Mississippi Valley Division,
Regional Planning and Environment Division South

Yazoo Backwater Area Water Management Project

Draft Environmental Impact Statement

June 2024

Cover Page

Title of Proposed Action: Yazoo Backwater Area Water Management Project

Location(s) of Proposed Action: Yazoo Basin, Mississippi

Lead Agency: U.S Army Corps of Engineers

Cooperating Agency(ies): U.S. Environmental Protection Agency; U.S. Fish and Wildlife Service; U.S. Forest Service, U.S. Department of Agriculture; Federal Emergency Management Agency; U.S. Department of Transportation; Mississippi Department of Environmental Quality; and Mississippi Department of Wildlife, Fisheries, and Parks

Abstract: Flooding in the Yazoo Backwater Study Area (YSA) occurs during high Mississippi River events that result in the closure of the Steele Bayou water control structure causing rainfall that occurs within YSA drainage to accumulate within the YSA. Most recently, backwater flooding in 2019 lasted for approximately 6 months, caused hundreds of millions of dollars in damages, flooded over 600 homes, and caused increased risks to human health and safety. The severe impacts of the 2019 flooding heightened collaboration between federal agencies and focused attention and resources by federal government leadership prompting renewed interest in the development of a new proposal for constructing the remaining features of the Yazoo Backwater Project in a way that would provide significant flood risk reduction for the YSA communities and the local economy while avoiding and minimizing impacts to important environmental resources. Building off decades of public input, interagency partnerships, and a legacy of environmental data updated with new environmental and hydraulic data, this Water Management Plan addresses the flood risk aspect of the YSA, inclusive of structural and non-structural features, while balancing the needs of the environment. The Water Management Plan consists of high-volume pumps to manage water levels, management of the flood water levels via the established water control plan, and a non-structural component consisting of acquisition of primary residential properties in the most frequently flooded areas and optional acquisition or placement of restrictive easements of agricultural lands in the most frequent flooded lands. Project implementation is anticipated to decrease flood depth and duration, and these changes are estimated to decrease wetland functions. However, establishment of wetland mitigation is expected to offset these declines. The draft Environmental Impact Statement serves the specific purpose of communicating potential solutions and associated environmental impacts for public review and comment. If approved, the next procedural phase of this process will include analysis of public feedback, selection of a final plan, and a refinement of the engineering and scientific data associated with the selected plan.

Date Comments must be Received by: 01 July 2024

Estimated Total Cost of EIS Preparation: TBD

Point of Contact for Additional Information :

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Executive Summary

Flooding in the Yazoo Backwater Study Area (YSA) occurs during high Mississippi River events that result in the closure of the Steele Bayou water control structure causing rainfall that occurs within YSA drainage to accumulate within the YSA. This flooding is known as backwater flooding. Most recently, backwater flooding in 2019 lasted for approximately 6 months, caused hundreds of millions of dollars in damages, flooded over 600 homes, and caused increased risks to human health and safety. In addition, the sustained duration of the 2019 flood had substantial effects on local underserved and overburdened communities and residents of the YSA. Following the 2019 flood event, representatives from the U.S. Army Corps of Engineers (USACE), the Environmental Protection Agency (EPA), and the U.S. Fish and Wildlife Service (USFWS) completed site visits of the backwater area and began evaluating options for addressing backwater flooding and began compiling new scientific data collected in recent years. This new and improved data, in combination with the realization that future flooding will likely be more frequent and more significant in light of climate change, and growing safety and economic concerns related to flooding, prompted the initiation of an updated evaluation of previous project area analysis and study.

Flood risk reduction for the entire Yazoo Backwater Area was authorized by the Flood Control Act of 1941 with the Yazoo Basin, Yazoo Backwater, Mississippi, Project (Yazoo Backwater Project). Since authorization and subsequent modification, USACE has completed construction of extensive flood risk reduction features authorized as part of the Yazoo Backwater Project, including levees, associated drainage channels, and water control structures which have significantly reduced the external (MS River Flooding) frequency and duration of flooding in the Yazoo Backwater Area. Since 1978 various proposals have been evaluated for completing remaining features of the Yazoo Backwater Project designed to alleviate backwater flooding specifically in the YSA, but were not pursued. The severe impacts of the 2019 flooding heightened collaboration between federal agencies and focused attention and resources by federal government leadership prompting renewed interest in the development of a new proposal for constructing the remaining features of the Yazoo Backwater Project in a way that would provide significant flood risk reduction for the YSA communities and the local economy while avoiding and minimizing impacts to important environmental resources. Building off decades of public input, interagency partnerships, and a legacy of environmental data updated with new environmental and hydraulic data, this Water Management Plan addresses the flood risk aspect of the YSA, inclusive of structural and non-structural features, while balancing the needs of the environment.

New environmental and hydraulic data analyzed in this draft environmental impact statement (DEIS) includes: (1) a revised period of record, (2) a higher resolution digital elevation model, and (3) the use of the 2018 National Agricultural Statistics Service (NASS) land use data. Prior to initiating this DEIS, USACE engaged with EPA and USFWS on key decisions regarding how impacts to environmental resources such as wetlands, terrestrial species, aquatic species, and waterfowl would be evaluated. For example, the new analysis evaluates the Water Management Plan’s impacts to all wetlands up to an elevation of 93.0

feet National Geodetic Vertical Datum of 1929 (NGVD29) at the Steele Bayou gage to ensure that potential impacts to wetlands across the entirety of the 5-year floodplain are assessed. This responds to criticism of prior evaluations which were limited to smaller geographic areas within the YSA. The YSA is home to highly functional, forested riverine wetlands, known as riverine backwater wetlands, which require periodic flooding at intervals at least every one to five years to deliver their full suite of wetland ecological functions, meaning these wetlands are limited to the 5-year floodplain (Smith and Klimas 2002). Thus, using the 5-year floodplain as the assessment area provides a more conservative estimate of the nature and magnitude of impacts to important wetland resources.

The Water Management Plan consists of four features. The first utilizes high volume pumps to manage water levels; this system will be located adjacent to the Steele Bayou Water Control structure. Second, management of the flood water levels will be done via the established water control plan. The water control plan will provide the parameters required to manage the hydrologic interaction between the Yazoo River and the backwater tributaries during high Mississippi River stages. Importantly, based on 43 years of hydrologic records and this water control plan, the pump station is on average, expected to need to operate biennially, for a period of several weeks. Adaptive management of the project includes continued monitoring of water control operations and long-term analysis to validate that the project features are performing as directed. The three agencies will collaborate on water control adjustments and long-term mitigation requirements based on continuous ecosystem analysis. Finally, to further reduce flood damages a non-structural component is included. The non-structural component involves acquisition of primary residential properties in the most frequently flooded areas and optional acquisition or placement of restrictive easements of agricultural lands in the most frequent flooded lands.

Project implementation is anticipated to decrease flood depth and duration, and these changes are estimated to decrease wetland functions. However, these changes are not anticipated to convert any wetlands to non-wetlands; rather, the impacts of the Water Management Plan are expected to result in changes to wetland class in some instances as precipitation is expected to sustain wetlands in the Yazoo Backwater Study Area. The establishment of wetland mitigation is expected to offset the estimated declines in wetland functions.

The mitigation plan for the Water Management Plan is designed to compensate for unavoidable environmental impacts. A multifaceted approach to mitigation planning will achieve the overall mitigation goals through the use of an existing in lieu fee program; USACE constructed mitigation sites; and/or the use of existing mitigation banks. A comprehensive monitoring and adaptive management plan that presents practical solutions to an array of environmental challenges within the YSA is also being developed.

In additional to environmental considerations, the Water Management Plan provides potential solutions that address the direct effects of flood risk to the locally affected community. The plan pays particular attention to potential indirect effects of long-duration floods such as impacts to community cohesion and social networks.

The solutions proposed under this Water Management Plan evaluates potential features to resolve the long-standing flood risk management impacts to the community and the environment, and the DEIS serves the specific purpose of communicating the potential solutions and associated environmental impacts for public review and comment. If a viable solution is determined, the next procedural phase of this process will include analysis of public feedback, selection of a final plan, and a refinement of the engineering and scientific data associated with the Water Management Plan. This phase will conclude through the documentation of a Record of Decision on this plan. Refinements to the design may require additional compliance document(s). If it is determined that additional NEPA or compliance documentation is required, USACE will work in coordination with the resource agencies to maintain compliance.

Additional Alternative 4, the Nonstructural Plan Only, is being considered and public comment is welcomed on this alternative.

The responsible lead agency for the preparation of this DEIS is the USACE Vicksburg District. The responsible cooperating agencies are the U.S. Environmental Protection Agency; U.S. Fish and Wildlife Service; 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 nonfederal sponsor is the Board of Mississippi Levee Commissioners.

To ensure the Corps has sufficient time to consider public input in the preparation of the Final EIS, comments should be submitted by email at YazooBackwater@usace.army.mil or by surface mail to Mike Renacker at U.S. Army Corps of Engineer, Vicksburg District, ATTN: CEMVK–PPMD, 4155 East Clay Street, Room 248, Vicksburg, MS 39183.

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Introduction

1.1 BACKGROUND

The Yazoo Basin, Yazoo Backwater, Mississippi, Project (Yazoo Backwater Project) was originally authorized by the Flood Control Act (FCA) on 18 August 1941 (House Document [HD] 359/77/1), and further amended by the FCA 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 designed to provide flood damage risk reduction to five subareas of the Yazoo Basin (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 Yazoo Backwater Area Water Management Plan and Draft Environmental Impact Statement (DEIS) analysis will evaluate remaining unconstructed features in one of the five subareas of the authorized , Yazoo Backwater Project Area, specifically the Yazoo Area, hereinafter referred to as the Yazoo Backwater Study Area (YSA). The YSA is referenced in Figure 1-1.

Currently, authorized work in the Yazoo Backwater Area includes levees, water control structures, connecting channel, and pump stations. The authorized 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 authorized connecting channel is located between the Little Sunflower and Steele Bayou water control structures and was completed in 1978. Figure 1-2 shows the completed features of the Yazoo Backwater Project. This Water Management Plan and DEIS will focus on the remaining unconstructed flood risk management features of the Yazoo Backwater Project, which are confined to the YSA.

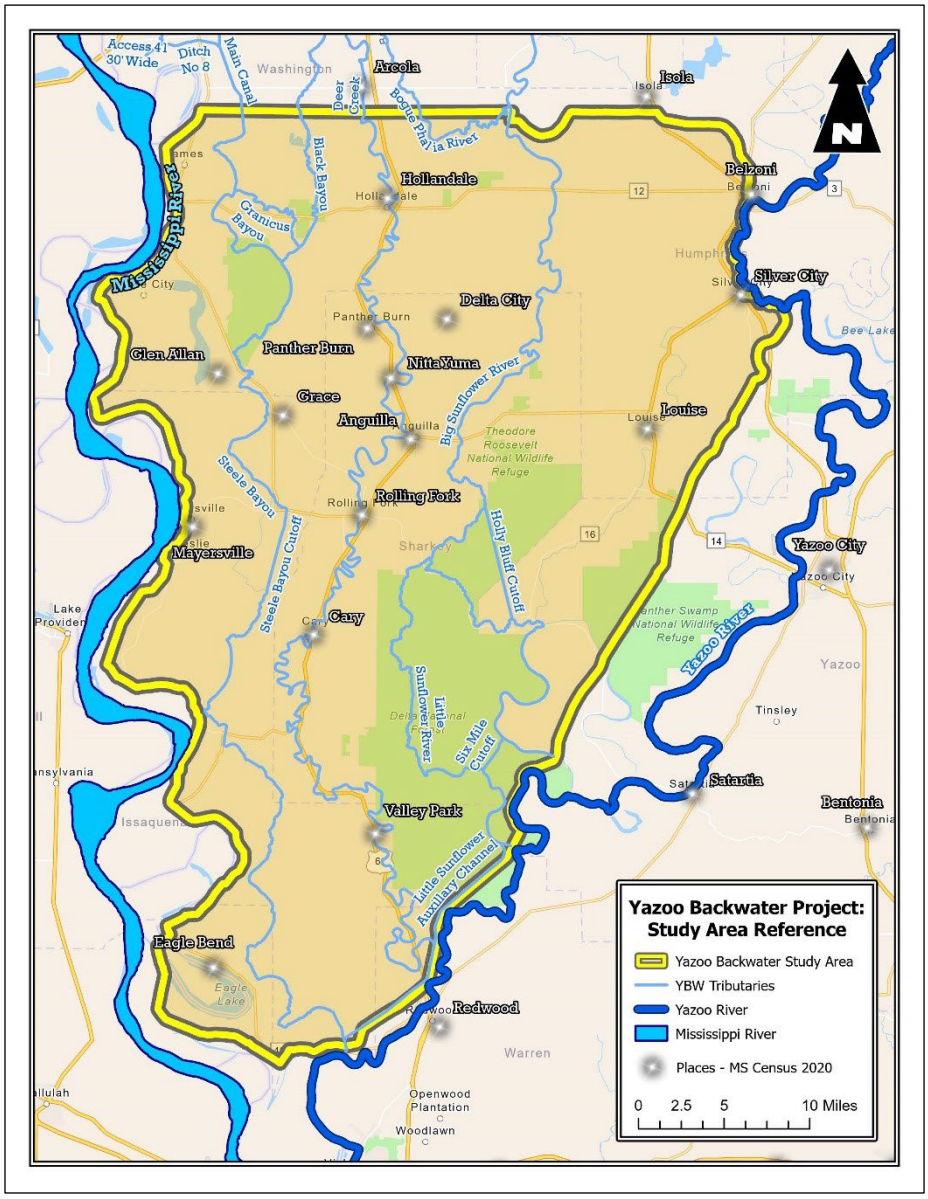

Figure 1-1. Yazoo Backwater Study Area (YSA)

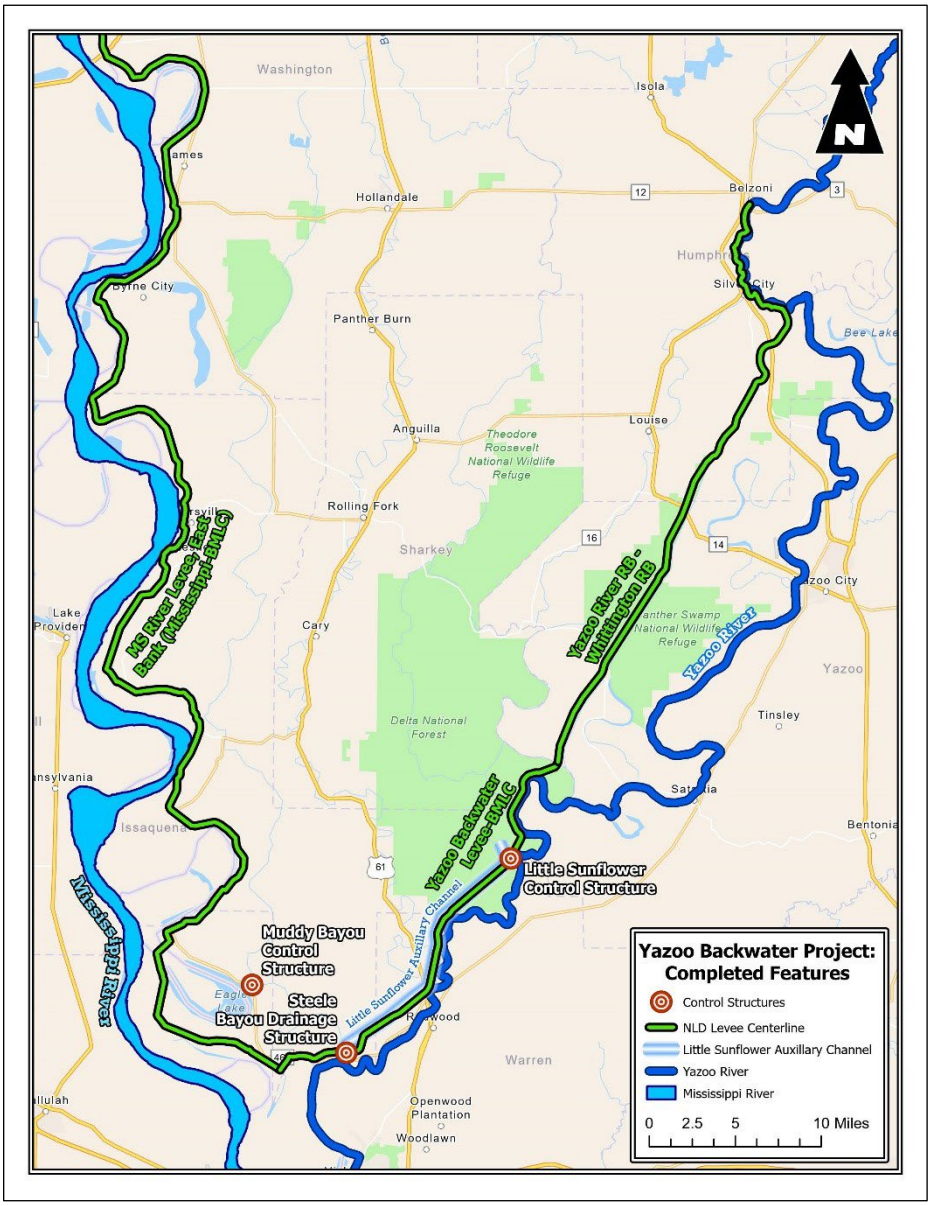

Figure 1-2. Completed Features of the Yazoo Basin, Yazoo Backwater, Mississippi, Project

Since 1978, various proposals for constructing the remaining features of the Yazoo Backwater Project have been evaluated by the U.S. Army Corps of Engineers (USACE), but were not pursued because of logistical, economic, and environmental reasons. However, recent flooding and new environmental data from the YSA prompted renewed interest in the development of a proposal for constructing the remaining features of the Yazoo Backwater Project in a way that would provide significant flood risk reduction for communities in the YSA and the local economy while also avoiding and minimizing impacts to important environmental resources. This Water Management Plan and DEIS is a new water management solution to reduce flood risk in the YSA, resulting from high stages of the

Mississippi River, and consists of structural and nonstructural components. The Notice of Intent (NOI) released in July 2023 presented the USACE preferred alternative which consisted of structural and nonstructural features and also discussed other alternatives to consider in this Water Management Plan and DEIS. The NOI also discussed the need for mitigation plans to mitigate for all unavoidable environmental impacts.

