construction needed to access and remove flood debris directly from or adjacent to a resource area. For archaeological sites, there is the further post-flood potential for displacement and relocation of archaeological materials/deposits to areas previously devoid of sites or to site areas (previously identified and unidentified), resulting in the mixing of archaeological deposits; either scenario ultimately results in the loss of integrity or a misrepresentation of the cultural history of a given area, both of which affect research potential. For historic properties, these post-flood impacts could also include the following: increased risk of rot, fungal/insect attack, mold and mildew from prolonged exposure to standing water; swelling/distortion of wooden building materials and architecture features; spalling, weathering of wood, brick, and stone materials during drying; and corrosion of external masonry and metal architectural elements/features (Morgan et al. 2016).

Cumulative Impacts. The regulations of the Council on Environmental Quality (CEQ), governing implementation of the procedural provisions of the NEPA, direct agencies preparing environmental assessments to consider whether the action they’re reviewing is related to other actions with … cumulatively significant impact. (40 Code of Federal Regulations (CFR) 1508.27(b)(7)). Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (40 CFR 1508.7). The cumulative impacts of post-flood impacts to cultural resources are difficult to assess and consider; however, there are long-term impacts that can be foreseen and most therefore be discussed.

Flood waters, especially combined with torrential rain, can have catastrophic effects on buildings, infrastructure, businesses and families. The moisture and humidity left behind is exceptionally high when water has seeped into every corner and hidden space of historic properties, and every material present has effectively acted like a sponge. Exposure to more frequent and more prolonged high relative humidity from moisture-heavy environments results in the following: changes in soil chemistry due to root penetration of new vegetation at archaeological sites; change in vegetation patterns, with the increase/spread of invasive, non-native species; increased resource vulnerability or susceptibility to damage from burrowing animals; site disruption from longer growing seasons and/or changing land use (irrigation use, harvest times); changes in resource or regional accessibility; reductions or alterations in length and timing of research/field seasons,; and possible reductions in resource visibility. The entirety of the cultural landscape has the potential to be impacted long-term, which could include: loss of synchronicity between local species; altered landscapes due to shifts in blooming times; loss of pollinators reducing plant fertility in historic agricultural landscape (Morgan et al. 2016).

Furthermore, as precipitation rates increase and extensive flooding becomes more frequent and pervasive, there are long-terms, cumulative impacts to cultural resources. Some include the following: increased pressure to relocate or elevate structures, and/or surrounding structures (may also be pre-flood)' wash out or damage to roads, trails, and landscape features leading to and servicing cultural resources, namely National Historic Landmarks and Mississippi Landmarks, leading to additional long-term maintenance needs and corporation with state and federal transportation agencies; decline/disappearance of important vegetation species, other species favored; and loss of cultural landscape features.

Proposed Plan

Data pertaining to cultural resources identified within the Yazoo Study Area as well as within and adjacent to the proposed borrow area, pump, and supplemental low flow relief well locations was incorporated into a GIS platform in order to analyze the spatial distribution of cultural resources against plotted flood coverage models across 1-, 2-, 5-, 10-, 20, 50-, and 100-year intervals for existing conditions and expected conditions if the Proposed Plan was in-place/operational. For the purposes of this analysis, the no action alternative equals the "Without," while the Proposed Plan equals the "With" (Tables 4.7 and 4.8). Below are brief discussions of the varying impacts the alternatives poses to cultural resources based upon direct, indirect, and cumulative effects.

Direct Impacts. In the case of the Proposed Plan, analysis involved comparisons between differing flood coverage projections between the two alternatives but discussion of impacts to the proposed borrow area, pump, and supplemental low flow groundwater well locations as well. Beginning with analysis of the flood modeling, the general trend noted and discussed previously with the no action alternative is noted here, with increasing numbers of cultural resources impacted by the "bigger" flood events. As noted previously, the numbers are virtually identical between the 1- and 2-year flood events, with a slight increase in the total number of cultural resources impacted by flooding noted between the 2- and 5-year intervals, the exception again being in Issaquena County (west/southwestern quarter of the Yazoo

Study Area adjacent the Mississippi River), where the numbers nearly doubled in size (Tables 4.7 and 4.8). Moderate increased are noted in the overall numbers between the 5- and 10-year intervals, with the largest increases observed in Sharkey and Washington counties (the south/southeastern and northwestern quarters, respectively, of the Yazoo Study Area adjacent the Mississippi River and the confluence of the Mississippi and Yazoo rivers). In contrast to observations noted with the no action alternative analysis, there were slight decreases in the number of cultural resources impacted by flood waters between the 10- and 20-year flood intervals in Issaquena, Washington, and Yazoo Counties.

There were no differences observed between the 20-, 50-, and 100-year intervals; all are unchanged over these intervals, which suggests that the 20-year flood frequency represents the maximum extent of cultural resources impacted by flooding within the study area for the Proposed Plan. This implies that the Proposed Plan results in reduced flood impacts in both coverage, or extent, and frequency. Furthermore, there are slight reductions in the number of cultural resources impacted by flood waters at these same flood intervals as well, with the most dramatic difference noted in Yazoo County, where the reduction in the number of cultural resources impacted by flood waters at the 100-year food interval associated with the Proposed Plan is nearly half number impacted by flood waters during this same interval associated with the no action alternative (Tables 4.7 and 4.8).

The physical impacts from flooding remain regardless of intensity or frequency for all cultural resources and involve physical damage to the resource and its immediate vicinity that often result in compromised integrity and loss of significant elements/characteristics (see no action alternative direct impacts discussion and Morgan et al. 2016). However, considerations must be taken to account for the direct impacts associated with the installation and construction of the pump and supplemental low flow groundwater wells and utilization of the borrow area. As stated previously, a literature and records review of data pertaining to cultural resources identified within and adjacent to the proposed borrow area, pump, and supplemental low flow groundwater well locations resulted in the identification of 179 cultural resources. None were noted within the proposed footprints or ROW of these features locations or their planned access routes/corridors (Tables 4.4 and 4.6).

The pump station is proposed as a means to reduce flooding in the Yazoo Study Area when the Mississippi River is high without draining the entire region. As such, the pump is designed to operate when water levels rise outside the levee system on the Mississippi River side. When the water level within the Yazoo Study Area is higher that outside due to excessive rain, the pump is off and existing relief measures would be enacted. When the above scenario occurs (waters outside the Yazoo Study Area [Mississippi River side] are higher than levels within the Yazoo Study Area, the pump would operate only when those levels reach a height of 87.0 feet, NGVD, at the Steel Bayou water control structure. While there were several Register-eligible and significant cultural resources within this 1.6 kilometer (1 mile) search radius, none were located within 300 meter (984 feet [0.19 miles]) of the above listed locations. Intensive cultural resource survey will be conducted over these locations and their Area of Potential Effect to identify all cultural resources. Survey methods will include remote-sensing technologies; e.g., satellite and low aerial imagery, as well as conventional ground-truthing

methods; e.g., surface reconnaissance, systematic and judgmental shovel testing and dry-screening, soil coring, etc.