The cooperating agencies are U.S. Fish and Wildlife Service (USFWS); U.S. Environmental Protection Agency, (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).

1.2 NON-FEDERAL SPONSOR

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

The Board is of the opinion that the YSA has been economically 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 6 feet on the Vicksburg gage. The Board feels that a plan should provide additional urban and agricultural flood damage risk reduction for the YSA. Therefore, the Board strongly supports a plan that balances the economic, social and environmental needs of the area. The Board has conducted numerous tours for Federal and state officials along with local officials as well as private citizens to explain the project and show their support.

1.3 STUDY AREA

The YSA is located in west-central Mississippi, immediately north of Vicksburg, Mississippi, and has historically been subject to flooding from Mississippi River backwater and headwater flooding from the Yazoo River, Sunflower River, and Steele Bayou (Figure 1-3). The YSA extends northward about 65 miles to the latitude of Hollandale and Belzoni, Mississippi, and comprises about 1,446 square miles. The Big Sunflower and Little Sunflower Rivers, Deer Creek, and Steele Bayou flow through the YSA. These four streams drain 4,093 square miles of the Mississippi Alluvial Valley (MAV) and include a major portion of the Mississippi Delta. 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 the mouth of the Little Sunflower River (upper ponding area) and the mouth of Steele Bayou (lower ponding area). Drainage areas of the four streams are shown in Figure 1-4.

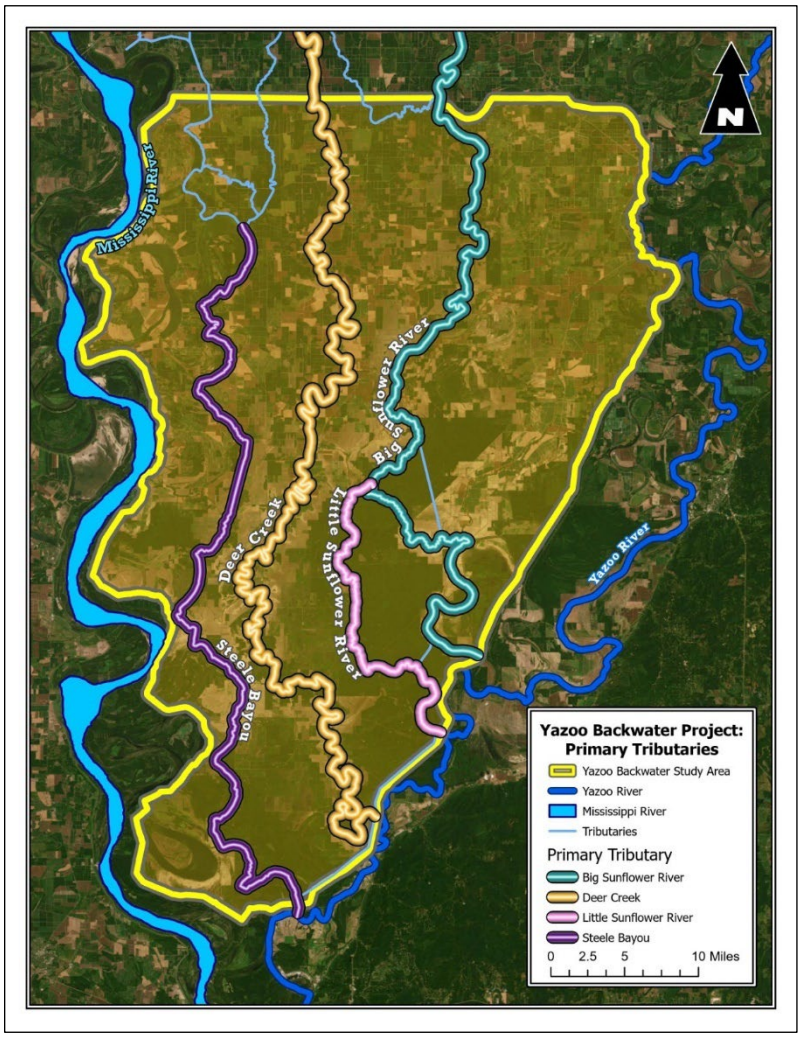

Figure 1-3. Primary Tributaries of the Yazoo Backwater Area

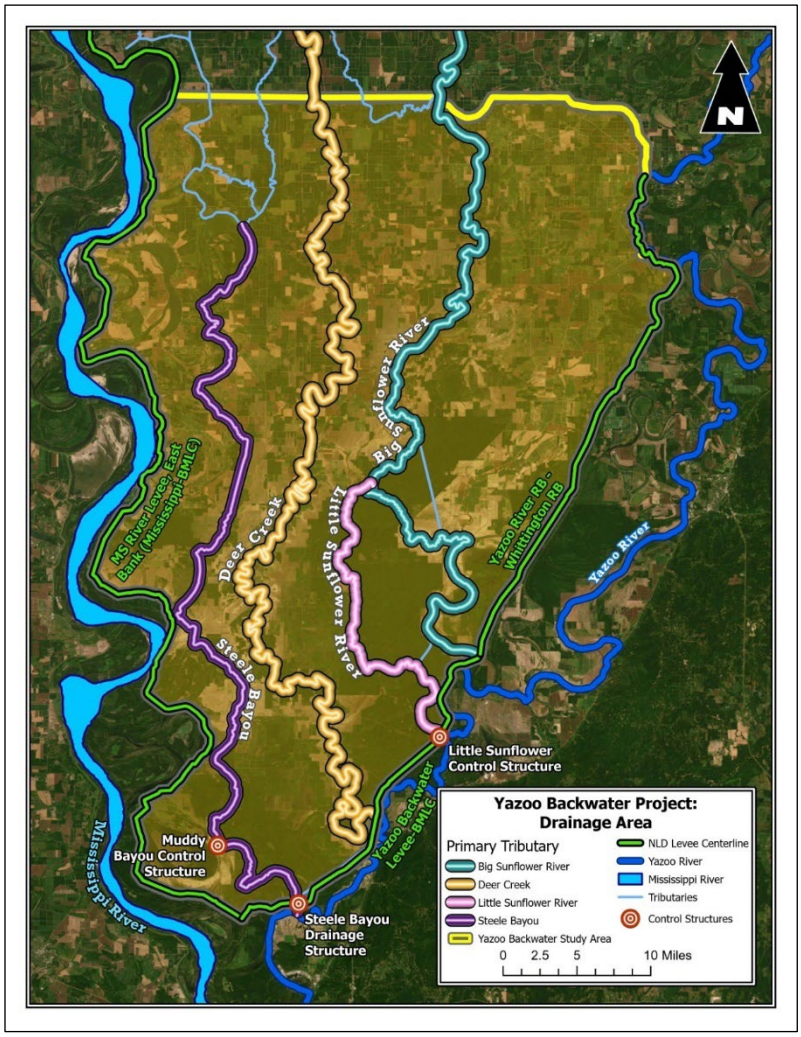

Figure 1-4. Project Area Drainage Basins

The YSA consists of approximately 926,000 acres, of which approximately 485,000 acres are lands within the 2019 flood extent (98.2-feet) (Figure 1-5). The YSA 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 1-6). The study area includes all or portions of Humphreys, Issaquena, Sharkey, Warren, Washington, and Yazoo Counties, Mississippi and part of Madison Parish, Louisiana.

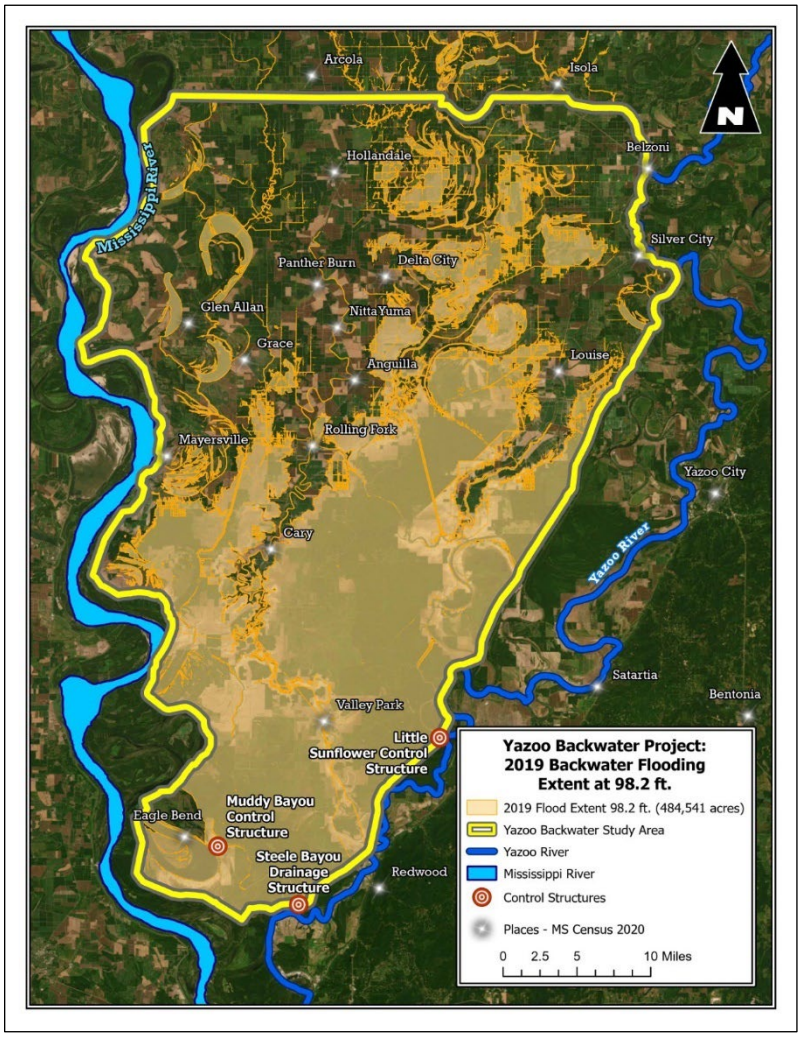

Figure 1-5. 2019 Flood Extent

Figure 1-6. Levees within the Vicinity of the Yazoo Backwater Area

1.4 AUTHORITY, HISTORY, AND PRIOR REPORTS

Through the 1941 Flood Control Act (FCA; Public Law 228, 77th Congress), approved 18 August 1941, Congress modified the MR&T project to include the provision that the levees in the Yazoo Basin on the east bank of the Mississippi River, south of the Coahoma-Bolivar County line should have a 3-foot freeboard over the project flood, and all levees should be constructed with adequate section and foundation to conform to increased levee heights. The act abandoned the Boeuf Floodway, the Eudora Floodway and its northward extension, and the back protection levee. The act also approved a revision of the authorized plan in the

Yazoo basin, permitting the Chief of Engineers, in his discretion, to substitute combinations of reservoirs, levees, and channel improvements for the authorized plan.

The FCA provided for the enlargement of 7 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 Mississippi River Commission (CEMRC) report, dated 7 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 (MVK), (USACE) created a document that became Annex L to the Comprehensive Review. That Annex addresses 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 6 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 Yazoo Backwater levee was completed in 1978. The authorized water control structures at Steele Bayou, Little Sunflower River, and Muddy Bayou 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.

The 23 July 1976, Yazoo Basin, Yazoo Backwater Area, Fish and Wildlife Mitigation Plan 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. As part of this plan, four green tree reservoirs (GTRs), five slough control structures, and one boat ramp were completed by the MVK in the Delta National Forest in the late 1970s and early 1980s. Currently, the GTRs and the slough control structures are not being operated by the U.S. Forest Service (USFS), nor are they being maintained by the MVK. The USFS agreed to operate and maintain the boat ramp in accordance with other features constructed in the Delta National Forest. Prior to the construction of the GTRs by the MVK, the MDWFP constructed one GTR 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 MVK in 1982. The results of the reevaluation are presented in the Yazoo Basin, Yazoo Backwater, Mississippi, Yazoo Pump Project report dated July 1982 and revised November 1982. The Yazoo Area Pump Project, Final Environmental Impact Statement, Flood Control, Mississippi River and Tributaries, Yazoo Basin, Mississippi (1982 FEIS) was included in the report and the Record of Decision (ROD) was signed in July 1983. The 1982 FEIS is available at: https://www.mvk.usace.army.mil/Missions/Programs-and-Project-Management/Project-Management/Yazoo-Backwater-Project/Yazoo-Backwater-Report/. Construction of the authorized pumping station was initiated in 1986, and the inlet and outlets channels, along with the cofferdams, were completed.

The WRDA of 1986 authorized the acquisition of perpetual easements on 40,000 acres of existing woodlands for mitigation of project-induced fish and wildlife losses within the YSA for the completed Yazoo Backwater levees and Satartia Area levees (33,500 acres) and for the authorized pumping station (6,500 acres), 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, rights-of-way, 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 authorized Yazoo Backwater Project were all deemed to be separable elements of and therefore, subject to the new cost-sharing provisions. Construction of the authorized pump station was halted in 1987 due to the inability of the non-Federal sponsor to provide financial capability. (The WRDA of 1996, Section 102(a)(2) amended Section 103(e)(1) of the WRDA of 1986 by physical defining construction as the date of construction contract award (25 March 1986 for the authorized Yazoo Area pump station). Since a contract on the Yazoo Area 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 1989, MVK prepared the Yazoo Backwater, Mitigation Plan. While progress toward the construction of the pumping station had been halted, the report presented a proposal to implement mitigation to compensate for 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:

- Development of existing public lands;
- Fee title acquisition and management of wooded lands;
- Perpetual land use easement acquisition of wooded lands;
- Fee title acquisition of cleared lands with reforestation/regeneration (selected alternative).

In lieu of the mitigation plan approved by WRDA 1986, the 1989 mitigation plan recommended the fee title acquisition and subsequent reforestation of 8,365 acres of cleared agricultural lands to fully offset the 526,950 annualized habitat units that were lost during the construction of the Yazoo Backwater Levees, which concluded in 1978. This construction included the right-of-way clearing of 5,900 acres of hardwoods and an additional 1,200 acres of estimated project-induced clearing that was projected to occur after levee construction.

The 1989 Mitigation Plan recommended the acquisition of lands from willing sellers and identified several properties that were currently available. USACE satisfied this recommendation with the acquisition of the 8,807 acres of frequently flooded cleared lands referred to as the Lake George Property in 1990. The mitigation requirement was subsequently reanalyzed by USACE and USFWS in 2007 to account for time between when the construction of the Yazoo Backwater levee projects were completed in 1978 and when mitigation activities were initiated in 1991. Additionally, the USFWS rightfully argued that USACE had failed to properly account for the amount of acreage that was reforested at the Lake George Property. After removing acreage consisting of roads, levees, standing water, and other areas not suitable for planting, it was determined that 8,082 acres were reforested at Lake George. This reanalysis resulted in the determination that an additional 3,848 acres of mitigation was required to fully offset the construction impacts associated with the Yazoo Backwater Levees. MVK also acknowledged that it had failed to provide compensatory mitigation for the clearing of 215.2 acres at the proposed pump station site in 1987. In 2007,

it was determined that an additional 519 acres of compensatory mitigation would be required to account for the impacts at the pump station and the time lost between 1987 and 2007. This left a total compensatory mitigation burden of 12,449 acres in 2007. When considering the additional 17 years between the 2007 reformulation and the present day, the current total requirement is 12,583 acres.

Congressionally authorized funding for the purchase and restoration of mitigation lands has been received intermittently since 2007, and additional tracts totaling 3,313 acres have been purchased and reforested. To date, MVK has acquired a total of 11,395 acres of cleared agricultural lands within the Yazoo Basin to compensate for completed construction of the Yazoo Backwater Levees, leaving MVK approximately 1,188 acres short of completely fulfilling the mitigation requirements. MVK currently has funding in hand to purchase additional mitigation property, and continues to work toward satisfying the total requirement required to fully offset the impacts of previous Yazoo Backwater Levee construction. USACE estimates that these outstanding mitigation obligations will be satisfied by 2035. The mitigation plan developed under this DEIS and provided in Appendix J details the work performed, including coordination and plan formulation, to develop a compensatory habitat mitigation plan for the current Water Management Plan under the Yazoo Backwater Area Water Management Project to account for the highest potential impact to the environment (i.e. 12,583 required acres). Mitigation requirements for already constructed portions from the overarching Yazoo Backwater, project described above are separate and not integrated into the impacts or recommendations described in the mitigation plan.

While verifying current backlog mitigation requirements, the team discovered that erroneous data was rolled into mitigation numbers previously reported in publicly available reports (https://www.usace.army.mil/Missions/Civil-Works/Project-Planning/Products/MitigationStatus/). This discrepancy has been corrected and will be part of all future reports.

In addition, mitigation is required for uncompleted construction within the Rocky Bayou area. MVK improved 3.7 miles of a 25-mile local levee system along with one water control structure before 1980; however, mitigation for these activities never occurred. The team is currently calculating impacts and will add the acreage to the backlog mitigation in the Final Environmental Impact Statement.

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 Basin, Yazoo Backwater, Mississippi, Project was initiated in 1993.

As a result, directives from the Assistant Secretary of the Army (Civil Works) and the Director of Civil Works requested the Corps reformulate the project to identify, display, and evaluate alternative plans for the following:

- Greater level of flood damage risk reduction for urban areas.
- Reduced levels of agricultural intensification.
- Reduced adverse impacts on the environment.

Based on this directive, in October 2007, the USACE released a feasibility report, which reformulated the remaining unconstructed features of the Yazoo Backwater, Project. An array of nonstructural, structural, and a combination alternatives emphasizing increased urban flood protection, reduced agricultural intensification, and reduced adverse environmental impacts were evaluated in the 2007 Final Supplemental Environmental Impact Statement (2007 FSEIS). The 2007 FSEIS is available at https://www.mvk.usace.army.mil/Missions/Programs-and-Project-Management/Project-Management/Yazoo-Backwater-Project/Yazoo-Backwater-Report/

The recommended plan consisted of a pump station at the Steele Bayou structure with a maximum combined pumping capacity of 14,000 cfs and a year round pumping elevation of 87.0 feet at the Steele Bayou gage; perpetual easements from willing sellers and reforestation/conservation measures on agricultural land primarily at or below the pump elevation operation plan. The plan also modified operations of the existing Steele Bayou structure to maintain water levels during low-water periods. The plan would have reduced the number of residential and nonresidential structures impacted by flooding and also increased returns to agricultural interests in the YSA. After a final review by the USACE Mississippi Valle Division Major Subordinate Command (MSC) no (ROD) was signed.

In 2008, EPA reviewed the 2007 recommended plan pursuant to its authorities under Section 404(c) of the Clean Water Act (CWA). EPA's review found that the 2007 recommended plan, as well as the other pumping station alternatives considered by USACE, would result in unacceptable adverse effects and prohibited "the specification of the subject wetlands and other waters of the United States as described in the [2007] FSEIS as a disposal site for the discharge of dredged or fill material for the purpose of construction of FSEIS Plans 3 through 7, and Modified Plan 6." Recognizing the need for continued collaboration on a solution to address flooding in the area, the 2008 Final Determination from the EPA states the following;

> EPA continues to support the goal of providing improved flood protection for the residents of the Mississippi Delta; however, it believes that this vital objective can be accomplished consistent with ensuring effective protection for the area's valuable natural resources. EPA is committed to participating in discussions with other federal and state agencies, and the public, concerning the best way to provide flood protection while protecting wetlands and other natural resources. (EPA 2008)

Since 2008, significant flooding events have occurred in the YSA. In 2019, backwater flooding up to an elevation of 98.2 feet (NAVD88) by 23 May 2019, caused hundreds of millions of dollars in damages, flooded over 600 homes, and increased risks to human health and safety. Also, since 2008, improved environmental and hydraulic data have become available to support more refined estimates of environmental impacts. The combination of more frequent and significant flooding, increased economic safety concerns, and the availability of new and improved environmental and hydraulic data prompted the initiation of an updated evaluation of the 2007 recommended plan. In 2020, the USACE issued a second supplement to the 1982 FEIS.

This 2020 Final Supplemental Environmental Impact Statement (2020 FSEIS) did not repeat the detailed work completed in the 2007 FSEIS, but tiered from it. A copy of the 2020 FSEIS is available at https://www.mvk.usace.army.mil/Missions/Programs-and-Project-Management/Project-Management/Yazoo-Backwater-Project/Yazoo-Backwater-Report/. The 2020 Recommended Plan consisted of a pump station with a maximum combined capacity of 14,000 cfs and a year-round pumping elevation of 87.0 feet NGVD29 at the Steele Bayou gage. However, the location of the pump station was moved to a site at Deer Creek and changes were made to the proposed compensatory mitigation measures. Compensatory mitigation included the acquisition of frequently flooded agricultural lands in fee-title and included the subsequent reforestation of these lands to offset unavoidable losses to wetlands, terrestrial habitat, waterfowl habitat, and a portion of aquatic resources.

The 2020 FSEIS was filed with the EPA on 11 December 2020 and circulated for a final 30-day State and Federal agency review and comment period. A ROD was signed on 15 January 2021. Following issuance of the ROD, EPA concluded that the 2008 CWA Section 404(c) Final Determination applies to the 2020 recommended plan [add hyperlink]. As a result, USACE withdrew the ROD on 11 December 2021 and sought opportunities for continued agency discussion on alternative plans to address flooding concerns in the area.

In January 2023, the U.S. Department of the Army (Civil Works) and the EPA signed a Joint Memorandum of Collaboration to continue to address flooding in the area. The memorandum stated that the agencies are “committed to a collaborative and expeditious path forward to establish flood risk reduction solutions(s) in the YSA that are compliant with the Clean Water Act and all other applicable regulations.” The Joint Memorandum also stated that “close collaboration between the agencies throughout the process will serve the federal government in meeting flood risk management objectives, fulfilling NEPA and CWA Section 404 requirements, addressing the needs of the affected communities, and reducing potential conflicts and delays with the implementation of the project.” Although the USFWS was not a signatory to the Joint Memorandum, they were subsequently included in the collaborative effort in recognition of their important role in the YSA. The Joint Memorandum identified activities to help enable USACE to deliver a proposed approach to flood risk management for the YSA by June 2023. USACE outlined its proposed approach in its July 2023 Federal Register Notice announcing its intent to prepare a new EIS (88 FR 43101 06 July 2023). Additional details are presented in Section 3.0.

SECTION 2
Purpose, Scope, and Need for the Study

The primary purpose of this Water Management Plan and DEIS is to reduce flood risk from flooding in the lower Mississippi Delta caused by excessive standing water for long periods of time. The purpose of this DEIS is also to evaluate any significant effects with any alternatives to address this flood risk. The YSA continues to experience periodic damaging backwater floods and therefore creates the need to reduce flood impacts that are causing undue hardships and economic losses to residents of the area from the flooding of homes and disruptions of sanitation facilities, lines of communications, and transportation. When high water stages occur on the Mississippi and Yazoo Rivers, the flood gates at the Little Sunflower and Steele Bayou water control structures in the Yazoo Backwater levee system are closed. Once these flood gates are closed, water from the Mississippi and Yazoo Rivers are kept out of the area. However, excess water from precipitation events and runoff within the 4,093 square mile drainage area of Steele Bayou, Deer Creek, Little Sunflower River, and Big Sunflower River ponds behind the Yazoo Backwater levee system and is unable to drain out of the area (Figure 2-1).

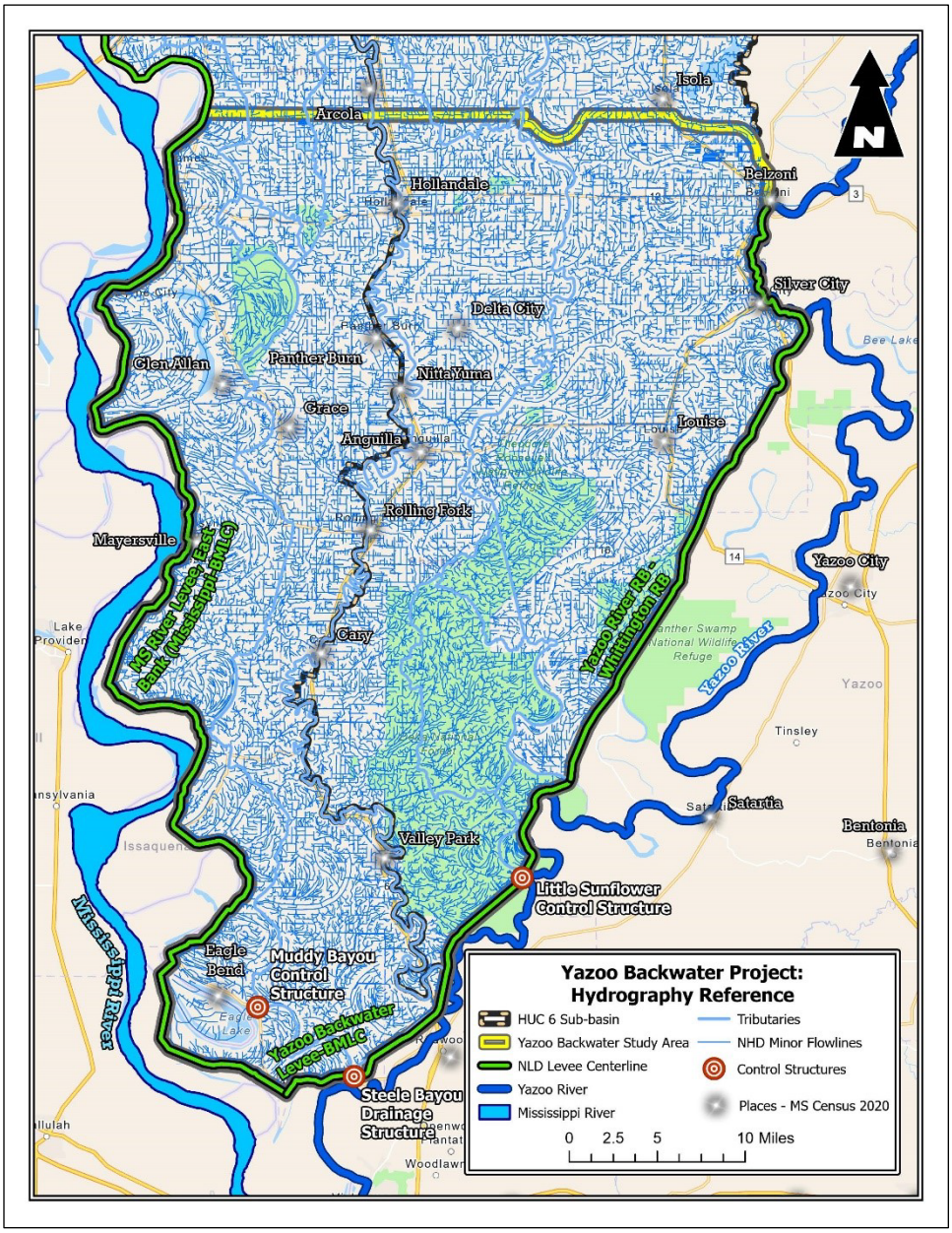

Figure 2-1. Yazoo Backwater Area Levees and Flowlines

The Steele Bayou water control structure is the principal structure of the authorized Yazoo Basin, Yazoo Backwater, Mississippi, Project. During low-flow periods, the Steele Bayou water control structure is operated to control water levels in YSA streams. Under the existing Water Control Manual, the present operation of the Steele Bayou water control structure holds water levels between elevation 68.5 and 70.0 feet, NGVD29. At these elevations, water is still in the river channels.

When water landside of the Steele Bayou water control structure is higher than the riverside and above 70.0 feet, NGVD29, the gates are opened. 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. 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 impounded interior runoff from the 4,093 square mile drainage area of Steele Bayou, Deer Creek, Little Sunflower River, and Big Sunflower River. Under the existing Water Control manual, with rising Mississippi and Yazoo rivers, the upper and lower ponding areas are allowed to rise to an elevation of 75.0 feet, NGVD29; however, the Water Control Manual (WCM) is incomplete without the availability of a pump feature.

When the Mississippi and Yazoo Rivers are experiencing high water stages and the water control structures are closed, inflow from the YSA drainage area ponds and causes backwater flooding. Flooding from precipitation in the YSA affects public roads and bridges; residential and nonresidential structures; other infrastructure; and agricultural, forested, and timber management lands. As a result of the impoundment effect during closure events, flooding has caused undue hardships and economic losses to residents of the area from flooding of homes, disruption to utilities, disruption to communication, and disruption to transportation. Flooding events pose a detriment to overall economic development in the YSA. There is a need to reduce impoundment and reduce flood risk associated with precipitation. A flood risk management project would benefit all sections of the economy and contribute to the well-being of residents located in the YSA.

2.1 NEPA SCOPING

The National Environmental Policy Act of 1969, as amended (NEPA) provides for an early and open process to determine the scope of issues to be addressed and identify the significant issues related to a proposed action. USACE conducted scoping in partnership with EPA and USFWS. A total of four public engagement sessions were held on 15 February 2023 at the USACE Vicksburg District, and a total of four public engagement sessions were held on 4 May and 5 May 2023. Three of these May meetings were held at the USACE Vicksburg District office and the fourth meeting was held at the Theodore Roosevelt National Wildlife Refuge in Hollandale, MS. The February 2023 sessions were held to receive input from the communities on their needs and on development of alternatives, and the May 2023 sessions were held to receive additional input from the communities in the YSA and other interested stakeholders. In addition, roundtable sessions were held on 16 February 2023, with various individuals, groups, and organizations, including a session for community leaders, local elected officials, agricultural interests, and environmental organizations. The input gathered throughout these early engagement sessions was used to inform this Water Management Plan and DEIS. Transcripts from the May 2023 sessions can be found at https://www.mvk.usace.army.mil/Missions/Programs-and-Project-Management/Yazoo-Backwater/.

Commenters spoke on a variety of topics regarding their concerns about, and lived experiences during, flood events, from lack of access to their homes and families, damages to their homes, lack of access to emergency services and education, lack of access to roads and loss of infrastructure, loss of agricultural crops and inability to plant crops, loss of ability

to receive payment from crop insurance, economic losses and business hardships with the community being supported generally by agricultural production, loss of recreational values, loss of wetlands through long duration of inundation, as well as trees and other flora, loss of environmental values and harms caused to fish and wildlife, environmental justice concerns, lack of community growth and development opportunities, and impacts to both physical and mental health. Commenters also raised concerns regarding the potential environmental impacts associated with construction and operation of a large pumping station, including adverse impacts to wetlands, fish, and wildlife, and some stated that only a fully nonstructural or nature-based solution should be put forth for any proposed action. The majority of commenters supported a solution that included a structural component.

The USACE used the information provided by engagements and comments and the joint agency collaborative efforts to develop alternatives for purposes of NEPA compliance. The USACE used information received, such as information related to crop season dates, to modify what the agencies presented to the public in May 2023.

A Notice of Intent (NOI) to prepare an Environmental Impact Statement (EIS) was published in the Federal Register 6 July 2023 (88 FR 43101). Public scoping meetings were held in February and May 2023 throughout the YSA. The purpose of the meeting was to inform the public about the preferred alternative and to gather input on issues to be addressed in an EIS. The scoping period ended on 7 August 2023 with a total of 21,011 emails and three mailed letters. Scoping comments reiterated comments identified in the pre-NEPA scoping discussed previously."

2.2 FEDERAL INTEREST

Since the construction of the Yazoo Backwater levee and water control structures of the authorized Yazoo Backwater, Project, the YSA has experienced flooding from headwater flooding from the Yazoo River, Sunflower River, and Steele Bayou. Such floods occur on an average of approximately 1.5 times a year with a duration in excess of 30 days. In 2019, the YSA experienced record flooding when over 550,000 acres were inundated for over 6 months, and the area has experienced flooding in nine out of the last ten years. Flood damage also occurs to agricultural crops and infrastructure. Flood damages occur to residences and other non-agricultural properties causing social and health problems. Flooding also requires residents to seek temporary housing.

Past study investigations have estimated flood reduction plans would reduce the number of residential and non-residential structures impacted by flooding by 68.5 percent and reduce flood damage for all damage categories by 75.2 percent. Additionally, past flood damage risk reduction plans would also reduce agricultural impacts in the area.

The combination of more frequent and significant flooding; increased economic, and safety concerns; and the availability of new environmental and hydraulic data concerning the YSA prompted the initiation of this Water Management Plan and DEIS pursuant to NEPA and follows the 2005 CEQ guidelines.