Indirect Impacts. Post-flood impacts remain a source of serious damage to cultural resources despite the reduction in coverage and intensity of the episodic flooding resulting from the Proposed Plan (see no action alternative indirect impacts discussion and Morgan et al. 2016). Additional consideration must be taken for the long-term operation, maintenance, and access of these work areas as well as impacts resulting from repair, replacement, relocation, or expansion activities, activities that extend well into the foreseeable future. Other indirect impact considerations include short-term effects associated with construction activities, including ground disturbance required to construct the various project components such as access roads, utility installation. Construction activities could create noise and vibration that would affect archaeological resources and stockpiling construction materials and equipment could cause short term visual effects.

Following completion of the Section 106 process, should any cultural resources be discovered during implementation of the proposed undertaking, work shall cease in that area until an archeologist can assess the situation and initiate proper consultation under provisions outlined under Section 106 of the National Historic Preservation Act of 1966, as amended (16 U.S. Code 470). Efforts will be taken to either preserve the significant resources in place or mitigate appropriately for any adverse effects created by the undertaking.

Cumulative Impacts. The regulations of the CEQ, governing implementation of the procedural provisions of the NEPA, direct agencies preparing environmental assessments to consider whether the action they're reviewing is related to other actions with … cumulatively significant impact. (40 CFR 1508.27(b)(7)). Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (40 CFR 1508.7). The cumulative impacts of post-flood impacts to cultural resources are difficult to assess and consider; however, there are long-term impacts that can be foreseen and most therefore be discussed.

Aside from those considerations raised earlier (see no action alternative cumulative impacts discussion and Morgan et al. 2016), additional consideration are examined with reference to the use of conservation easements, designed to convert existing agricultural area that are the subject of the most frequent and longest-duration food events to forested areas. This program targets cleared/agricultural lands at or below the 87.0 feet, NGVD (approximately 2,700 acres [1,092.7 hectares]). In doing so, there is environmental gain through the improvement of water quality.

Currently, there are eight archaeological sites and no historic properties that exist at or below this elevation threshold; five are located in Issaquena County, and one each in Sharkey, Washington, and Yazoo counties. Of these resources, three are linear features (cut-off canal, lock and dam, and historic bridge and roadway), two are mound complexes, two are surface scatters of historic debris, and one is a shell midden. The three linear features are still in active use and are managed by Issaquena County (historic bridge and roadway), USACE (lock and dam), and the USFS (cut-off canal). The three linear resources currently serve as

water crossings or water control structures located settings that by design are not eligible for conservation easements, while the remaining five are located within existing managed forested areas representing lands under federal control (USFS) or private control (timber harvesting company).

5.1.5 Recreation Resources

For the recreation resource assessment, consideration was given to wetlands resources, terrestrial resources, wildlife resources, waterfowl resources, aquatic resources, and respective appendices located within this report. These resources directly inform consumptive recreation resources within the Yazoo Study Area.

No Action Alternative

Under the No Action Alternative, unique public recreation areas within the Yazoo Study Area would continue to face multiple habitat stressors due to seasonal low flows and seasonal inundation with prolonged duration, depth, and extent. Access to unique public recreation areas would continue to be dependent upon erratic hydrology with seasonal closures (see Recreation Appendix, Figures F-3.4 through F-3.17).

Proposed Plan

The Proposed Plan would cause some direct impacts to recreation associated with the construction and operation of the well YBP-BP-LB-19 at Charlie Capps Wildlife Management Area (WMA). Approximately 0.75 acres would be cleared for the well ROW which is near the WMA headquarters and part of a No Hunting area of the WMA. However, with the relatively small footprint of the well, these impacts are anticipated to be short term in nature as benefits of freshwater flow into adjacent Lane Bayou and connected water bodies would accrue (see Recreation Appendix, Figure F-3.8).

Additionally, indirect impacts associated with changing hydrology due to operations under the Proposed Plan would impact some public recreation areas. However, impacts would vary over the short- and long-term with differential effects between recreation areas. While impacts for identified recreation areas would be moderate in the short-term, indirect impacts to recreation areas are anticipated to be negligible over the long-term (see Recreation Appendix, Figures F-3.4 through F-3.17).

Finally, cumulative impacts associated with construction and operation of the Proposed Plan are anticipated to be negligible and may even yield positive effects on recreation over the life of the project. Prevention of prolonged duration inundation events would reduce periods of extreme habitat reduction due to flooding. Seasonal access to unique public recreation areas would continue to be dependent upon hydrology, however operations under the Proposed Plan could help alleviate some erratic hydrology.

5.1.6 Aesthetics (Visual)

No Action Alternative

The forecasting of what the Yazoo Study Area's visual landscape will look like in the future is determined by:

1. Physical and ecological changes (e.g., land use or vegetative succession).
2. Identifying trends in recreation and land use.
3. Reviewing government agencies' planning documents.

The extent of effort involved for forecasting the Yazoo Study Areas' visual landscape's future is limited by time and the availability of relevant information. Additionally, physical and ecological changes combined with trends in recreation and land use may be found elsewhere is this document. Therefore, the focus of this section is on identifying relevant study area planning documents containing information specific to desired visual resources' conditions; these include:

- The National Forests in Mississippi, Land and Resource Management Plan (https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fseprd561872.pdf).
- The Mississippi Delta Great River Road Scenic Byway Corridor Management Plan (https://mdot.ms.gov/portal/scenic_byways_details).
- The Lower Mississippi Historic Scenic Byway Corridor Management Plan (https://mdot.ms.gov/portal/scenic_byways_details).

Desired scenic conditions for the Delta National Forest include: scenery (that) is natural appearing and generally consist(ing) of a mix of closed-canopy forest and park-like, semi-open woodlands, except in young regeneration areas, bogs, prairies, and wildlife openings. Signature landscapes that are unique to Mississippi national forests, such as . . . bottomland hardwoods . . . found throughout the National Forests in Mississippi. Rare showcase plant communities . . . (that) provide opportunities for nature study, wildflower viewing, and photography. Primitive and semi-primitive settings (that) provide visitors with a feeling of solitude and challenge. Facilities and constructed improvements that are visually appealing and blend into the surrounding environment.

Desired conditions for the Mississippi Delta Great River Road and Lower Mississippi Historic Scenic Byways focuses on maintaining the intrinsic scenic, natural, historic, cultural and recreational qualities; this includes the signage necessary to highlight the sights along the route.