2.3 PROBLEMS AND OPPORTUNITIES

The YSA has experienced damaging floods from backwater flooding and from headwater flooding events. However, the focus of this DEIS and of this proposed project for the YSA will be on backwater induced flooding event(s) when the Mississippi and Yazoo rivers exceed flood stages (>90.0 feet, NGVD29). Once the Yazoo River reaches flood stage, due to flooding along the Mississippi River, the Steele Bayou and Little Sunflower water control structures are closed to prevent backwater flooding from the Mississippi River into the YSA. When these waters control structures are closed for high river stages, rainfall that falls within the YSA drainage or areas contributing water to the Yazoo Study Area YSA is trapped and cannot be released to the Yazoo River through the closed water control structures. This trapping or pooling of the water fills the existing water channels and, if the trapped water exceeds the capacity of those channels, overtops the channel banks and floods adjacent lands. Although the closure of the water control structures reduces the danger for intense backwater flooding from the Mississippi and Yazoo Rivers, flooding within the interior of the YSA can still occur if heavy rainfall within the YSA occurs when the gates are closed, flooding that can result in impact to residential and nonresidential structures, to infrastructure servicing the communities and residents, to commercial facilities, and to agricultural production. Furthermore, prolonged closure of the water control structures prevents proper mixing of floodwaters and contributes to water quality degradation and fish passage limitations.

This project presents opportunities for more efficient and effective management of water levels and water quality within the YSA. Opportunities exist to reduce the risk of backwater flooding within the YSA when the water control structures are closed because of high water levels in the Mississippi and Yazoo Rivers. Opportunities also exist to improve water quality and aquatic connectivity through changes in when the water control structures are open and closed.

2.4 GOALS AND OBJECTIVES

Based on the documented problems, the overall goal of this Water Management Plan and DEIS is to reduce the severity of flood damages and risk to public health and safety, caused by rainfall, when the rainfall that falls into the YSA is trapped and cannot be released to the Yazoo River due to closure of the two water control structures. The Federal objective of water and related land resources project planning is to contribute to the National Economic Development (NED) in a manner that is consistent with protecting the Nation’s environment, and in compliance with environmental laws and regulations, applicable Executive Orders, and other Federal planning requirements.

Planning objectives stem from national, state, and local water and related land resource management needs specific to the YSA. These objectives were developed through problem analysis and a public involvement program and have provided the basis for formulation of alternatives, environmental impact assessment, environmental design and evaluation.

The planning objectives, as directed by Congress, are as follows:

a) 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 structures are closed and floodwaters pond landside of the structures;
b) Provide reduced levels of agricultural intensification;
c) Reduce adverse environmental impacts through design.
d) Consistent with USACE policy, the project also has a planning objective of compensating for 100 percent of unavoidable environmental impacts from the proposed action as described in this DEIS.

While the objectives of subparagraphs a through d above were utilized to address future problems and opportunities of the YSA associated with the proposed action, this DEIS does recognize there are separate and ongoing mitigation requirements for the already completed Yazoo Area and Satartia Area Backwater levees projects.

2.5 PLANNING CONSIDERATION

For purposes of comparing alternatives, the Vicksburg District utilized the first four objectives identified above as an appropriate summary description of project purpose and need. While the primary purpose of the project is flood risk management, these four objectives were balanced, in screening and evaluating alternatives under NEPA. As discussed in Section 3, this process led to the development of a proposed plan that would provide significant flood risk reduction for communities in the YSA and the local economy while also avoiding and minimizing impacts to important environmental resources.

SECTION 3
Alternative Formulation

As discussed in Chapter 1, after the issuance of the Joint Memorandum, the USACE, EPA, and USFWS organized interagency technical and engagement teams to identify issues of concern and to develop this Water Management Plan and DEIS. The agencies conducted public engagement sessions to allow for the public to provide comments on preliminary options under consideration by USACE for a project. All comments received were cooperatively reviewed by the interagency teams and considered in the development of this Water Management Plan.

Four public engagement sessions were held on 15 February 2023 at the USACE Vicksburg District, and a total of four public engagement sessions were held on 04 and 05 May 4 2023. Three of these May meetings were held at the USACE Vicksburg District office, and the fourth meeting was held at the Theodore Roosevelt National Wildlife Refuge in Hollandale, MS. The February 2023 sessions were held to receive input from the communities on their needs and on development of a draft preferred approach. Roundtable sessions were held on 16 February 2023, with various individuals, groups, and organizations, including a session for community leaders, local elected officials, agricultural interests, and environmental organizations. In addition, a virtual community meeting was held 16 March 2023 for community members who could not attend the in-person engagement sessions. The May 2023 sessions were held to receive input from the communities in the YSA and other interested stakeholders.

The USACE used the information from historical studies, information provided by public engagements, and information generated as part of the joint agency collaborative effort to develop various alternatives for purposes of NEPA compliance. The USACE used information provided by the United States Department of Agriculture's Natural Resource Conservation Services and the Mississippi Agriculture Commissioner, such as information related to crop season dates for the primary crops raised in the YSA (corn, soybeans, wheat, and cotton) to develop an initial and final array of alternatives for consideration under this EIS.

3.1 INITIAL ARRAY

In light of the results of the historical NEPA Process, with this current NEPA effort, USACE has sought to develop a new approach for implementing the unconstructed features of the Yazoo Backwater, Project. The goal of this new approach is to provide flood risk management solutions to the communities in the YSA and the local economy. Flood risk management targets primary residences (and roads isolating them), schools, infrastructure, commercial properties, and prime farmland while also avoiding and minimizing impacts to important environmental resources.

The Vicksburg District considered alternatives that included nonstructural features, structural features, and combined nonstructural and structural features. Alternatives were formulated to minimize and/or avoid potential adverse project impacts on the environment, while still meeting the congressional mandated objectives stated in Section 2. These alternatives were developed and evaluated by an interdisciplinary team representing disciplines such as engineering, hydrology, economics, and environmental. Each of the alternatives was developed through a multi-objective process to satisfy the specific needs identified in this report. Water management and mitigation features were evaluated to avoid, minimize, and compensate for unavoidable adverse environmental impacts. A “no-action” alternative was evaluated to display future conditions in the absence of a Federal project. As described above, the affected public was consulted to guide the formulation and evaluation of alternatives for this study.

As part of this Water Management Plan and DEIS effort, various pumping elevations were evaluated to determine the level of flood risk management and the associated level of environmental impact. Unique aspects of the YSA were considered to guide the development of operational schemes, pump station capacities, and targeted elevation.

3.2 MANAGEMENT MEASURES

3.2.1 Pump Stations

Structural features evaluated included pump stations, to work with the existing levee system and drainage systems within the YSA. Past reports considered various locations, however, engineering investigations determined that past pump station locations would limit the operational flexibility. The Steele Bayou site is one of the only locations that has direct access to the Little Sunflower or Steele Bayou sump, and thus provides adequate access to the majority of the YSA. Other locations would have limited the different pump capacities the USACE could have considered and could have limited the time to drain the YSA. Additional details can be found in Appendix A – Engineering Report/H&H.

3.2.2 Pump Station Operation

As discussed in Section 2, part of the objective of this study efforts is to reduce adverse environmental impacts through design. To avoid and minimize impacts on sensitive habitats various pump station capacities and operational times were considered for the Steele Bayou Location. Options considered in this Water Management Plan and DEIS propose managing water levels at elevations under varying conditions to benefit flood risk management goals and to avoid and minimize wetland impacts. Pumping elevations that did not allow some level of periodic flooding to reach the entire 5-year floodplain were not considered (e.g., year-round pumping elevation set at 90 feet only); a range of elevations were evaluated

As discussed above, a range of elevations were considered consistent with the use of crop and non-crop seasons.

- Upper Bound
    - The YSA is home to highly functional, forested riverine wetlands, known as riverine backwater wetlands, which require periodic flooding at intervals at least every one to five years to deliver their full suite of wetland ecological functions (Smith and Klimas 2002). This means that riverine backwater wetlands are limited to the 5-year floodplain which is currently estimated to be bounded by the 92.8-foot elevation.
    - Pumping elevations proposed in the past would have significantly reduced or in some cases eliminated the periodic flooding necessary for these wetlands to deliver their full suite of wetland ecological functions.
    - To minimize impacts to riverine backwater wetlands, it was recognized that some level of periodic flooding would need to be provided to the entire 5-year floodplain.
    - Many residents in the YSA either own or work on farms within the 5-year floodplain to sustain their livelihood, and excessive flooding threatens the community and the economy by the uncertainty of safe and timely access to farmland.
    - An elevation of 93 feet was selected as the first pump elevation since it would be the upper bound to include the entire 5-year floodplain while sustaining economic livelihood.

- Lower Bound
    - A large proportion of riverine backwater wetlands occur within the 2-year floodplain. Wetlands in the 2-year floodplain are sustained by more frequent flooding than those in the 5-year floodplain and are thus typically utilized more frequently by aquatic-dependent species and migratory birds.
    - The 2-year floodplain is currently estimated to be bounded by the 89.9-foot elevation.
    - More frequently flooded agricultural lands within the 5-year floodplain, such as those within the 2-year floodplain, tend to be more challenging to farm and less productive due to the higher frequency of flooding and poorer drainage.
    - An elevation of 90 feet was selected as the second pumping elevation since it would be the lower bound to include the entire 2-year floodplain.

3.2.3 Seasonal Pump Operation

Operating pumps at different times during the year, while focusing on planting seasons and growing periods (for crops) could limit flooding to existing agricultural interest in the area while balancing impacts to wetlands. While a year-round pumping elevation of 90 feet would address backwater flooding concerns for all interests greater than 93 feet, it would not

provide flood risk management for interests less than 93 feet during non-crop season. Due to this, nonstructural measures as discussed below are offered to address this flood risk.

In discussions with local stakeholders, it was determined that to further minimize impacts to wetlands between the 2-year and 5-year floodplain, the pump operation would have variable on and off triggers at different times of the year. There is a significant amount of acres of land in farm production between the flood plains. See Table 3-3 for land classifications between 90 and 93 feet elevation in the flood plain. To maximize the time the surrounding wetlands are flooded while still maintaining farming practices in these areas, the USACE reviewed times when the water elevations could be headed at a higher elevation when the fields are fallow.

3.2.4 Agricultural Production Considerations

Mississippi Delta crop information was solicited through information requests from the Natural Resource Conservation Service and the Mississippi Agriculture Commissioner as well as through outreach to the local stakeholders and public (Table 3-1). The dominant crops in the Yazoo backwater area up to the 5-year floodplain include field corn, soybeans, wheat, and cotton. The information requests included earliest planting date, latest planting date, days to reach maturity, and pre-and post-planting practices. Field corn has the earliest planting range between 01 March and 20 April and cotton has a later planting range between 20 April and 15 May and the longest maturity length at 160 days. The crop date ranges represented in each alternative were derived iteratively by calculating ranges between the earliest crop planting season (corn) along with the longest days to reach maturity (cotton) and adding 2 weeks on the beginning and end of each of the season to account for pre- and post-land preparation, planting, and harvest. However, it should be noted that late season planting of corn lowers yields due to high temperatures during pollination.

In addition, modeling showed that using a 25,000 cfs pump with the largest flood of record (2019 at 98.2 feet elevation) would take 8 days to draw the water down one foot. This calculation indicates that from the pump turn on date, it can take up-to 24 days to draw the water from 93 feet to 90 feet and then there is further drying time prior to planting and getting machinery on the land.

Table 3-1. Mississippi Delta Crop Information

5-year floodplain dominant Crops	Earliest planting date	Latest planting date	Days to reach maturity	Field preparation time needed before the planting date? (y/n)	Pre-plant preparation types in place (e.g. tilling, pre-planting field application treatments) (y/n)
Field Corn	3/1	4/20	115	Y	Y
Soybeans	4/1	5/30	142	Y	Y
Soybean after wheat	6/5	6/25	135	N/A	N/A
Cotton	4/20	5/15	160	Y	Y
Wheat	10/28	11/10	220	Y	Y

Three different crop seasons were considered in discussions with stakeholders throughout the YSA.

- Crop Season 01 March – 15 October / Non-crop season 15 October – 28/29 February
    - The crop season of 01 March – 15 October was eliminated because it eliminated March spring flood frequency and early fish guild spawning.
    - It provided excess drying and preparation time at the detriment to aquatic, wetland, and terrestrial resources.
- Crop Season 16 March – 15 October / Non-crop season 16 October – 15 March
    - The crop season of 16 March – 15 October was the revised crop season date range based on comments received through 04 and 05 May 2023 public engagement meetings.
    - This crop season allows for the preparation and drying time to the agriculture community and ensures that crop yields are not significantly impacted due to high temperatures during pollination.
    - It provides 15 days for spawning of the early fish guild which spawns as early as March 1st and is estimated to require 8-days for spawning.
    - Similarly, 16 March leaves water on wetlands during 15 days of the March spring flood regime.

- Crop Season 25 March – 15 October / Non-crop season 15 October–24 March
    - The crop season of 25 March – 15 October was the original crop season date range proposed to the public at the 04 and 05 May 2023 engagement meetings.
    - This crop season was estimated as the latest start date to allow crops to be planted before the end of the planting range. However, it should be noted that late season planting of some crops such as corn, lowers yields due to high temperatures during pollination.
    - It provides 24 days for spawning of the early fish guild which spawns as early as 01 March and is estimated to require 8-days for spawning.
    - Similarly, 25 March leaves water on the wetlands longer and allows for more flooding opportunities as demonstrated by Table 2-29 *Pump Operations by Month* in Appendix A – Engineering Report/H&H.
    - The later crop season date is the most environmentally protective because it allows for thorough spawning of the early fish guild, more flooding for wetlands and terrestrial resources, and minimizes environmental losses.

3.2.5 Pumping Capacity

To ensure that the pumps would be able to manage water elevations at 90.0 feet during crop seasons and up to 93.0 feet during non-crop seasons, varying pump sizes were also considered.

- The following pump capacities were evaluated: 14,000 cfs; 17,500 cfs, 20,000 cfs; 22,100 and 25,000 cfs (See Table 2-27 and 2-28 of Appendix A – Engineering Report/H&H).
- Pumping capacities less than 25,000 cfs were screened out for two reasons.
    - First, they would not allow USACE to effectively manage water levels from not exceeding 93 feet. These lower pump capacities would require pumping to be initiated at much lower elevations in order to effectively manage water at 93 feet. Initiating pumping at lower levels would increase impacts to riverine backwater wetlands.
    - Second, they would not allow USACE to allow rising water from the Mississippi and Yazoo Rivers to flow into the YSA up to an elevation of 75 feet. The smaller pump capacities would require USACE to close the gates at lower water elevations in order to preserve more freeboard in the sump areas in the event of rainfall events occurring within the YSA drainage while the gates are closed.

3.2.6 Low Flow Wells

In addition to the pump operations and structure operations to reduce adverse environmental impacts through design releases from low-flow wells from shallow groundwater are also being proposed as a measure. Since the fish-carrying capacity of a river system is dependent in part on the habitat quantity and quality during annual low flow

conditions a measure is being proposed to supplement the existing river flows. 34 low-flow groundwater wells within 30,000 feet of the Mississippi River channel and upstream of the YSA are being proposed as a measures. Each well is expected to deliver a maximum of 5.0 cfs during traditionally low flow periods. The increased low-flow aquatic habitat provided with the operational feature could significantly increase standing stock and production for many fish species and support aquatic resources in the YSA.

3.2.7 Local Protections (Ring Levees)

Historical local protection projects were considered for the towns of Rolling Fork, Eagle Lake, Cary, Holly Bluff, and Valley Park. Local protection works usually consisted of ring levees, interior structures, and often a pump station to remove interior drainage. This measure was screened out for consideration. Past efforts have shown that the amount of land required to construct the levees, pumps, and structures would make it difficult to construct due to the rural nature of the YSA. Also, flooding would still occur outside the ring levees and roadways would still incur damages. Residents will be isolated by submerged roadways and endure hardships from traveling flooded roads, traveling miles out of the way taking alternative routes, and/or having to use boats to get to their destinations. Disruptions would also occur to other daily operations, such as school bus routes, water supply, electric service, sewage systems, and emergency services. Due to these reasons above local protections were not considered for alternative development.

3.2.8 Nonstructural Measures

All practicable nonstructural features to manage flood risk were considered during the development of alternatives. While some were eliminated during the early formulation of alternatives due to past study efforts; others were evaluated in detail to determine whether a combination of structural and nonstructural features would comprise the best solution for the YSA.

An evaluation of the YSA shows that there is a wide number of structures and types of land at risk from flooding depending on the elevation measured at the existing Steele Bayou control structure (Table 3-2 and Table 3-3). As shown in the table there are estimated 55 residential structure below the 90 feet elevation.