Future unimpeded vehicular access into the Yazoo Study Areas' visual landscape is undetermined. A detailed transportation analysis is not available nor was it a part of this study. Additionally, there are no known plans for elevating the Yazoo Study Area's flood prone roads. Therefore significant roadways providing primary vehicular access into the Yazoo Study Area's visual landscape including Highways' 61, 1, and 16 will continue to be impassable at times for various durations due to flooding.

Proposed Plan

Impacts to significant visual resources caused by physical and ecological changes combined with changes to recreation, cultural and land use resources can be found elsewhere is this document.

Significant roadways providing primary vehicular access into the Yazoo Study Area's visual landscape include Highways' 61, 1, and 16. Highway 61 and parts of Highway 1 are designated the Mississippi Delta Great River Road and Lower Mississippi Historic Scenic Byways. Highway 16 provides vehicular access to primary recreation features in the Delta National Forest. Historically, parts of these roads are impassable due to flooding at various times for various durations. Future unimpeded vehicular access into the Yazoo Study Areas' visual landscape is undetermined. A detailed transportation analysis is not available nor was it a part of this study. Additionally, there are no known plans for elevating the Yazoo Study Area's flood prone roads. Therefore significant roadways providing primary vehicular access into the Yazoo Study Area's visual landscape including Highways' 61, 1, and 16 will continue to be impassable at times for various durations due to flooding.

5.1.7 Noise

No Action Alternative

Without implementation of the Proposed Plan, no direct, indirect, or cumulative impacts to noise would occur.

Proposed Plan

Implementation of the Proposed Plan will have impacts on noise. Direct impacts on noise will result from the construction and operation of the pump station, borrow area, and supplemental low flow groundwater wells, and reforestation feature activities. Increased noise levels are expected during the construction, operation, and reforestation activities. Noise producing activities would occur intermittently and vary depending on the type, number, and duration of equipment used and nature or phase of construction, operation, or reforestation activities. Table 5.1 shows typical noise levels, according to the U.S. Department of Transportation, Construction Noise Handbook (https://www.nrc.gov/docs/ML1805/ML18059A141.pdf), produced by various types of construction equipment that are anticipated for use with implementation of the Proposed Plan.

The pump station, borrow area, and supplemental low flow groundwater wells right-of-ways are not adjacent to or within the near vicinity of any highly populated areas. The nearest residence appears to be approximately 100 feet from one of the supplemental low flow groundwater wells. Reforestation activities are not anticipated to be adjacent to or within the near vicinity of highly populated areas. These direct impacts on noise will be short-term and will subside upon completion of construction and reforestation activities and when the pump and supplemental low flow groundwater wells are not being operated. Noise levels associated with the construction and operation activities will occur but are not anticipated to be significantly different from the current noise associated with the common working environment

currently existing in the Yazoo Study Area. No long-term or permanent impacts on noise are anticipated. Therefore, direct impacts on noise are considered short-term and negligible.

Indirect impacts on noise will result from the removal of trees and vegetation for the construction of the pump station, borrow area, and supplemental low flow groundwater wells and the operation of the pump and supplemental low flow groundwater wells. Trees and vegetation act as a noise attenuating barrier and as a practical method to reduce noise in rural environments. These indirect impacts on noise will be long-term, however there sufficient trees and vegetation surround the pump station, borrow area, and supplemental low flow groundwater wells right-of-ways to continue to act as a noise barrier and a practical method to reduce noise within the Yazoo Study Area. Therefore, indirect impacts on noise are considered long-term but negligible.

Since the direct and indirect impacts are considered negligible, noise impacts associated with the implementation of the Proposed Plan are not deemed cumulatively considerable. Therefore, no cumulative impacts on noise are anticipated as a result of the implementation of the Proposed Plan.

5.1.8 Air Quality

No Action Alternative

Without implementation of the Proposed Plan, no impacts to air quality would occur.

Proposed Plan

Direct affects to air pollution would be adversely impacted in the short term at the construction site due to emissions from ICEs and the increase in dust due to vehicular traffic, as well as any exhaust generated by the pumps in the proposed project. Indirectly, the nonstructural features would improve the air quality in the area due to the removal of up to 2,700 acres of agricultural land from production. Farming practices within the Yazoo Study Area would cease and thus, dust and heavy exhaust from ICEs would no longer be generated.

During construction, the MVK would require as part of the contract that the contractor control the fugitive dust. The borrow/disposal areas would be used to contain any sediment removed during maintenance dredging of the inlet channel to the pump station. Once the disposal area becomes unwatered, it would be seeded with native grasses to control dust emissions. The original diesel pumps have been rejected to favor natural gas or electric motors in order to decrease the long-term impacts on emissions.

Implementation of the Proposed Plan would not interfere with the region's ability to maintain compliance with National Ambient Air Quality Standards for attainment area pollutants and would not interfere with the ability to achieve compliance for pollutants that contribute to ozone nonattainment.

Adverse impacts to air quality associated with construction would be minor and short in duration. Overtime, this project would have a positive effect on the air quality in the proposed

location. Therefore, significant cumulative adverse impacts are not anticipated from activities associated with the Proposed Plan when considered with past, present, or reasonably foreseeable future actions.

5.1.9 Hazardous, Toxic, and Radioactive Waste

No Action Alternative

Without implementation of the Proposed Plan, no direct, indirect, or cumulative impacts to HTRW would occur.

Proposed Plan

During the preliminary, onsite HTRW assessment (see HTRW Appendix), several items were found which will warrant further attention during the preconstruction engineering and design phase:

- It is recommended that the irregularly shaped object containing used 5-gallon buckets of oil observed in the northeast quadrant of the borrow area be removed and disposed of at an approved disposal facility before construction would commence. The object appeared to have floated into the observed location from the Steele Bayou channel during a high-water event. No signs of petroleum products were observed in the surrounding vegetation or on the ground.
- It is recommended that the large quantity of used tires observed along the left descending bank of the auxiliary channel be removed and disposed of at an approved disposal facility before construction of the inlet channel would commence.
- It is recommended that the wooded area delineated in the southeast corner of the pumping station ROW (approximately 2 acres) be excised from the ROW limits of construction in an effort to avoid the dilapidated barn site where a large cylindrical tank, a rusted truck frame, and multiple rusted farm implements were observed.
- It is recommended that the site footprint of the supplemental low flow groundwater well site labeled YBP-BB-HB-34 (Horseshoe Bayou), be moved toward the east a few hundred feet along top bank in the agricultural field to avoid impacts to the existing underground gas pipeline utility.

None of the facilities identified in the online federal and state environmental databases buffer zones are believed to pose a significant risk to the construction of the project's structural features.

Based on the results of the preliminary, onsite HTRW assessment and the online federal and state record search, the probability of HTRW direct or indirect impacts occurring during construction of the project's structural features is low.