Table 3-2 Structures at 90, 93, and 98.2-foot Elevations

	Elevation (NGVD29) at Steele Bayou Control Structure		
Structure Type	**90 feet**	**93 feet**	**98.2 feet (2019 Flood Limits)**
Agriculture	7	31	239
Commercial	5	8	26
Residential	**55**	**150**	**909**
Utility	23	112	578
Unclassified*	11	31	93
Total	101	332	1,845

Table 3-3. Land Cover Acres at 90, 93, and 98.2 Foot Elevations

	Elevation (NGVD29) at Steele Bayou Control Structure		
Land Cover	**90 feet**	**93 feet**	**98.2 feet (2019 Flood Limits)**
	-acres-	**-acres-**	**-acres-**
Cleared (Farmland)	11,816	39,491	137,926
Forestry	3,042	5,476	6,892
Developed	681	967	1,775
Woody Wetlands	110,058	167,822	226,447
Grasslands	348	511	986
Wetlands	989	1,153	1,246
Water	4,320	4,480	7,197
Other[1]	17,299	24,187	40,247
Total	**148,553**	**244,088**	**422,717**

Source 2022 CDL
[1]The Other is comprised of lands around the edges of other land cover types, cloud cover, undefined, and scrublands.

Two types of nonstructural features were considered — (1) Physical Nonstructural measures, which reduce existing damages and – (2) Non-physical Nonstructural measures those which reimburse for existing damages or reduce future damage potential;

3.2.8.1 Physical Nonstructural Measures Considered Included

Elevation (Screened Out)

Elevations were initially considered, but it was determined to be impractical due to the types of structures in the YSA and elevations would still leave many of the structures isolated by submerged roadways and endure hardships from traveling flooded roads, traveling miles out of the way taking alternative routes, and/or having to use boats to get to their destinations. In addition, many of the structures are slab-on-grade construction with a septic system, which would be costly to elevate and costly to retrofit safe and sanitary facilities.

Relocation (Screened Out)

Relocations were considered, but due to the rural nature of the YSA and the extent of the flooding in the YSA, it was screened. As discussed above most of the structures are slab on grade and it would be costly to relocate these structures. In addition, due to the nature of the flooding in the YSA, structures would have to be moved over a significant number of miles on rural roads to reach elevations outside of the 1 percent annual chance flood (100-year flood) plain.

Acquisition (Carried Forward)

Acquisition was considered, but was broken into two categories, mandatory and voluntary.

Mandatory acquisition of residential structures vulnerable to the most frequent flooding (2 year and below), and voluntary acquisition of structures in the less frequent floodplain (above the 2 year) were considered. Acquisition of lands, particularly lands in crop production were also considered, but only voluntarily when the land was not tied to a residential structure acquired for mandatory purposes.

As discussed in Table 3-2 previously, there is a total of 101 structures in the 2-year floodplain based on existing structure inventory databases. It is important to note that only 55 structures are residential structures in Table 3-2, and acquisitions would only apply to primary residential structures. The existing structure inventory likely overestimates the number of primary residential structures in the floodplain, since a windshield survey conducted after the 2019 flood event showed that many of the residential structures have been removed or appear to not be the primary residential structure. There are other structures in the study area that are agricultural support facilities, such as storage shed, pump houses, equipment trailers. Due to this uncertainty, the full structure count was used in the evaluation of this document, however, the final count for mandatory implementation will likely be lower than the 55 residential structures identified. Past reconnaissance level field investigations have shown a number as low as 20 primary residential structures. Detailed real-estate investigations would have to take place in the future before determining whether a structure is a primary residential structures and would be eligible for mandatory acquisitions.

Structures above the 2-year floodplain were considered to be voluntarily acquired. There are a total of 231 structures between the 2-year and 5-year floodplain, or a total of 1,845 structures within the most recent historical floodplain (2019) that could be considered for voluntary acquisition.

Table 3-3 also identifies 11,816 acres of cleared land at or below the 2-year floodplain. For this document, it was assumed that this land was agricultural land in production. For this measure, the report evaluated the acquiring of these lands voluntarily, even when tied to a structure at or below the 2-year floodplain. It was assumed that some of the land ownership was tied to structures being proposed for mandatory acquisition. In those cases, the lands associated with the structures would be acquired through a fee or a conservation easement to limit activities. This would still allow private ownership of the land once the structures have been removed, but it would also limit the risk of flooding crops in this floodplain by taking them out of production permanently. The same consideration would be given to lands not tied to structures. In addition to the cleared lands at or below the 2-year floodplain, this measure also evaluated acquiring through fee or a restrictive easement cleared lands above the 2-year floodplain. There are a total of 27,675 acres of cleared lands between the 2-year and 5-year floodplain, or a total of 137,926 acres of cleared land within the most recent historical floodplain (2019) that could be considered for a fee or a restrictive easement.

Considerations for the acquisition of other lands (existing wetlands and forested wetlands) through fee or restrictive easements in the YSA were considered but screened out due to that fact existing programs maintain these lands or protect these lands from development and would still exist under the future without project (FWOP) and future with project (FWP) conditions. These wetlands would be subject to existing Federal, State, and local laws and regulations regarding the development of wetlands. This would include but is not limited to; Section 404 of the Clean Water, as well as local zoning ordinances. Addressing these laws and regulations would likely still be a significant economic cost to overcome for developing in these areas under both the FWOP and FWP conditions.

Dry Flood Proofing or Wet Flood Proofing (Screened Out)

Dry floodproofing involves sealing building walls with waterproofing compounds, impermeable sheeting, or other materials to prevent the entry of floodwaters into damageable structures, while wet floodproofing measures allow floodwater to enter the structure, vulnerable items such as utilities, appliances, and furnaces are relocated or waterproofed to higher locations. By allowing floodwater to enter the structure, hydrostatic forces on the inside and outside of the structure can be equalized reducing the risk of structural damage.

Both of these measures were screened out for consideration. To some extent, there have been some existing local efforts to implement these measures in commercial structures and some residential structures (dry floodproofing through small walls and levees around individual structures), but due to the long periods of elevated water levels, it places significant risk on the failure of these types of measures. Also as discussed with the Local Protections (Ring Levees), it still leaves residents isolated (with dry floodproofing) or places

residents in situations where they have to find alternative living arrangements until floodwaters recede.

3.2.8.2 Additional Physical Nonstructural Measures Considered Included

Flood Warning Systems; Evacuation Plans; Risk Communication; Floodplain Mapping; and Flood Emergency Preparedness Plans (Carried forward for future updates)

Flood Warning Systems alert inhabitants in flood-prone areas of impending high water. Warning systems in conjunction with evacuation plans allow inhabitants to have the opportunity to evacuate damageable property and themselves from the flood-prone area. Floodplain Mapping is a nonphysical nonstructural measure that identifies flood risk, whether in the form of a map that portrays flood boundaries or as an inundation map illustrating the depth of flooding, this measure is a significant tool when addressing flood risk. With flood emergency preparedness plans local officials are encouraged to develop and maintain a flood emergency preparedness plan (FEPP) that identifies hazards, risks, and vulnerabilities, and encourages the development of local mitigation. The FEPP should include the community's response to flooding, the location of evacuation centers, evacuation routes, and flood recovery processes.

For this document, these measures were carried out for consideration, but only for updates in the future once a final recommendation is made for the YSA. The area already has an ample forecast/warning system; floodplain maps; and FEPP's provided by the local government, state agencies, and the federal government. The National Oceanic and Atmospheric Administration (NOAA), FEMA, and the USACE already produce flood maps under existing flood plain management authorization and will continue to produce these maps and continue with flood notifications under the FWOP conditions. These systems would also be updated with any changes to the way the authorized Yazoo Basin, Yazoo Backwater, Mississippi, Project features are operated.

Flood Insurance; Land Use Regulations (Screened Out, due to Existing Programs)

Flood Insurance provides insurance to assist in recovery from a flood event. Currently, the YSA is covered by the National Flood Insurance Program (NFIP), and at the time of the release of this document, the YSA is eligible for participation under the United States Department of Agriculture's (USDA) program for crop insurance. Since these programs would exist under the FWOP conditions or any FWP conditions it was removed from consideration as a new measure. Land Use Regulations are also effective tools in reducing flood risk and flood damage. The National Flood Insurance Program (NFIP) in the YSA already provides a minimum standard of floodplain regulation. All six Mississippi counties and nine communities in the YSA are participants in the National Flood Insurance Program (NFIP). The unincorporated communities participate in NFIP through the local counties. This program allows property owners to purchase flood insurance at subsidized rates and mandates the local government to adopt and enforce flood plain regulations that require all future development within the 100-year flood plain to be elevated above the 100-year flood elevation. Further restrictions, such as zoning ordinance regulation and building code could

be implemented at the local level to reduce flood risk above NFIP through zoning restrictions.

3.3 FINAL ARRAY

Based on the remaining management measures above, the following alternatives carried into the final array are described below. Alternatives include the no-action, alternative 1, alternative 2, alternative 3, and alternative 4. Two strategies in addition to the no-action were proposed. The first strategy was a combination of a structural and nonstructural solution with two different operation scenarios. A sole nonstructural solution was also proposed.

3.3.1 Alternative 1, No Action

The following is the no-action alternative. Choosing this alternative would mean that flood risk within the YSA would not be reduced. As a result, both residential and nonresidential structures, as well as agricultural production within the YSA would still be susceptible to flooding, which would have an economic impact on the area. Flood-fighting efforts, as well as repairs to urban and rural roads, bridges, and other infrastructure, will continue to be funded by local, state, and Federal governments. It is important to note that selecting the no-action alternative will not have any project impacts.

3.3.2 Combined Structural and Nonstructural Plans

The following alternatives contain a combination of structural, operational, nonstructural, federal memorandums of agreement, environmental enhancement, and mitigation components. The alternatives listed throughout the DEIS, referenced here forth as Alternative 2 & Alternative 3, contain identical components and differ only on the crop season range shown below.

3.3.2.1 Alternative 2 (Crop Season 16 March – 15 October and Non-crop Season 16 October – 15 March)

Structural Feature

To reduce flood stages across all frequency flood events a 25,000 cfs pump station is proposed adjacent to the Steele Bayou structure. To minimize and/or avoid potential adverse project impacts on the environment and still meet the goals of the project discussed in Chapter 2, two different operations were proposed; water levels managed at 90.0 feet during crop season (16Mar-15Oct) and up to 93.0 feet during noncrop season (16 October - 15 March).

Operation Conditions

In its current state, the YSA is an isolated system due to the Yazoo Backwater levee and outlet structures preventing inflow of water from the Yazoo-Mississippi Rivers. During potential flood-prone periods with rising Mississippi and Yazoo rivers, the operations plan for the Steele Bayou Water Control Structure (WCS) would allow free movement of water into and out of the lower Yazoo Basin up to an elevation of 75.0 feet, NGVD29 before closing the

gate. This full utilization of the current Water Control Manual (1985) for the operation of Steele Bayou WCS will promote fishery species diversification. During low-water periods, the operation plan of the Steele Bayou WCS is currently operated to maintain water elevations between 68.5 and 70.0 feet, NGVD29, and this will be continued. This operation plan optimizes the potential for inter-basin water exchange improving reaeration in the lower Yazoo basin and benefits fisheries exchange. No additional real estate is required for this feature. Consideration of new or different operating elevations to encourage aquatic resource recruitment and retention will be evaluated in the M&AM process.

Low Flow Wells

In addition to the pump operations and structure operations to reduce adverse environmental impacts through design; releases from low-flow wells from shallow groundwater is also being proposed as part of this alternative. Since the fish-carrying capacity of a river system is dependent in part on the habitat quantity and quality during annual low flow conditions a measure is being proposed to supplement the existing river flows. Thirty-four low-flow groundwater wells within 30,000 feet of the Mississippi River channel and upstream of the YSA are being proposed as a part of this alternative. Each well is expected to deliver a maximum of 5.0 cfs during traditionally low flow periods. The increased low-flow aquatic habitat provided with the operational feature could significantly increase standing stock and production for many fish species and support aquatic resources in the YSA.

Nonstructural Feature

To further manage flood risk below the pump operation elevation (i.e. 90 feet), mandatory acquisition of all structures (101 Structures) is being proposed; while voluntary acquisition of residential and commercial properties (231) up to 93.0 feet is being proposed. This measure would address the most vulnerable structures at risk from frequent flooding. As discussed in the measures listed above, it is important to note that the number of structures implemented in the mandatory and voluntary plan could be less once individual structure investigations take place.

The plan would also include the acquisition of up to 11,816 acres of cleared land at or below the 2-year floodplain through fee or a restrictive easement based on voluntary participation. As discussed in the measures above, it was assumed that this land was agricultural land in production. For this alternative, the report evaluated acquiring these lands on a voluntary basis, even when tied to a structure at or below the 2-year floodplain. It was assumed that some of the land ownership (outside of the structure footprint) was tied to structures being proposed for mandatory acquisition. In those cases, the lands associated with the structures would still be on a voluntary basis acquired through fee or through a restrictive easement to limit activities. This would still allow private ownership of the land once the structures have been removed, but it would also limit the risk of flooding crops in this floodplain by taking them out of production permanently. The same consideration would be given to lands not tied to structures.

In addition to the cleared lands at or below the 2-year floodplain, this alternative includes the acquiring of lands through fee or a restrictive easement for cleared lands above the 2-year floodplain. There are a total 27,675 acres of cleared lands between the 2 year and 5 year floodplain. Consistent with acquiring structures on a voluntary basis in this floodplain (2 year -5 year) to further reduce risk, the alternative proposes to voluntary acquire these using fee or through a restrictive easement to further reduce flood risk to crops.

Considerations for nonstructural measures (structural and land acquisition) above the 5 year floodplain were not considered with the alternative since the pump operation is expected to maintain stages at or below the 5 year floodplain elevation.

Compensatory Mitigation

Although the variable pump operations and modification of the operation of the Steele Bayou WCS to optimize fisheries exchange minimized and/or avoid potential adverse project impacts on the environment. It did not remove all impact. It is expected that this proposal would impact wetlands, aquatic resources and fisheries habitat, waterfowl habitat, and terrestrial wildlife habitats. A detailed analysis of the affected environment that evaluates both beneficial and adverse effects to significant resources in the YSA is provided in Section 5.0 of this Water Management Plan and DEIS. A compensatory mitigation plan for unavoidable environmental impacts would be included with this plan.

3.3.2.2 Alternative 3 (Crop Season 25 March – 15 October and Non-Crop Season 16 October – 24 March)

Structural Feature

To reduce flood stages across all frequency flood events a 25,000 cfs pump station is proposed adjacent to the Steele Bayou structure. To minimize and/or avoid potential adverse project impacts on the environment and still meet the goals of the project discussed in Chapter 2, two different operations were proposed; water levels managed at 90.0 feet during crop season (25 March – 15 October) and up to 93.0 feet during noncrop season (16 October - 24 March).

Operation Conditions

In its current state, the YSA is an isolated system due to the Yazoo Backwater levee and outlet structures preventing inflow of water from the Yazoo-Mississippi Rivers. During potential flood-prone periods with rising Mississippi and Yazoo rivers, the operations plan for the Steele Bayou Water Control Structure (WCS) would allow free movement of water into and out of the lower Yazoo Basin up to an elevation of 75.0 feet, NGVD29 before closing the gate. This full utilization of the current Water Control Manual (1985) for the operation of Steele Bayou WCS will promote fishery species diversification. During low-water periods, the operation plan of the Steele Bayou WCS is currently operated to maintain water elevations between 68.5 and 70.0 feet, NGVD29, and this will be continued. This operation plan optimizes the potential for inter-basin water exchange improving reaeration in the lower Yazoo basin and benefits fisheries exchange. No additional real estate is required for this

feature. Consideration of new or different operating elevations to encourage aquatic resource recruitment and retention will be evaluated in the M&AM process.

Low Flow Wells

In addition to the pump operations and structure operations to reduce adverse environmental impacts through design; releases from low-flow wells from shallow groundwater is also being proposed as part of this alternative. Since the fish-carrying capacity of a river system is dependent in part on the habitat quantity and quality during annual low flow conditions a measure is being proposed to supplement the existing river flows. 34 low-flow groundwater wells within 30,000 feet of the Mississippi River channel and upstream of the YSA are being proposed as a part of this alternative. Each well is expected to deliver a maximum of 5.0 cfs during traditionally low flow periods. The increased low-flow aquatic habitat provided with the operational feature could significantly increase standing stock and production for many fish species and support aquatic resources in the YSA.

Nonstructural Feature

To further manage flood risk below the pump operation elevation (i.e. 90 feet), mandatory acquisition of all structures (101 Structures) is being proposed; while voluntary acquisition of residential and commercial properties (231) up to 93.0 feet is being proposed. This measure would address the most vulnerable structures at risk from frequent flooding. As discussed in the measures listed above, it is important to note that the number of structures implemented in the mandatory and voluntary plan could be less once individual structure investigations take place.

The plan would also include the acquisition of up to 11,816 acres of cleared land at or below the 2-year floodplain through fee or a restrictive easement based on voluntary participation. As discussed in the measures above, it was assumed that this land was agricultural land in production. For this alternative, the report evaluated acquiring these lands on a voluntary basis, even when tied to a structure at or below the 2-year floodplain. It was assumed that some of the land ownership (outside of the structure footprint) was tied to structures being proposed for mandatory acquisition. In those cases, the lands associated with the structures would still be on a voluntary basis acquired through fee or through a restrictive easement to limit activities. This would still allow private ownership of the land once the structures have been removed, but it would also limit the risk of flooding crops in this floodplain by taking them out of production permanently. The same consideration would be given to lands not tied to structures.