Ongoing and future regional projects would likely contribute to cumulative beneficial impacts on HTRW, since many projects in the area, which include ecosystem restoration and infrastructure improvements, would identify, evaluate, and potentially remediate existing HTRW issues.

When the final SEIS I is completed, Record of Decision signed, and funding allocated, then a final, full Phase I ESA would be executed on the project features prior to construction. The final, full Phase I ESA would include any identified easement properties prior to any real estate transaction.

5.2 NATURAL ENVIRONMENT

5.2.1 Hydraulics and Hydrology

No Action Alternative

When the Little Sunflower River and Steele Bayou water control structures are closed because of high stages on the Mississippi River, flooding or the threat of flooding, from ponding of interior drainage is the principal problem in the Yazoo Study Area. Major problems that have resulted from frequent flooding include flood damages to agricultural crops, rural residential property, timber management, and public roads and bridges. Major floods have caused hardships and economic losses to residents of the area due to flooding of residential and nonresidential structures, disruption of sanitation facilities, lines of communications, and transportation. Without additional project construction in the Yazoo Backwater Area, future hydrologic conditions are not expected to change and significant periodic flood damages will continue. With the reforestation of agricultural lands under the Conservation Reserve Program (CRP) and Wetland Reserve Program (WRP), water quality could improve as well as a reduction in the amount of sediment carried into streams.

Proposed Plan

The structural feature has a 14,000 cfs pump station, with a pumping elevation of 87.0 feet, NGVD. There were six gages in the project area that were used to analyze the impacts of this project. Table 5.2 shows the reductions in the water surface elevations at those six gages for the seven flood frequency events. The reductions in stages vary significantly as you move upstream from the Steele Bayou LS gage. Little Callao (78.2 miles upstream) is the most upstream gage and it shows a maximum reduction of 0.1 feet. The next gage downstream, Anguilla (55.4 miles upstream), shows reductions ranging from 0.1 feet to 0.5 feet. The most downstream of the three gage locations on the Big Sunflower River, Holly Bluff (34.7 miles upstream), shows reductions in stage, which are about half of the reductions observed at Steele Bayou. The two most downstream gages receive the most benefit of the pump, with stage reductions of approximately three feet. Table 5.3 shows the changes in the areal extent of the seven flood frequency events, the overall change in flooded acres, and the percent reduction of the flooded area due to the pump. The percent reduction of flooded area is much less than was shown in the 1982 and other reports. The main reason for this reduction in apparent benefits is the use of all six gages in the analysis. A backwater flood produces a flat pool. The pool will have some slope during the various headwater events which bring flood waters downstream to the pool. Table 5.4 shows the area flooded with and without the pump, the reductions in the flooded area, and the percent reduction of the flooded area, but it uses a flat backwater pool as was done in the 1982 report. The use of a sloped water surface masks the benefits of the pump by flooding headwater areas that are only flooded by

headwater events. As can be seen by the lack of changes in the elevations at the headwater gages, the pump will have little effect at the more upstream areas of the project area. Based on Table 5.4, the project will reduce flooded acres by approximately 35 percent, and add protection to up to 140,000 acres.

The structural feature provides considerable flood damage reduction benefits to both the agricultural lands and residential and nonresidential structures. However, as the pump-on elevation rises, the flood damage reduction benefits are reduced, and fewer acres are protected by the structural feature.

5.2.2 Wetlands

No Action Alternative

Under the no action alternative, no direct, indirect, or cumulative impacts to wetlands would occur.

Proposed Plan

The Proposed Plan would cause direct impacts to wetlands. A total of 84 acres of jurisdictional wetlands were identified by the MVK within the direct impact area; 61 acres associated with the pump station and surrounding infrastructure, including 59 acres of forested wetlands and two acres of agricultural wetlands. The proposed borrow area contained 23 acres of agricultural wetlands. Implementation of the Proposed Plan would result in a direct impact decrease of 444 AAFCUs (Average Annual Functional Capacity Units), requiring 93 acres of mitigation.

Indirect impacts to wetlands are associated with changes in flood duration levels under the Proposed Plan; these impacts will result in a loss of 11,054 AAFCUs. The impacts, both direct and indirect cumulatively, require establishment of 2,405 acres of reforested compensatory mitigation lands. As a nonstructural component of the Proposed Plan, 2,700 acres of agricultural lands will be reforested which will generate an additional 10,667 AAFCUs over the period of analysis. The nonstructural component will provide substantial environmental benefits but were not included in the calculation of the 2,405 acre compensatory mitigation effort. Recent research in the Yazoo Basin validates the efficacy of reforestation for recovery and enhancement of wetland functions through time (Berkowitz 2019).

When combined, the compensatory mitigation and reforested areas included in the nonstructural component will result in a net 2.1% increase in wetland functions in the Yazoo Basin under the Action Alternative (Proposed Plan). Thus, cumulative impacts of the Proposed Plan will be negligible and perhaps positive over the long-term life of the project.

For more details on wetlands, see the Wetlands Appendix.

5.2.3 Terrestrial

No Action Alternative

The no action alternative results in no direct, indirect, or cumulative impacts to terrestrial resources.

Proposed Plan

The Proposed Plan will impact terrestrial resources. As a result of construction of the Proposed Plan, 267.6 Habitat Units (HUs) would be lost in direct impacts requiring up to 199.5 acres of reforestation (range from 97.5 to 199.5). Carolina Chickadee, Barred Owl, and Gray Squirrel would be most affected by the direct impacts of construction activities associated with the Proposed Plan, while Wood Duck and Mink would experience moderate impacts, and Pileated Woodpecker experiencing low impacts. However, these impacts are anticipated to be relatively short term in nature as benefits begin to accrue on reforested mitigation lands.

Indirect impacts will result from changes in inundation frequencies in the Yazoo Study Area affecting a single species, the Wood Duck. When considering indirect impacts on habitat inundated < 12 inches in depth, the HEP model calculated an additional 984.6 HUs would be lost in Wood Duck brood-rearing habitat as averaged across the entire POR; this loss would require 1570 acres of compensatory mitigation. Indirect impacts associated with changes in hydrology are not anticipated to affect Mink, Carolina Chickadee, Barred Owl, Pileated Woodpecker, or Gray Squirrel.

While there will be some direct and indirect impacts to each species considered, significant cumulative impacts to terrestrial resources are not anticipated as a result of the Proposed Plan.

5.2.4 Wildlife

No Action Alternative

Under the no action alternative, wildlife would continue to grapple with erratic hydrology within the Yazoo Study Area. While some years may be dry with reduced volume and extent of habitat, other years may bring prolonged duration, depth, and extent of inundated areas presenting a host of multiplicative stressors. As such, with the no action alternative there are no direct, indirect, or cumulative impacts occurring due to the Proposed Plan; yet, with no action, these stressors will continue to impact the wildlife species inhabiting the Yazoo Study Area.

Proposed Plan

There will be some direct impact on wildlife associated with the construction of the pump station associated with the Proposed Plan. Removal of habitats in lieu of the pump station and borrow area will reduce habitat availability for both terrestrial and aquatic species (see Terrestrial and Aquatic Resources Appendices); however, as the footprint of the direct impacts is relatively small and mitigation compensating for long-term impacts, direct impacts of the Proposed Plan are anticipated to be negligible.

Additionally, indirect impacts associated with changing hydrology due to operations under the Proposed Plan will impact some wildlife species. However, impacts will vary over the short- and long-term with differential effects between species (see Aquatic Resources, Terrestrial, Migratory Birds, and Waterfowl appendices). While impacts for select species will be moderate in the short-term, indirect impacts to wildlife are considered negligible over the long-term.

Cumulative impacts associated with construction and operation of the Proposed Plan are anticipated to be negligible and may even yield positive effects on wildlife over the life of the project. Prevention of prolonged duration inundation events would reduce periods of extreme habitat reduction due to flooding and associated density-dependent resource reductions for both aquatic and terrestrial organisms (i.e., shade, food, normoxic water). Furthermore, predation associated with flooding induced concentration of wildlife populations may also be avoided. Finally, implementation of reforested mitigation lands in addition to alternative mitigation measures are anticipated to more than offset the habitat reduction associated with hydrologic change due to operations under the Proposed Plan.

5.2.5 Waterfowl

No Action Alternative

The Yazoo Study Area currently provides an average of 10,858,339 duck use days (DUDs) each year during the winter waterfowl period. With no changes implemented, the no action alternative results in no direct, indirect, or cumulative impacts to waterfowl.

Proposed Plan

Construction of the Proposed Plan would not directly impact waterfowl due to pump station location and indirect impacts would be minimal since very little pumping is performed during the waterfowl season.

The Proposed Plan is expected to indirectly impact waterfowl by altering hydrology and flooded acreage suitable for wintering waterfowl foraging (flooded 18 inches in depth or less) resulting in a reduction of between 85-1,030 acres depending on the month during the winter season with forested habitats being most affected. DUD calculations for the Yazoo Basin, Yazoo Backwater, Mississippi, Project estimate the Proposed Plan would provide 9,509,111 DUDs during the winter waterfowl period each year. A reduction in flooded area will result from operation of the Proposed Plan with a reduction, on average, of 1,349,228 DUDs each year (see Waterfowl Appendix). To address these losses, mitigation calculations were based on restoring existing cropland to bottomland hardwood forest consisting of at least 50% Red Oak or developing moist soil management units (i.e. Grassland/Seasonal Herbaceous Wetland (SHM -passively unmanaged)). Conversion of soybean fields to bottomland hardwood forest requires 925.5 acres of compensatory mitigation to address indirect impacts over a 50-year project life. Conversely, conversion of soybean fields to SHM-passively unmanaged moist soil management unites requires 568.5 acres of compensatory mitigation to address indirect impacts of the Proposed Plan over the 50-year project life. Though there

are some indirect impacts to waterfowl as a result of the Proposed Plan, losses are relatively small when compared to the available habitat within the Yazoo Study Area (3.4 to 18.3% loss dependent on month during the winter season). Thus, indirect impacts are considered minimal.

As direct impacts are absent and indirect impacts are minimal, waterfowl impacts associated with the implementation of the Proposed Plan are not deemed cumulatively considerable. Therefore, no cumulative impacts on waterfowl are anticipated as a result of the implementation of the Proposed Plan.

5.2.6 Threatened and Endangered Species

The following analysis does not include impacts to the pondberry. An effects determination cannot be made at this time due to limited data availability, however no pondberry is known to occur within the direct footprint of the pump station, borrow area, or supplemental low flow groundwater well field ROWs. Coordination on this species is ongoing and will be included in the final EIS.

No Action Alternative

With the no action alternative, construction and operation of the pump station and reforestation of up to 2,700 acres of bottomland hardwood forest would not take place. Therefore, the impacts associated with the Proposed Plan would not occur and neither would the compensatory mitigation. Any threatened, endangered, and/or other species of concern that might potentially be present in the Yazoo Study Area would not experience direct, indirect, or cumulative impacts associated with the Proposed Plan. The Yazoo Study Area would continue to flood at the current elevations and frequencies. Any of the species sensitive to high waters would continue to be impacted as they are currently.

Proposed Plan

There would be no direct impacts to threatened or endangered species as direct impacts would be avoided in accordance with the ESA and the MBTA. Adverse indirect impacts to the listed bird species and the long-eared bat would be in the form of potential avoidance of the area during construction, habitat loss, and habitat switching (due to less frequent flooding). However, there would be beneficial impacts to the long-eared bat associated with the non-structural portion (reforestation) of the project. The pallid sturgeon and the listed mussels could be indirectly impacted by increased turbidity, increased current velocity, and potential change in substrate configuration during pumping operations. Potential cumulative impacts to the threatened or endangered species that could occur in the vicinity of the Yazoo Study Area from construction of the Proposed Plan would involve the combined adverse effects on each species from other projects within the Yazoo basin. Due to the unlikelihood of any of the listed species to be present in the Yazoo Study Area and the ability of most listed species to avoid the area during the construction period, the Proposed Plan would add very little and only temporary impacts to any other impacts resulting from past, present, and reasonably

foreseeable projects in the Yazoo basin and would not contribute significantly to cumulative impacts to listed species or their habitat in the basin.

Based on historic data and recent surveys, there is low probability of any of the above listed species to occur in the Yazoo Study Area. Therefore, USACE has made the determination that any impacts that might occur would be insignificant and the Proposed Plan may affect but would not likely adversely affect any of the listed species discussed above (see Threatened and Endangered Species and Migratory Birds Appendices).

Other Species of Concern

There would be no direct impacts to the bird species in the area that are protected under the MBTA or to the bald eagle. Adverse indirect and cumulative impacts to these species would be similar to those discussed for the federally listed species above. The area could switch from supporting species that depend on more frequently flooded forests to those that depend on reduced flooding periods. A survey would be conducted prior to construction to determine if any bald eagle nests are present. If an eagle nest is found, the National Bald Eagle Management Guidelines would be followed.

5.2.7 Aquatic Resources/Fisheries

For the aquatic resource assessment, Envirofish was used to calculate changes in the number of flooded acres the Proposed Plan compared to the no action alternative (Killgore et al. 2012). EnviroFish integrates the daily flood elevations, floodplain land use, and Habitat Suitability Indices to calculate a response variable, HUs, for spawning and rearing habitat lost as result of construction and operation of the Proposed Plan (see Aquatic Resources Appendix).