In addition to the cleared lands at or below the 2-year floodplain, this alternative includes the acquiring of lands through fee or a restrictive easement for cleared lands above the 2-year floodplain. There are a total 27,675 acres of cleared lands between the 2 year and 5 year floodplain. Consistent with acquiring structures on a voluntary basis in this floodplain (2 year -5 year) to further reduce flood risk, the alternative proposes to voluntary acquire these using fee or through a restrictive easement to further reduce flood risk to crops.

Considerations for nonstructural measures (structural and land acquisition) above the 5 year floodplain were not considered with the alternative since the pump operation is expected to maintain stages at or below the 5 year floodplain elevation.

Compensatory Mitigation

Although the variable pump operations and modification of the operation of the Steele Bayou WCS to optimize fisheries exchange minimized and/or avoid potential adverse project impacts on the environment. It did not remove all impact. It is expected that this proposal would impact wetlands, aquatic resources and fisheries habitat, waterfowl habitat, and terrestrial wildlife habitats. A detailed analysis of the affected environment that evaluates both beneficial and adverse effects to significant resources in the YSA is provided in Section 5.0 of this Water Management Plan and DEIS. A compensatory mitigation plan for unavoidable environmental impacts would be included with this plan.

3.3.2.3 Alternative 4, Nonstructural Plan Only

This alternative contains operational and nonstructural features which influence land-use patterns and activities. There is a no-pump station feature in this alternative. To be consistent with other alternatives (i.e., some level of benefit across the YSA), this alternative would include voluntary acquisition of structures and croplands to the historical flood elevations (i.e. 98.2 feet NGVD29).

Operational

In its current state, the YSA is an isolated system due to the Yazoo backwater levee and outlet structures preventing inflow of water from the Yazoo-Mississippi Rivers. During potential flood-prone periods with rising Mississippi and Yazoo rivers, there would be no changes to the existing operations plan for the Steele Bayou Water Control Structure (WCS). During low-water periods, the operation plan of the Steele Bayou WCS is currently operated to maintain water elevations between 68.5 and 70.0 feet, NGVD29, and this will be continued. No additional real estate is required for this feature.

Nonstructural Feature

There are a total of 1,845 structures within the most recent historical floodplain (2019) that could be considered for voluntary acquisition under this alternative. In addition to the structures, the plan would also include the acquisition of up to 137,926 acres of cleared land to the most recent historical floodplain through fee or a restrictive easement based on a voluntary basis. As discussed in the measures above, it was assumed that this land was agricultural land in production. Using a restrictive easement would still allow private ownership of the land once the structures have been removed, but it would also limit the risk of flooding crops in this floodplain by taking them out of production permanently.

3.4 SCREENING OF ALTERNATIVES

Alternative 4, the Nonstructural Plan Only, is being considered and public comment is welcomed on this alternative, particularly as it relates to the following concerns identified.

As discussed above, there are a total of 1,845 structures within the most recent historical floodplain (2019) that could be considered for voluntary acquisition basis and there are also up to 137,926 acres of cleared land (farmland) that could be considered through fee or a restrictive easement based on a voluntary basis. When compared to Alternative 2 or 3, Alternative 4 works toward the goal of reducing flood risk in the study area; however, there is anticipated risk associated with assumed participation rate. The initial planning assumption to compare Alternative 4 to the other alternatives assumed a 100 percent participation rate; however, in socially vulnerable areas, the realized participation rate is lower than the initial planning assumption. A reduced participation rate limits the ability of the nonstructural plan to provide adequate flood risk reduction. Also, there would be no flood risk management provided to ineligible structures or structures whose owners choose not to participate. While the nonstructural plan would provide flood risk management benefits to eligible and participating structures, the nonstructural plan would not address any other ongoing flooding issues within the YSA.

Significant portions of the study area have been identified as low-income communities; therefore, some structure owners may not have the financial ability to address potential additional costs such as relocating outside of the floodplain. Primary residential structures are only eligible for acquisitions; however, due to the fact that they are voluntary in nature, uniform relocation assistance would not apply. This may be a financial hardship for low-income communities which would likely reduce the participation rate.

Flooding displacement, whether through voluntary or involuntary methods, does not ensure communities access to improved environmental conditions following migration, and may compromise human security. Displacements can be detrimental to communities, in particular EJ communities, ability to secure food and income. (Kakinuma et al, 2020) The complex dynamic between a community's "right to stay" and their inability to mobilize is difficult to untangle. (Black et al, 2013) USACE is particularly interested in the willingness and ability of the backwater community to accept a fully nonstructural solution to flood risk reduction and hopes to receive feedback in the public comment period on this topic.

Similarly, a significant element of the overall project purpose is flood risk reduction for the local economy of the YSA, in particular to agricultural production in the YSA. As discussed above, Alternative 4 would include the acquisition of nearly 140,000 acres of cleared land, which are assumed to be in agricultural production within the floodplain of the 2019 flood. Although this acquisition would be voluntary through fee or a restrictive easement, these agricultural lands would be taken out of crop production and converted to conservation lands. This could have significant impact on the tax base of the local communities going from agricultural productive lands to conservation and even the communities ability to secure income, thereby impacting the economy of the YSA.

The acquisition and subsequent loss of up to 140, 000 acres of YSA agricultural lands could significantly impact employment within the YSA with the loss of jobs directly or indirectly supported by agricultural production thereby impacting the local economy.

3.5 SELECTION RATIONALE FOR A PREFERRED WATER MANAGEMENT PLAN

The preferred water management plan updates and reevaluates the recommended plan from the past reports to a more effective plan. The key differences are: 1) relocating the pump site to better manage water in the system to reduce impacts to sensitive habits, 2) allows for full utilization of the current Water Control Manual (1985) for operation of Steele Bayou WCS to promote fishery species diversification and allows for additional inter-basin water exchange to improve reaeration in the lower Yazoo Basin and benefits fisheries exchange, 3) using natural gas to power the pump station, 4) includes additional nonstructural measures to potential further reduce flood risk,) reducing unavoidable impacts to the environment due to the new preferred management plan and based upon new, and previously unavailable, environmental and hydraulic data, an updated period of record, improved digital elevation models and the use of 2018 NASS land use data, and 6) using new approaches to mitigation to better compensate for unavoidable aquatic impacts.

Dependent on the final outcome of the selection of the operation scenarios between Alternatives 3 and 2, the proposed compensatory mitigation feature includes the acquisition of approximately between 5,722 and 7,650 acres of land, respectively, with a portion of these acres at or below the 2-year flood frequency with the remaining remnant at or below the 4-year frequency to the greatest extent possible. These acres would be restored to wetlands and used to compensate for the unavoidable impacts resulting from the construction and operation of the Yazoo Backwater Pump. A detailed write-up of the comprehensive mitigation plan is included in Section 6 and Appendix J – Compensatory Mitigation Plan.

The solutions proposed under this Water Management Plan evaluates potential features to resolve the long-standing flood risk management impacts to the community and the environment, and the DEIS serves the specific purpose of communicating the potential solutions and associated environmental impacts for public review and comment. If approved the next procedural phase of this process will include analysis of public feedback, selection of a final plan, and a refinement of the engineering and scientific data associated with the selected plan. As such, it is anticipated that additional NEPA document(s) may be developed based on refinements to design. If it is determined that additional NEPA documentation is required, USACE will work in coordination with the resource agencies to maintain NEPA compliance. Any future NEPA document(s) may include modification or improvement to mitigation, monitoring and adaptive management plans, as appropriate.

3.6 PREFERRED WATER MANAGEMENT PLAN DETAILED PROJECT DESCRIPTION

The preferred water management plan includes structural, nonstructural, and mitigation features as discussed below.

3.6.1 Pump Station Design Features

The pump station will be located in Warren County, Mississippi, adjacent to the Steele Bayou water control structure (0.5 miles), between the authorized Yazoo Basin, Yazoo Backwater, Mississippi levee and the Yazoo River, and approximately 4.75 miles west of

Highway 61 and approximately 7.5 miles north of Vicksburg, Mississippi. The pump station capacity will be 25,000 cubic feet per second (cfs), total station capacity. The increase in pumping plant capacity requires an increase in the length of the pump station (perpendicular to flow) from 377 feet to 475 feet. This affects the intake structure, substructure, and superstructure; as well as architectural, mechanical, and electrical features.

The managed water elevations have been modified to 93.0 feet during non-crop season and 90.0 feet during crop season. A final decision on the pump operational scenarios between Alternative 3 and 2 will be made at a later date. Table 3-4 provides the design elevation of the current design.

Table 3-4. Design Elevation of Current Design

Description	Elevation (feet, NGVD29)
Project Flood – 2-Year	90.0*
Project Flood – 100-Year	99.0*
Pump Floor	115.0
Top of Structure (Floodwall)	119.0
Pump On/Off	89.5 or 92.5
Inlet Channel Invert	71.0
Discharge Channel Invert	76.0

Major design features include:

- The pump engines will be natural gas-fueled engines. This will reduce energy costs and emissions. It will also eliminate the need for diesel fuel infrastructure, including the fuel dock and fuel storage tanks.
- The service bay and control house structures will be slab-on-grade foundations with grade beams. This will reduce the overall cost of the structure by reducing the concrete volume and by reducing the total excavation and backfill requirements. The substructure tunnels will be accessed via a reinforced concrete stairwell.
- The pump station superstructure will be a prefabricated metal building. This change will reduce the overall cost of the structure.
- It is assumed that potable water will be provided by Valley Park Water District.
- It is assumed that on-site pump storage will not be required because the project will be solicited under one contract and pumps will be installed upon delivery.
- The standby emergency generator building has been removed. The generator will be housed in an enclosure near the service bay.
- The pump station will be heated by natural gas unit heaters, eliminating the hydronic heating system, including boilers, pumps, heaters, and piping. Engines will be cooled by remote radiators, one each per engine, eliminating the centralized raw water-cooling system. The bridge crane will be used to provide vertical movement of equipment to the tunnels, eliminating the need for an elevator. The potable water system (exterior hose bibbs and pressure washer) will

be used for exterior building maintenance, which eliminates the “fire hose” type wash down system, including the water storage tank.

- Supplemental low flow groundwater wells will be installed in 34 strategic locations throughout the Mississippi Delta as an environmental feature to the project. Future engineering studies will evaluate the geologic and hydro-geologic conditions of each of the well field sites, and the wells will be pumped to supplement annual low flow conditions. It is estimated that each well site will impact approximately 0.25 to 1.25 acres of land.

3.6.2 Construction & Permanent Access

Construction and permanent access to the new pump station will be accessed by traveling southwest on the existing Highway 465 for approximately 6.8 miles from Highway 61, or in the alternative, traveling along the existing authorized Yazoo Basin, Yazoo Backwater, Mississippi, Levee across the Steele Bayou structure. The new levee and pump station are joined and tie into the Yazoo Backwater levee and Highway 465.

The existing levee road does not need to be widened for construction. 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 Yazoo Backwater levee. Utilities (both natural gas and electricity) are readily available and in close proximity to the pump station.

3.6.3 Inlet/Outlet Channel

An inlet channel will be constructed to connect the pump station to the existing auxiliary channel. The inlet channel will be approximately 3,100 feet long and require the excavation of approximately 381,846 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 3,500 feet long and require the excavation of approximately 333,169 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 third means of transferring floodwaters from the YSA into the Yazoo River via the pump station to reduce the flood risk resulting from Mississippi River flooding.

3.6.4 Borrow Area

The proposed borrow area is located on the east side of Highway 61, 0.60 miles north of the intersection of Highway 465 and Highway 61 and approximately 7.4 miles east of the proposed pump station. The borrow area ROW is approximately 210 acres. Access to the borrow site will be from Highway 61. The borrow area(s) will also be used as a disposal site for unsuitable material.

Material from the on-site borrow pit will be used to fill in the gap of the existing cofferdam and preload pad. Material from an offsite borrow pit will be used to construct the new levees, structural fill and pads, and the new road for Highway 465 across the outlet channel. The new levee will be constructed to finish grade elevation of 112.80 feet, NGVD29, with 1 on 4

side slopes. A bridge will be constructed across the outlet channel to connect the existing authorized levee for continued public use, however access to the new pump station will be restricted. The new bridge will be pile founded and approximately 1,150 feet long. Construction will require the use of a cofferdam that will be at an elevation of 107 feet, NGVD29, and will have 1 on 3 side slopes. The cofferdam will require approximately 46,355 cubic yards of borrow material for construction. Construction will require a preload at the site which will have a crown elevation of 125 feet, NGVD29, and a berm at elevation 107 feet, NGVD29, which will be 850 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 construction activities associated with constructing the new pump station will adhere to federal, state, and local laws.

3.6.5 Operational

In its current state, the YSA is an isolated system due to the Yazoo Backwater levee and outlet structures preventing inflow of water from the Yazoo-Mississippi Rivers. During potential flood-prone periods with rising Mississippi and Yazoo rivers, the operations plan for the Steele Bayou Water Control Structure (WCS) would allow free movement of water into and out of the lower Yazoo Basin up to an elevation of 75.0 feet, NGVD29 before closing the gate. This full utilization of the current Water Control Manual (1985) for the operation of Steele Bayou WCS will promote fishery species diversification. During low-water periods, the operation plan of the Steele Bayou WCS is currently operated to maintain water elevations between 68.5 and 70.0 feet, NGVD29, and this will be continued. This operation plan optimizes the potential for inter-basin water exchange improving reaeration in the lower Yazoo basin and benefits fisheries exchange. No additional real estate is required for this feature. Consideration of new or different operating elevations to encourage aquatic resource recruitment and retention will be evaluated in the M&AM process.

3.6.6 Low Flow Wells

In addition to the pump operations and structure operations, installation of low-flow wells from shallow groundwater is also being proposed as part of this alternative. Since the fish-carrying capacity of a river system is dependent in part on the habitat quantity and quality during annual low flow conditions a measure is being proposed to supplement the existing river flows. Each well is expected to deliver a maximum of 5.0 cfs during traditionally low flow periods. The increased low-flow aquatic habitat provided with the operational feature could significantly increase standing stock and production for many fish species and support aquatic resources in the YSA.

Thirty-four supplemental low-flow groundwater wells would be located north of the YSA in Washington, Bolivar, and Coahoma counties, Mississippi within the project drainage area and would be installed within 30,000 feet of the Mississippi River channel, in areas primarily utilized for agricultural production, and adjacent to headwater streams.

Figure 3-1 shows the locations of the 34 supplemental low-flow groundwater wells in relation to the YSA. The supplemental low flow groundwater wells would pull from the alluvial aquifer

adjacent to the Mississippi River which is recharged annually. The supplemental low flow groundwater wells would be operated only during low flow periods (generally the fall), when the pumps are not operating. Flooding typically occurs during the spring so no additional flooding would occur as a result of the supplemental low flow groundwater wells since they would only be used during low flow periods (generally the fall).

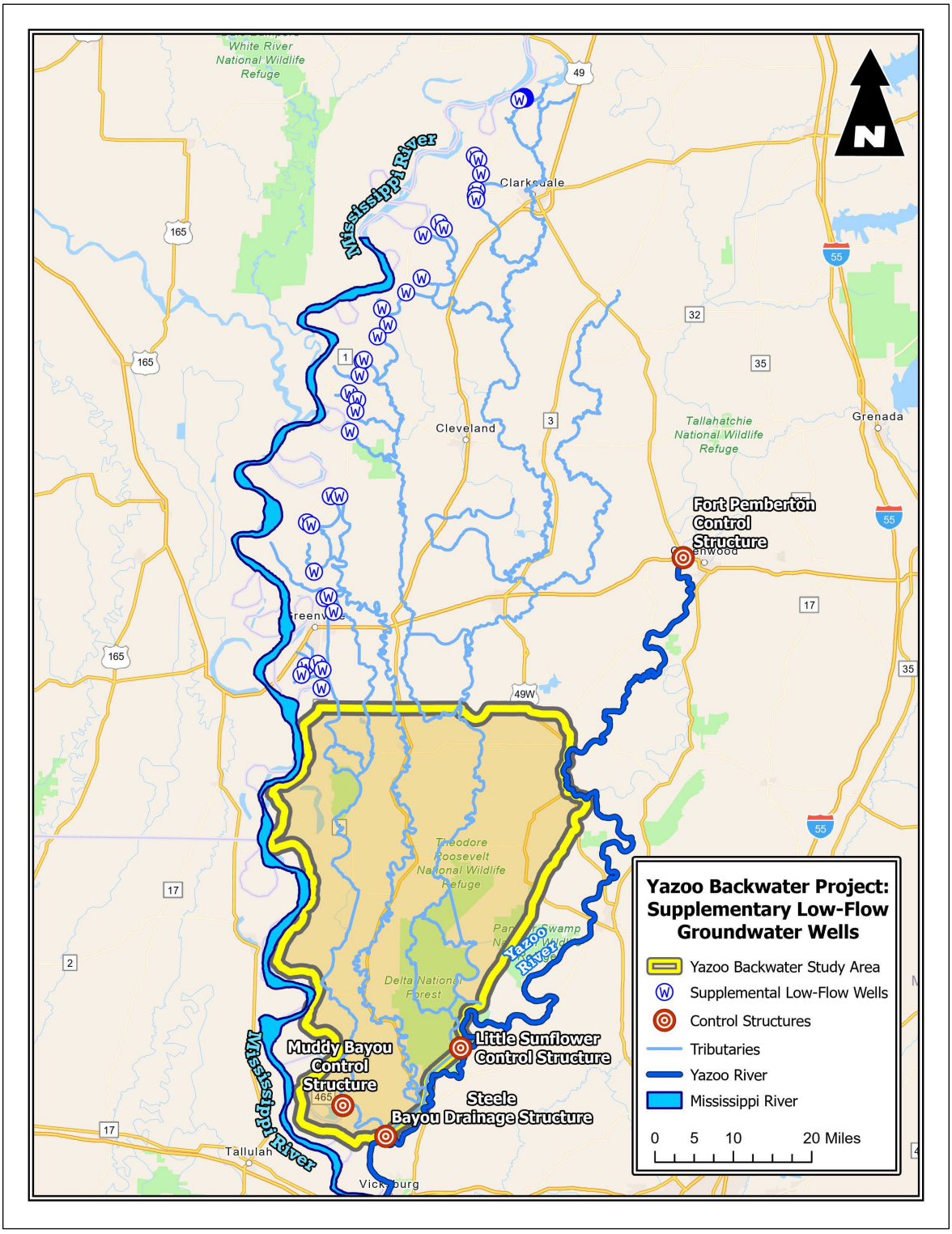

Figure 3-1. Supplemental Low-Flow Groundwater Wells in the YSA

Engineering studies would evaluate the geologic and hydrogeologic conditions at potential supplement low flow groundwater well sites. Installation of the supplemental low flow groundwater wells would 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 would be obtained from the MDEQ upon completion of final design.