No Action Alternative

Without implementation of the Proposed Plan, aquatic resources and fish communities would continue to face multiple stressors throughout the year including low dissolved oxygen levels, a lack of riparian buffers, and periodic low flows. Under the no action alternative there are no direct, indirect, or cumulative impacts occurring due to the Proposed Plan; yet, with no action, these stressors will continue and do result in frequent and cascading impacts to the aquatic resources and fisheries within the Yazoo Study Area.

Proposed Plan

The Proposed Plan will result in direct, indirect, and cumulative impacts to aquatic resources and fisheries. Direct impacts such as loss of habitat due to pump station construction and supplemental low flow groundwater well installation will occur but will be significantly less, due to the relatively small aquatic area impacted, than indirect impacts which include alteration of the flood frequencies associated with operations under the Proposed Plan. Reductions in the area flooded for spawning include those areas falling below the required 1.0 feet minimum whereas the much larger calculated rearing reforestation requirements reflect the shallower minimum depth requirement for rearing acres is 0.1 feet.

When considering both direct and indirect impacts, Envirofish results suggest a reduction of 2,838 and 3,232 HUs for spawning and rearing, equivalent to a reduction of 2,404 and 3,861 Average Daily Flooded Acres, respectively. To compensate for direct and indirect impacts, 3,998 and 4,553 acres of agricultural lands need to be reforested in the 2-year floodplain for spawning and rearing, respectively. However, due to extensive and prolonged periods of hypoxia with the Yazoo Study Area, a relative value index (0.6) was applied to weight the difference in the functional value of hypoxic and normoxic water in the floodplain. This weighting resulted in a reduction of reforestation requirements of 2,399 and 2,732 acres for spawning and rearing, respectively, indicating the limited utility of reforestation to address impacts to aquatic resources and fisheries.

Cumulative impacts of the Proposed Plan would be both negative and positive with regard to aquatic resources and fisheries. Negative cumulative impacts include a reduction in the areal extent and associated volume of flooded acres with most occurring at short durations and depths of less than 1.0 feet. While a reduction in the quantity of the habitat is apparent, positive cumulative impacts will occur via improvements to habitat quality. Interannual variations in stage and durations of inundated areas may results in stagnant, hypoxic conditions which can severely limit habitat availability for aquatic communities. Additional mitigation measures including re-establishment of perennial flows with supplemental low flow groundwater wells will work together to improve habitat quality. In all, improvement of environmental flows would benefit a total of 9,321 acres of streams within the Yazoo Study Area.

5.2.8 Water Quality

No Action Alternative

The Yazoo Study Area experiences damaging floods from rainfall events when the Mississippi and Yazoo rivers reach certain flood stages. Once the Yazoo River reaches a certain flood stage, due to flooding along the Mississippi River, the Steele Bayou and Little Sunflower water control structures are closed to prevent flooding in the Yazoo Study Area. However, additional rainfall that falls into the Yazoo Study Area is trapped and cannot be released to the Yazoo River when these two water control structures are closed. This scenario creates damaging backwater floods that negatively impact water quality. Without additional project construction in the Yazoo Study Area, future water quality conditions are not expected to change and would thus negatively impact the health of the aquatic environment. Extended periods of low dissolved oxygen concentrations would continue to negatively impact aquatic species in the Yazoo Study Area. With the reforestation of agricultural lands under the CRP and WRP, water quality could improve and there could be a reduction in the amount of sediment carried into nearby streams. Without implementation of the Proposed Plan, negative water quality impacts would continue to impact the Yazoo Study Area.

Proposed Plan

The Proposed Plan will result in direct, indirect, and cumulative impacts to water quality. Potential direct impacts from construction of the pump station, completion of the inlet and

outlet, development of borrow area and adjacent access roads, and completion of the supplemental low flow groundwater wells would include temporary increases in turbidity and suspended solids in adjacent water bodies. However, these impacts to water quality are expected to be minimal and limited. A stormwater pollution prevention plan would be developed to minimize any potential effects to water quality during construction.

Reforestation under the nonstructural feature of up to 2,700 acres would result in indirect and cumulative benefits to the quality of water in the Yazoo Study Area. Reforestation would reduce erosion and sediment yield in stormwater runoff by adding permanent ground cover and eliminating tillage. Removing land from agricultural production will also reduce the amount of nutrients and pesticides entering adjacent water bodies and ultimately the Gulf of Mexico. In addition, reforestation would improve the wetland functional value of frequently flooded land. Reforestation would also increase nutrient uptake and provide structure and a supply of organic carbon (leaf litter) to benefit downstream fisheries.

The pump station would help increase dissolved oxygen in the water column by minimizing the overall depth of a flood event thus allowing better mixing to occur with the surface water over time; this would lessen the negative impacts on aquatic species. These effects should have positive indirect and cumulative benefits to water quality and aquatic life in the Yazoo Study Area during extended flood events. The contribution of TN and TP loading caused by the pump station from the Yazoo Study Area during flood events would contribute a minimal amount of nutrients to the Mississippi River. The timing of the nutrient loading to the Mississippi River during backwater flood events would be increased by a few weeks, however, the overall mass loading should remain the same.

The construction of 34 supplemental low flow groundwater wells would help supplement needed base flow in the major arteries of these Big Sunflower and Steele Bayou Basins allowing for year-round in-channel habitat during critical low or no flow periods. Each of the 34 supplemental low flow groundwater wells would supply up to 5.0 cfs per site with an aggregate contribution of 40 cfs to the Steele Bayou Basin, 25 cfs to the Upper Deer Creek Basin, and 105 cfs to the Big Sunflower Basin. A common well design will incorporate an agitation feature to facilitate re-aeration prior to mixing with the tributary. In the upper headwater streams, temporary conditions of reduced dissolved oxygen would be experienced at the point of addition until ambient conditions are reached. The supplemental water provided to increase base flow should stimulate re-aeration through agitation minimizing the presence of stagnant intermittent pools in the downstream channels. These supplemental low flow groundwater wells would provide positive indirect and cumulative benefits to the Yazoo Study Area by increasing the low dissolved oxygen concentrations typically observed during the warmer months. This would in turn improve the water quality and aquatic life in the Yazoo Study Area.

The MVK will obtain water quality certification from the MDEQ under Section 401 of the CWA for the Proposed Plan prior to signing of the ROD.

Section 6
Compensatory Mitigation and Monitoring

6.1 MITIGATION

To compensate for unavoidable losses to environmental resources from the construction, operation, and maintenance of the proposed project, compensatory mitigation requirements were calculated based on impacts from the entire calendar year, various flood frequencies, and variable flood depths. Based on these calculations it was determined that the acquisition of 2,405 acres of frequently flooded agricultural lands in fee title and subsequent reforestation of these lands would be pursued to offset any unavoidable losses to wetlands, terrestrial, wildlife, waterfowl, and a portion of the aquatics resources. Monitoring studies have documented extensive hypoxia in the Yazoo Study Area during flood inundation, questioning the value of reforestation to fully address aquatic impacts. Therefore, the project delivery team has determined that a portion of the unavoidable aquatic loses (attributed to hypoxia) could be offset by out of kind mitigation through the installation of 34 supplemental low flow groundwater wells. Environmental flows benefit a total of 9,321 acres of streams, and based on a statistical habitat model yields an approximate 40% increase compared to existing conditions (see Aquatic Appendix). A maximum loss of approximately 3,232 AAHU's for fish rearing without hypoxia calculated by Envirofish will be partially mitigated by planting 2,405 acres of BLH, and the remainder will be compensated by the supplemental low flow groundwater wells. This demonstrates that using both in-kind and out-of-kind mitigation fully compensates for adverse impacts of the project, takes a watershed approach rather than localized, and addresses all life stages of fish during the year. Additionally, the nonstructural flood damage feature (2,700 acres of reforestation) would provide substantial environmental benefits to all resource categories but were not included in the calculation of the 2,405 acre compensatory mitigation effort. Therefore, the anticipatory ecological benefits from the nonstructural benefits would be in addition to those benefits resulting from the compensatory mitigation efforts. See Mitigation Appendix for further details.

6.2 MONITORING AND ADAPTIVE MANAGEMENT

Adaptive management is a decision process that promotes flexible decision making that can be adjusted in the face of uncertainties as outcomes from management actions and other events become better understood (NRC 2004). Careful monitoring of these outcomes both advances scientific understanding and helps adjust policies or operations as part of an iterative learning process. The active form of adaptive management employs management actions in an experimental design aimed primarily at learning to reduce uncertainty and improve near-term benefits to resources. The true measure of adaptive management, and it value to the USACE, is in how well it helps meet environmental, social, and economic goals; increases scientific knowledge; and reduces tensions among stakeholders.

The approach to monitor and adaptively manage resources within the Yazoo Study Area is detailed in the Monitoring and Adaptive Management Appendix. The plan discusses monitoring approaches and adaptive management strategies related to the supplemental low flow groundwater wells, aquatic biology, water quality, adaptive management, basin-wide assessment, and wetlands; and the interactions between these ecological components.

A robust monitoring approach incorporating ground water hydrology and wetland functional assessment is required to conduct effective adaptive management for the Proposed Plan. These approaches will need to be conducted both within the Yazoo Study Area and at compensatory mitigation sites. There is substantial published data available to support established of restoration trajectory milestones in support of the adaptive management approach for wetlands described in the Monitoring and Adaptive Management Plan. Additionally numerous management strategies exist at both landscape and field scales to increase wetland functional outcomes. The combination of available existing data and strategies for targeted remedial interventions provides an ideal opportunity to implement the Monitoring and Adaptive Management Plan for the Proposed Plan as detailed in Monitoring and Adaptive Management Appendix.

Section 7
Environmental Laws and Compliance

The relationship of the Proposed Plan to environmental protection statutes or other environmental requirements is summarized in Table 7.1 and discussed below. Information concerning the resources addressed under each of the laws in Table 7.1 is presented fully in previous sections of this Final Supplemental Environmental Impact Statement (FSEIS), as well as in the Main Report and its appendices.

Table 7.1 Relationship of Proposed Plan to environmental protection statutes or other environmental compliance.

Federal Statutes	**Compliance**
Archeological and Historic Preservation Act, as amended, 16 U.S.C. 469, et seq.	PC
Clean Air Act, as amended, 42 U.S.C. 7401, et seq.	Full
Clean Water Act, as amended (Federal Water Pollution Control Act), 33 U.S.C. 1251, et seq.	PC
Coastal Zone Management Act, as amended, 16 U.S.C. 1451, et seq.	NA
Endangered Species Act, as amended, 16 U.S.C. 1531, et seq.	PC
Estuary Protection Act, 16 U.S.C. 1221 et seq.	NA
Federal Water Project Recreation Act, as amended, 16 U.S.C. 460-1(2), et seq.	Full
Fish and Wildlife Coordination Act, as amended, U.S.C. 661, et seq.	PC
Land and Water Conservation Act, as amended, 16 U.S.C. 4601, et seq.	NA
Marine Protection, Research and Sanctuaries Act, 22 U.S.C. 1401, et seq.	NA
National Historic Preservation Act, as amended, 16 U.S.C. 470a, et seq.	PC
National Environmental Policy Act, as amended, 42 U.S.C. 4321, et seq.	PC
ER 1165-2-132, Water Resource Policies and Authorities, HTRW Guidance for Civil Works Projects, 27 June 1992	Full
Rivers and Harbors Act, 33 U.S.C. 401, et seq.	Full
Watershed Protection and Flood Prevention Act, 16 U.S.C. 1001, et seq.	NA
Wild and Scenic Rivers Act, as amended, 16 U.S.C. 1271, et seq.	NA
Farmland Protection Policy Act	Full
Executive Order/Memoranda	
Flood Plain Management (E.O. 11988)	Full
Protection of Wetlands (E.O. 11990)	Full
Environmental Effects Abroad of Major Federal Actions (E.O. 12114)	NA
Environmental Justice Considerations (E.O. 12898)	Full

State and Local Policies	
Mississippi Water Quality Standards	PC
Notes: Compliance categories: a. Full Compliance. All requirements have been met for this stage of planning. b. Partial Compliance. Some requirements remain to be met for this stage of planning. c. Noncompliance. None of the requirements have been met for this stage of planning. d. Not Applicable. Statute, E.O., or other policy not applicable.	

Section 8
Public Involvement and Coordination

A Notice of Intent (NOI) to prepare an SEIS was filed on 16 April 2020. No public scoping meetings were held since the project has received substantial input from the public through the years. The public's input provided significant contribution to the reformulation of alternatives in the 2007 Main Report. A full description of the public's past involvement can be seen on pages 43 - 46 of the 2007 Main Report.

Comment letters were received in response to the NOI from multiple non-governmental organization providing comment(s) on the project. These non-governmental organizations included American Rivers; National Audubon Society, Audubon Mississippi; and the Conservation Organization (collectively consisting of American Rivers, Delta Land Trust, Earth Justice, Environment America, Environmental Defense Fund, Gulf Restoration Network, National Audubon Society, National Wildlife Federation, Sierra Club, and the Surfrider Foundation-Central Gulf Coast Chapter). Approximately 45,000 emails and 9,700 postcards were received in response to the NOI publication.