Discharge pumps would be electrically driven. The discharge pipe would be installed from each supplemental low flow groundwater well location to the bank of the receiving stream. The discharged water would flow down through a constructed reaeration trough to the channel. All disturbed areas would be stabilized to prevent erosion.

Water levels in the YSA would continue to be maintained between 68.5 and 70.0 feet, NGVD29, during low flow periods by the Steele Bayou water control structure. This addition of water from the supplemental low flow groundwater wells would increase the velocities in the streams of the headwaters of the YSA, therefore improving aquatic habitat and ultimately benefitting up to 654 stream miles within the Big Sunflower, Deer Creek, and Steele Bayou basins. The 654 stream mile estimate does not include benefits to smaller streams and ditches, typically first- and second-order streams. These additional small streams and ditches would add approximately 100 additional miles to the total length of streams receiving benefits.

3.6.7 Nonstructural

Mandatory acquisition of all structures (101 Structures) is being proposed; while voluntary acquisition of residential and commercial properties (231) up to 93.0 feet is being proposed. As discussed in Section 3.2.8, it is important to note that the number of structures implemented in the mandatory and voluntary plan could be less once individual structure investigations take place. A detailed implementation plan will be developed after a detailed investigation of each structure is conducted. Since a mandatory acquisition is being recommended for some structures, the Uniform Relocation Assistance and Real Property Acquisition Policies Act (URA) would be applied to the implementation plan where it is appropriate. URA is the federal law that establishes minimum standards for federally funded programs and projects that require the acquisition of real property (real estate) or displace persons from their homes, businesses, or farms.

Acquisition of up to 11,816 acres of cleared land at or below the 2-year floodplain would take place through fee or a restrictive easement based on a voluntary basis and would be subject to congressional funding. The Proposed Plan would acquire these lands on a voluntary basis, even when tied to a structure at or below the 2-year floodplain. It was assumed that some of the land ownership (outside of the structure footprint) was tied to structures being proposed for mandatory acquisition. In those cases, the lands associated with the structures would still be on a voluntary basis, acquired through fee or through a restrictive easement to limit activities. This would still allow private ownership of the land once the structures have been removed, but it would also limit the risk of flooding crops in this floodplain by taking

them out of production permanently. The same consideration would be given to lands not tied to structures.

In addition to the cleared lands at or below the 2-year floodplain, the proposed plan also includes the acquiring of lands through fee or a restrictive easement for cleared lands between the 2-year floodplain and 5 year floodplain based on a voluntary basis and would be subject to congressional funding. There are a total 27,675 acres of cleared lands between the 2 year and 5 year floodplain.

A detailed implementation plan would be developed after a detailed investigation of each parcel of land is conducted. It is important to understand that the nonstructural features acquisition limits were established based upon flood frequency stage elevations. The implementation plan would include a real estate investigation to determine the final dimensions of the lands acquired on a voluntary basis. The implementation plan will be based upon sound real estate practices and guidance as found in the USACE real estate regulations, blocking out would be utilized to address such items as access, the extent of severance damages, and avoidance of an uneconomic remainder. The blocking out would result in the acquisition of some lands outside a given flood event or elevation.

3.6.8 Mitigation

Compensatory mitigation is dependent on the final outcome of the selection of the operation scenarios between Alternatives 3 and 2, and will include acquisition between 5,722 and 7,650 acres of land, respectively, with a portion of these acres at or below the 2-year flood frequency with the remaining remnant at or below the 4 year frequency to the greatest extent possible. These acres would be restored to wetlands and used to compensate for the unavoidable impacts resulting from the construction and operation of the Yazoo Backwater Pump. A detailed write-up of the comprehensive mitigation plan is included in Section 6 and Appendix J – Compensatory Mitigation Plan.

3.6.9 Maintenance

The MVK would be responsible for the majority of the operation and maintenance (O&M) of the Proposed Plan, which would 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, would be responsible for some minor maintenance of the inlet and outlet channels. Maintenance over the project life would entail the periodic removal and deposition/disposal of sediment accumulations from the inlet and outlet channels and would be the responsibility of the MVK. The timing of maintenance dredging would depend upon hydrologic events and the rate of deposition. Dredged material from the periodic maintenance dredging would be deposited in the borrow areas.

3.6.10 Best Management Practices

The majority of lands impacted by construction and deposition of fill material would be isolated from neighboring water bodies by dikes, existing levees, and additional BMPs. Any

unavoidable impacts would be further minimized by the implementation of BMPs, such as silt screens, hay wattles, buffer zones, containment dikes, and erosion reduction techniques, in accordance with the State of Mississippi laws and regulations. A Stormwater Pollution Prevention Plan would be completed and submitted to MDEQ prior to initiation of construction. All required permits for construction and operation would be obtained prior to construction and all construction activities would adhere to state, federal, and local laws. The nonstructural and mitigation features would be monitored for environmental success. Additional monitoring practices are discussed in Appendix K - Monitoring and Adaptive Management. For additional information on the Proposed Plan see Appendix A - Engineering Report/H&H.

3.7 FEDERAL AGENCY COORDINATION

Another important component of the proposed water management solution will be three Memorandums of Agreement (MOAs) between the USFWS, the EPA, and the USACE (the Agencies).

The first MOA under this proposal is an agreement on the final water control operations which will require agreement by the Agencies for any deviations of the pump operation plan and water control structure operation plan envisioned by the proposed water management solution.

The second MOA is a joint Mitigation agreement designed to ensure the effective and timely development and review of the mitigation plan for each compensatory mitigation component. This MOA will require the approval of the Agencies on each mitigation plan and describe agency roles in the review of compensatory mitigation monitoring reports and future adaptive management decision-making for each mitigation component.

Finally, the third MOA is an agreement to collect and evaluate monitoring data across the YSA using field-based and satellite imagery approaches and to use this monitoring data to help inform adaptive management decisions regarding ongoing implementation of water management in the YSA.

SECTION 4
Environmental 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 YSA 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.

The YSA lies within the Mississippi River alluvial plain and is comprised of forested lands and open fields. Area soils are alluvial and generally level, with little to no topographic relief in the project area. Areas that are unaltered by agriculture are 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*).

4.1 AFFECTED ENVIRONMENT

The YSA 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, NGVD29, from north to south.

4.1.1 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.

4.1.2 Hydrology

The YSA 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. Steele Bayou, Big Sunflower, and Yazoo Rivers drain most of the area. The hydrology of the YSA is affected by both internal and external sources, which 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 YSA. 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 YSA has also benefited from other flood risk management features of the MR&T project that have been completed within the YSA (internal sources). These features are listed below.

- 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.
- 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.
- 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.
- 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 controls Eagle Lake inflows and outflows for environmental purposes.

4.1.3 Climate

Climate in the YSA 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 YSA 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.

Climate change has been a point of discussion for years within the Mississippi River Valley. According to the Fourth National Climate Assessment, the southeastern United States has experienced an uneven trend in observed warming since the mid-20th century (Carter et al. 2018). Similarly, Mississippi has not experienced an overall warming trend since 1900 and instead has only experienced a near or slightly above average near-surface air temperature since the 1990s (Runkle et al. 2017). The projected temperature change in Mississippi over the next 50-75 years is forecast to increase, which follows the trend from 1950 to 2016

(Carter et al. 2018). In addition to daily temperatures, the annual precipitation in Mississippi has been above average since the 1970s (Runkle et al. 2017). Currently, climate projections indicate the number of extreme rainfall events will become more frequent and intense in the future (Runkle et al. 2017, Carter et al. 2018, and Easterling et al. 2017). The above normal precipitation projected for the northern United States, during the Lower Mississippi River Basin's wet season, will increase the potential for flooding along the Mississippi River and consequently within the Mississippi Delta. The recent history of peak stages in the Yazoo Backwater, shown on Figure 2-111 of Appendix A – Engineering Report/H&H, illustrate that the Yazoo Backwater pump would have operated for 10 of the past 13 years during the study. However, 2019 and 2020 are the only 2 years the pumps would have operated over 100 days during the year as shown on Figure 2-112 of Appendix A – Engineering Report/H&H. More information on climate change can be found in Appendix A – Engineering Report/H&H.

4.2 RELEVANT RESOURCES

For the purposes of this Water Management Plan and DEIS, 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 to local communities is recognized by Public Law 99-662 (requires in-kind mitigation to the extent possible) for the consumptive and non-consumptive 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 public.

Table 4-1. Relevant Resources and Their Institutional, Technical, and Public Importance

Resource	Institutionally Important	Technically Important	Publicly Important
Wetlands	Clean Water Act of 1977, as amended; Executive Order 11990 of 1977, Protection of Wetlands; Coastal Zone Management Act of 1972, as amended; and the Estuary Protection Act of 1968., EO 11988, and Fish and Wildlife Coordination Act.	They provide necessary habitat for various species of plants, fish, and wildlife; they serve as ground water recharge areas; they provide storage areas for storm and flood waters; they serve as natural water filtration areas; they provide protection from wave action, erosion, and storm damage; and they provide various consumptive and non-consumptive recreational opportunities.	The high value the public places on the functions and values that wetlands provide. Environmental organizations and the public support the preservation of marshes.
Bottomland Hardwood Forest	Section 906 of the Water resources Development Act of 1986 and the Fish and Wildlife Coordination Act of 1958, as amended.	Provides necessary habitat for a variety of plant, fish, and wildlife species; it often provides a variety of wetland functions and values; it is an important source of lumber and other commercial forest products; and it provides various consumptive and non-consumptive recreational opportunities.	The high priority that the public places on its esthetic, recreational, and commercial value.
Aquatic Resources/Fisheries	Fish and Wildlife Coordination Act of 1958, as amended; Clean Water Act of 1977, as amended; Coastal Zone Management Act of 1972, as amended; and the Estuary Protection Act of 1968.	They are a critical element of many valuable freshwater and marine habitats; they are an indicator of the health of the various freshwater and marine habitats; and many species are important commercial resources.	The high priority that the public places on their esthetic, recreational, and commercial value.
Soils and Water Bottoms	Fish and Wildlife Coordination Act, Marine Protection, Research, and Sanctuaries Act of 1990	State and Federal agencies recognize the value of water bottoms for the production of benthic organisms.	Environmental organizations and the public support the preservation of water quality and fishery resources.
Essential Fish Habitat (EFH)	Magnuson-Stevens Fishery Conservation and Management Act of 1996, Public Law 104-297	Federal and state agencies recognize the value of EFH. The Act states, EFH is “those waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity.”	Public places a high value on seafood and the recreational and commercial opportunities EFH provides.
Wildlife	Fish and Wildlife Coordination Act of 1958, as amended and the Migratory Bird Treaty Act of 1918	They are a critical element of many valuable aquatic and terrestrial habitats; they are an indicator of the health of various aquatic and terrestrial habitats; and many species are important commercial resources.	The high priority that the public places on their esthetic, recreational, and commercial value.
Threatened and Endangered Species	The Endangered Species Act of 1973, as amended; the Marine Mammal Protection Act of 1972; and the Bald Eagle Protection Act of 1940.	USACE, USFWS, NMFS, NRCS, EPA, and MDWFP cooperate to protect these species. The status of such species provides an indication of the overall health of an ecosystem.	The public supports the preservation of rare or declining species and their habitats.

Resource	Institutionally Important	Technically Important	Publicly Important
Cultural Resources	National Historic Preservation Act of 1966, as amended; the Native American Graves Protection and Repatriation Act of 1990; and the Archeological Resources Protection Act of 1979	State and Federal agencies document and protect sites. Their association or linkage to past events, to historically important persons, and to design and construction values; and for their ability to yield important information about prehistory and history.	Preservation groups and private individuals support protection and enhancement of historical resources.
Recreation Resources	Federal Water Project Recreation Act of 1965 as amended and Land and Water Conservation Fund Act of 1965 as amended	Provide high economic value of the local, state, and national economies.	Public makes high demands on recreational areas. There is a high value that the public places on fishing, hunting, and boating, as measured by the large number of fishing and hunting licenses sold in Mississippi; and the large per-capita number of recreational boat registrations in Mississippi.
Aesthetics	USACE ER 1105-2-100, and National Environmental Policy Act of 1969, the Coastal Barrier Resources Act of 1990, Louisiana's National and Scenic Rivers Act of 1988, and the National and Local Scenic Byway Program.	Visual accessibility to unique combinations of geological, botanical, and cultural features that may be an asset to a study area. State and Federal agencies recognize the value of beaches and shore dunes.	Environmental organizations and the public support the preservation of natural pleasing vistas.
Air Quality	Clean Air Act of 1963, Louisiana Environmental Quality Act of 1983.	State and Federal agencies recognize the status of ambient air quality in relation to the NAAQS.	Virtually all citizens express a desire for clean air.

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

The following resources have been considered and determined to not be affected or to be minimally and temporarily affected and therefore were not carried forward in the evaluation by any alternative under consideration: Soils and Water Bottoms; Essential Fish Habitat; and Navigation. However, soils are considered further within specific resources analyses and associated appendices such as Wetlands, Cultural Resources, Section 404(b)(1) Evaluation, HTRW, Prime and Unique Farmland, etc.

A Section 404(b)(1) Evaluation has been completed for the project in compliance with the EPA guidelines (see Appendix I - Section 404(b)(1) Evaluation Report).

4.2.1 Human Environment

4.2.1.1 Socio-Economics

This section outlines the social and economic environment of the proposed action area in of the Yazoo Backwater 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 Backwater 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 in the east and the Yazoo River Levee in the west; it is located about 15 miles south of Hollandale and about 50 miles north of Vicksburg.

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 2020 census, Sharkey County and Issaquena County reported populations of 3,800 and 1,338 respectively. The largest population center, Rolling Fork, is located in Sharkey County, and reported a population of 1,883. 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.