MVK held a cooperating agency meeting on 19 May 2020 in which representatives from each of the six cooperating agencies (USFWS, EPA, USFS, NRCS, MDEQ, and MDWFP) attended. MVK requested comments, as a result of the cooperating agency meeting, regarding the models used for analysis of wetland, terrestrial, waterfowl, and aquatic and fisheries impacts and/or adaptive management approach of which EPA, NRCS, and MDEQ responded. Subsequent cooperating agency specific meetings were requested by EPA and MDEQ and held on 29 May and 08 July 2020 respectively.

Section 9
Conclusion

The Proposed Plan reduces average annual flood damages to urban and agricultural areas through a combination of structural and nonstructural flood damage reduction features, minimizes adverse impacts through project design, and provides net gain in environmental value to the entire Yazoo Backwater Area. The Proposed Plan represents a balanced approach to addressing the flood damage reduction and environmental opportunities in the Yazoo Study Area.

The alternative includes a pump station with a maximum combined pumping capacity of 14,000 cubic feet per second (cfs), located near Deer Creek, with a year-round pumping elevation of 87.0 feet, NGVD, when the riverside water elevation is greater than the landside water elevation at the Steele Bayou water control structure and acquisition of perpetual conservation easements (from willing sellers) with reforestation/conservation features on up to 2,700 acres of agricultural land primarily at or below elevation 87.0 feet, NGVD. The pump station provides structural flood damage reduction above elevation 87.0 feet, NGVD, and the reforestation provides nonstructural flood damage reduction primarily at or below elevation 87.0 feet, NGVD. Operation of the Steele Bayou water control structure would remain the same, maintaining the water levels in the Yazoo Study Area between 68.5 and 70.0 feet, NGVD, during low flow periods.

Adverse effects to environmental resources would result from the construction and operation of the pump station (structural feature) which will bring about changes to the physical environment as a result of changes in flood duration and frequency of Yazoo Backwater flooding. Impacts associated with the Proposed Plan include, impacts to wetlands (reduction of 11,498 FCUs, see Wetlands Appendix), waterfowl (reduction of 1,349,228 DUDs, see Waterfowl Appendix), aquatic resources (reduction of 2,838 AAHUs of spawning habitat and 3,232 AAHUs of rearing habitat, see Aquatic Resources Appendix), and terrestrial wildlife (reduction of 1,252 AAHUs, see Terrestrial Appendix). The majority of impacts are attributed to indirect impacts as a result of reducing flood frequencies and durations.

To compensate for unavoidable losses to these environmental resources from the construction, operation, and maintenance of the Proposed Plan, compensatory mitigation requirements were calculated based on impacts from the entire calendar year, various flood frequencies, and variable flood depths. Based on these calculations it was determined that the acquisition of 2,405 acres of frequently flooded agricultural lands in fee title and subsequent reforestation of these lands will be pursued to offset any unavoidable losses to wetland, terrestrial, aquatic, and waterfowl resources (see Section 6). Additionally, the nonstructural flood damage feature (reforestation) will provide substantial environmental benefits to all resource categories but were not included in the calculation of the 2,405 acre compensatory mitigation effort. Therefore, the anticipatory ecological benefits from the

nonstructural benefits will be in addition to those benefits resulting from the compensatory mitigation efforts.

Additional compensatory mitigation will be accomplished through the installation of 34 supplemental low flow groundwater wells. The supplemental low flow groundwater wells will improve environmental flows in 9,321 acres of streams, directly benefiting fish, mussels, and other ecological attributes of the Yazoo Study Area. Monitoring studies have documented extensive hypoxia in the Yazoo Study Area during flood inundation, questioning the value of reforestation to fully address aquatic impacts. Therefore, the additional mitigation method of the installation of supplemental low flow groundwater wells will address a range of other habitat impairment in the Big Sunflower-Steele Bayou drainage negatively impacting the overall fish communities and aquatic habitat through environmental flow establishment during the low water season. Re-establishing perennial flows with supplemental low flow groundwater wells is anticipated to offset high mortality of larvae and juvenile fish in the spring from hypoxia and improve survival of juveniles and adults during autumn. This approach address the overall aquatic community during all life stages and improves a total of 9,321 acres of streams by improved environmental flows (see Section 6 and Aquatic Resources Appendix).

The Proposed Plan is the most balanced, implementable approach, and meets the economic and environmental needs of the basin. The Proposed Plan includes a reforestation/conservation features on up to 2,700 acres, primarily at or below 87.0 feet, NGVD, as a nonstructural flood damage reduction feature, and reforestation of 2,405 acres and installation of 34 supplemental low flow groundwater wells as the compensatory mitigation effort to offset adverse environmental impacts. In summary, the Proposed Plan provides for a balanced approach to the development and environmental needs of the area.

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List of Acronyms and Abbreviations

AAFCUs	Average Annual Functional Capacity Units
ASTM	American Soceity for Testing and Materials
BMPs	Best Management Practices
CEMRC	Corps of Engineers Mississippi River Commission
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
cfs	cubic feet per second
CRP	Conservation Reserve Program
CWA	Clean Water Act
dB	decibel
dBA	A-weighted decibel
DNL	day-night average sound level
DO	dissolved oxygen
DUDs	Duck Use Days
EJ	Environmental Justice
EPA	U.S. Environmental Protection Agency, Region 4
ER	Engineer Regulation
ESA	Engineering Site Assessment
FCA	Flood Control Act
FPPA	Farm Protection Policy Act
FSEIS	Final Supplemental Environmental Impact Statement
HD	House Document
HEC-RAS	Hydraulic Engineering Center – River Analysis System
HEP	Habitat Evaluation Procedure
HTRW	Hazardous, Toxic, and Radiological Wastes
HU	Habitat Unit
ICE	internal combustion engines
LMRV	Lower Mississippi River Valley
LWCF	Land and Water Conservation Fund
MAV	Mississippi Alluvial Valley
MDEQ	Mississippi Department of Environmental Quality
MDWFP	Mississippi Department of Wildlife, Fisheries and Parks
MR&T	Mississippi Rivers and Tributaries
MVK	Vicksburg District, U.S. Army Corps of Engineers
NEPA	National Environmental Policy Act
NGVD	National Geodetic Vertical Datum
NHPA	National Historic Preservation Act
NOI	Notice of Intent
NPS	U.S. Department of Interior, National Park Service

NRCS	U.S. Department of Agriculture, Natural Resources Conservation Service
NRHP	National Register of Historic Places
O&M	Operation and Maintenance
PDF	Project Design Flood
ROD	Record of Decision
ROI	Region of Influence
SEIS	Supplemental Environmental Impact Statement
SHPO	State Historic Preservation Officer
TN	total nitrogen
TP	total phosphorous
TSS	total suspended solids
USACE	U.S. Army Corps of Engineers
USFS	U.S. Department of Agriculture, U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VRAP	Visual Resources Assessment Procedure
WMA	Wildlife Management Area
WRDA	Water Resources Development Act
WRP	Wetland Reserve Program