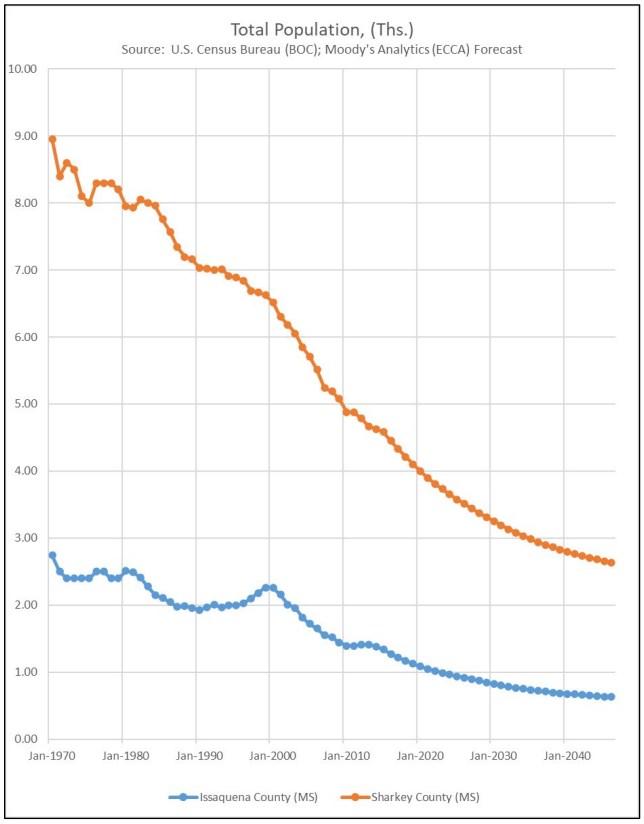

Figure 4-1. Historical Population Trends and Future Projections in the ROI

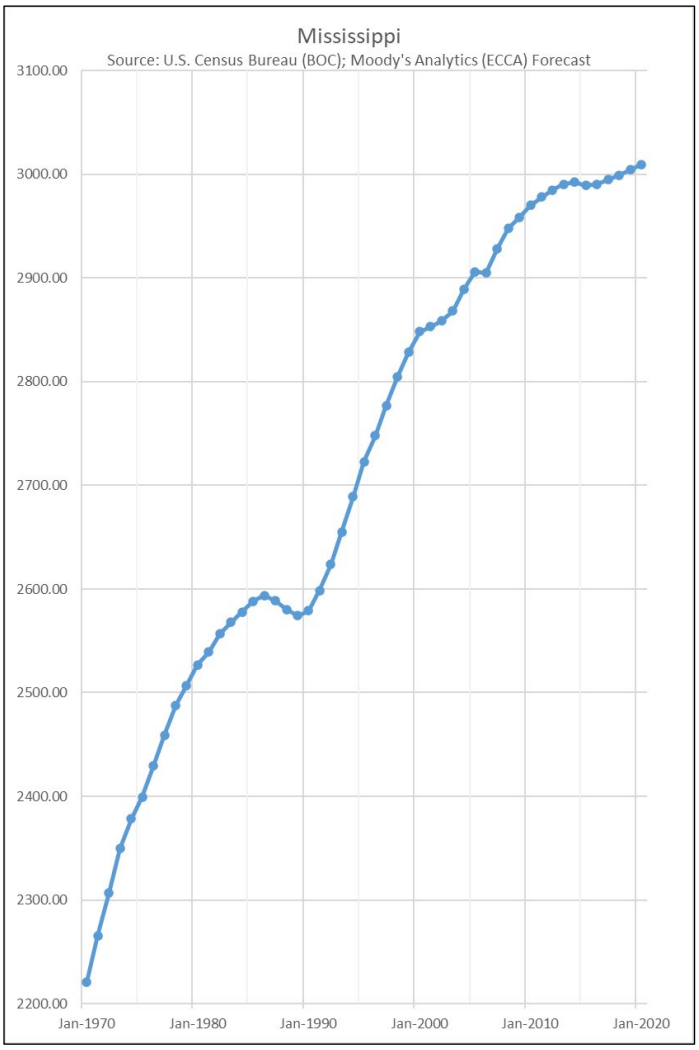

Figure 4-2. Historical Population Trends and Future Projections in Mississippi

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 United States. 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 remained around the same while Sharkey County's income per capita rose. A gap between the two counties is expected to continue over the next 20 years.

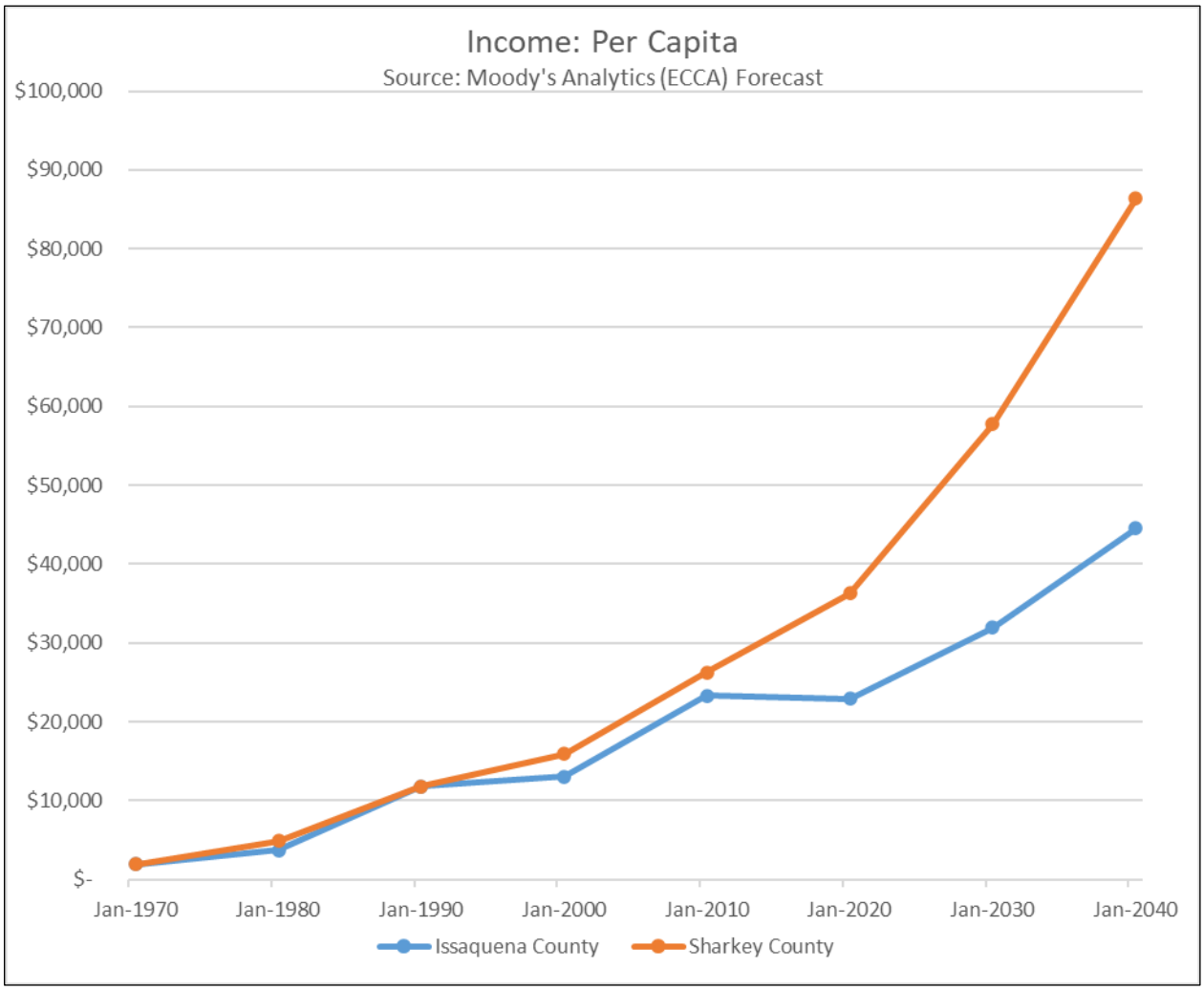

Figure 4-3. Historical Income Per Capita Trends and Future Projections

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.

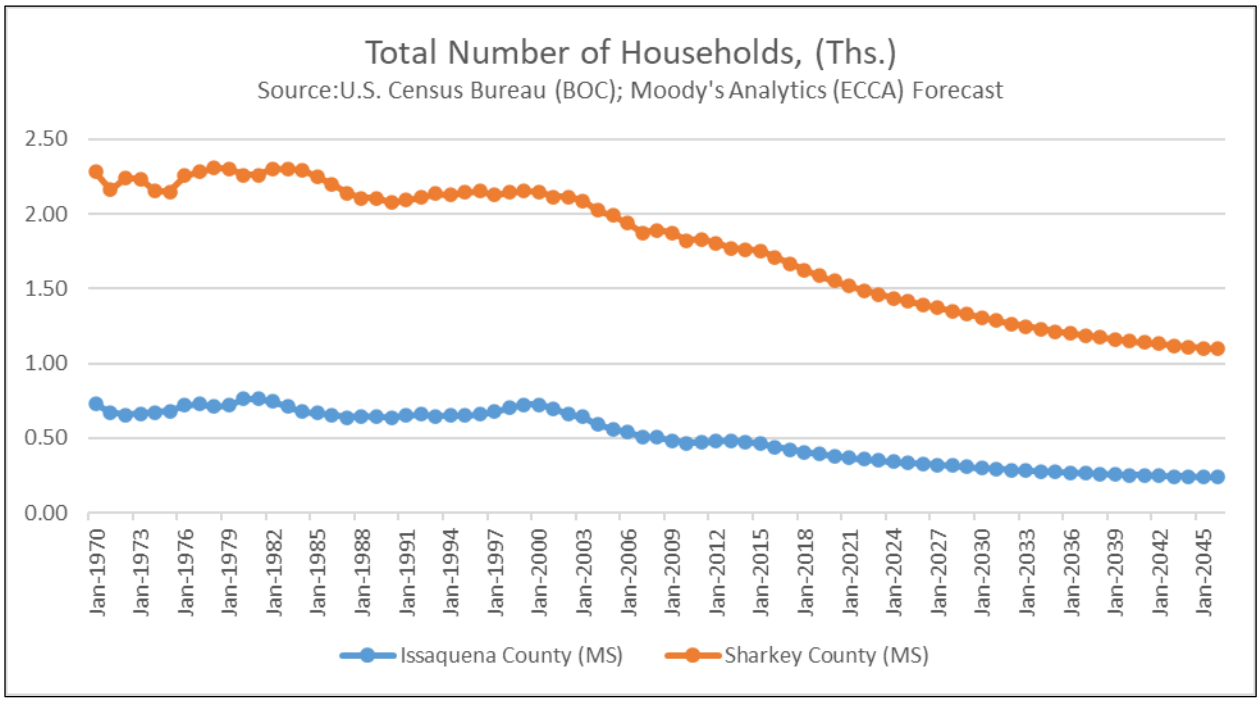

Figure 4-4. Historical Households Trends and Future Projections

4.2.1.1.4 Labor and Employment

Labor force and employment data illustrate level of economic activity in the ROI. 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). Figure 4-5 illustrates the total labor force in the ROI over the past 30 years and estimates for the next 16 years. In the past 30 years the labor force in the ROI has been declining. The most significant drop was in Sharkey County in 2020 when the labor force decreased from 2,065 to 1,340 following trends in population decline during the same time period. Labor force is expected to decline steadily over the next 16 years.

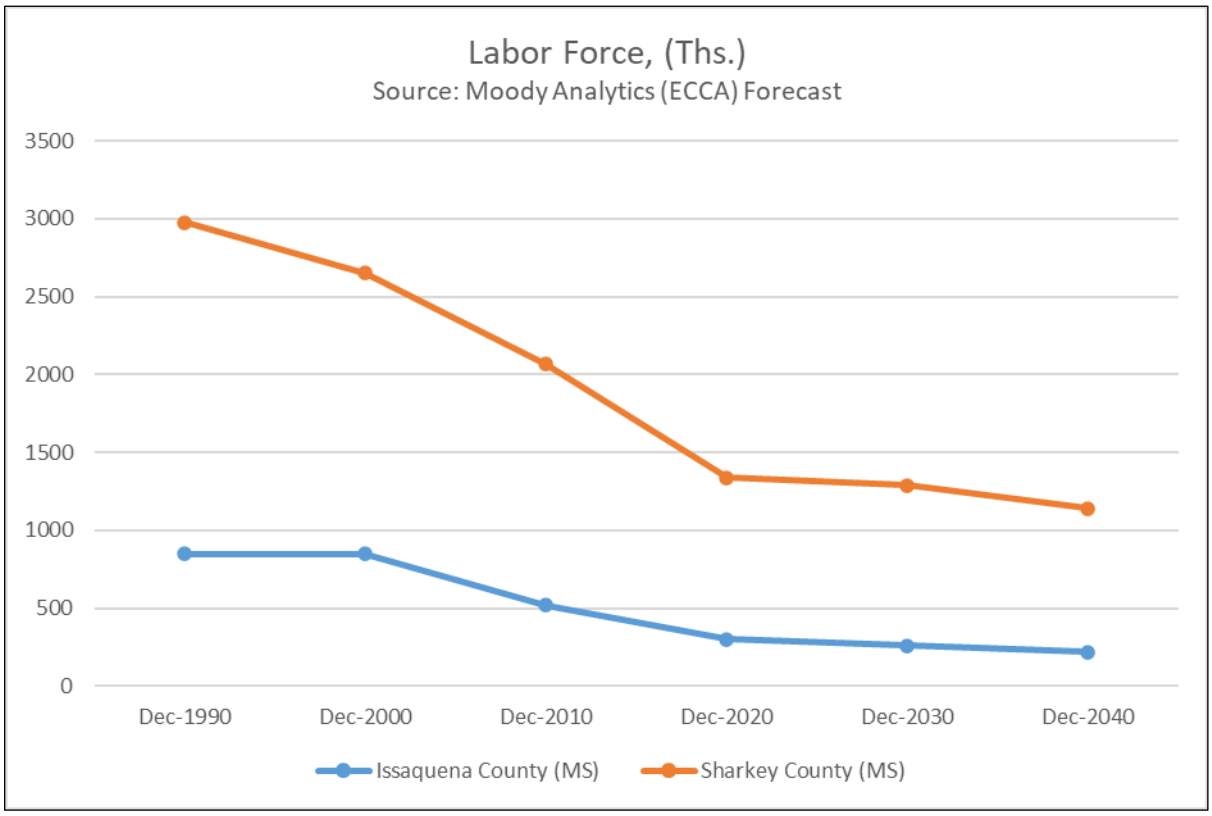

Figure 4-5. Historical Labor Force Trends and Future Projections in Issaquena and Sharkey Counties, MS

Total Employment

Total employment is the total number of people out of the labor force that are employed. Figure 4-6 details the total number of people employed over the past 30 years and estimates for the next 16 years. This is important to include in the socioeconomic profile as a measure of the economic environment in the ROI. The biggest drop in employment was in 2010 in the wake of the 2008 recession, which affected employment numbers across the nation. Over the past 30 years there is a decline in the total employment in the ROI, especially following the pandemic, and these patterns closely mirror overall declining labor force and population trends in the ROI.

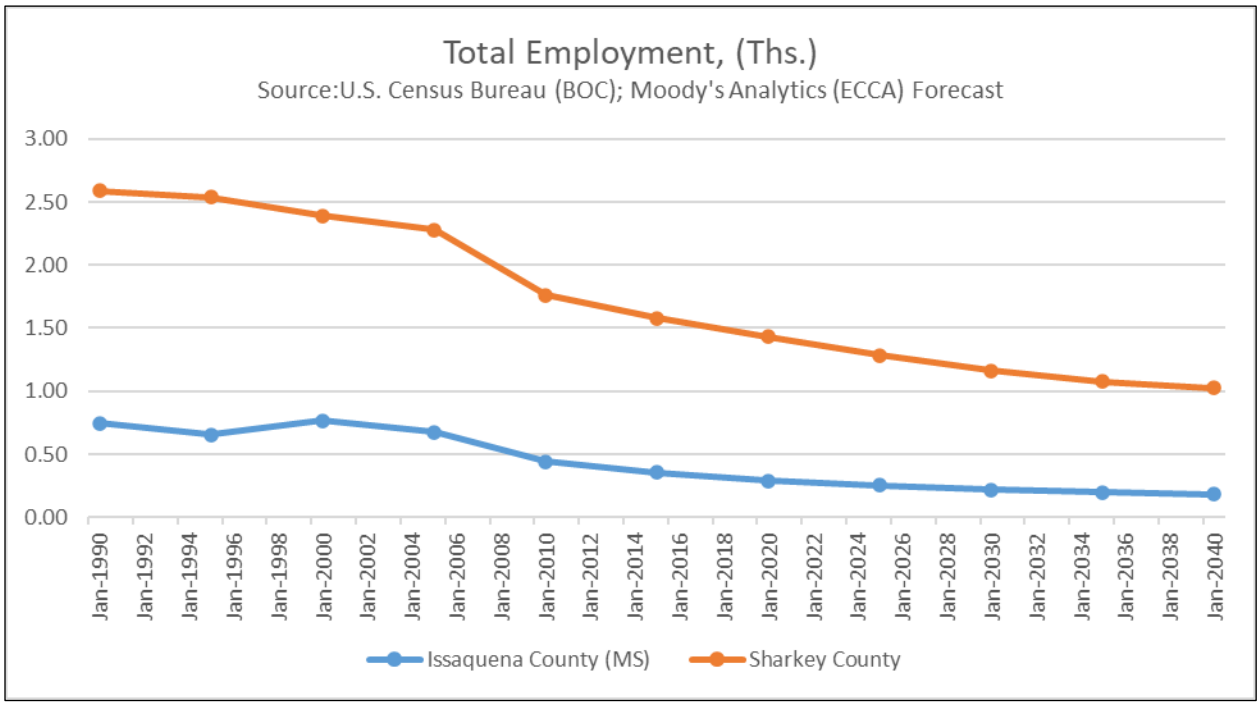

Figure 4-6. Historical Employment Trends and Future Projections in Issaquena and Sharkey Counties, MS

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. Figure 4-7 details the unemployment rate over the past 30 years and projects for the next 20 years. 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 percent higher than the state unemployment rate. Projections estimate the gap between the state unemployment and Sharkey County's unemployment rate will remain around 3 percent while the gap between the state unemployment rate and Issaquena County's unemployment rate is expected to increase to almost 10 percent in the next 20 years.

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.

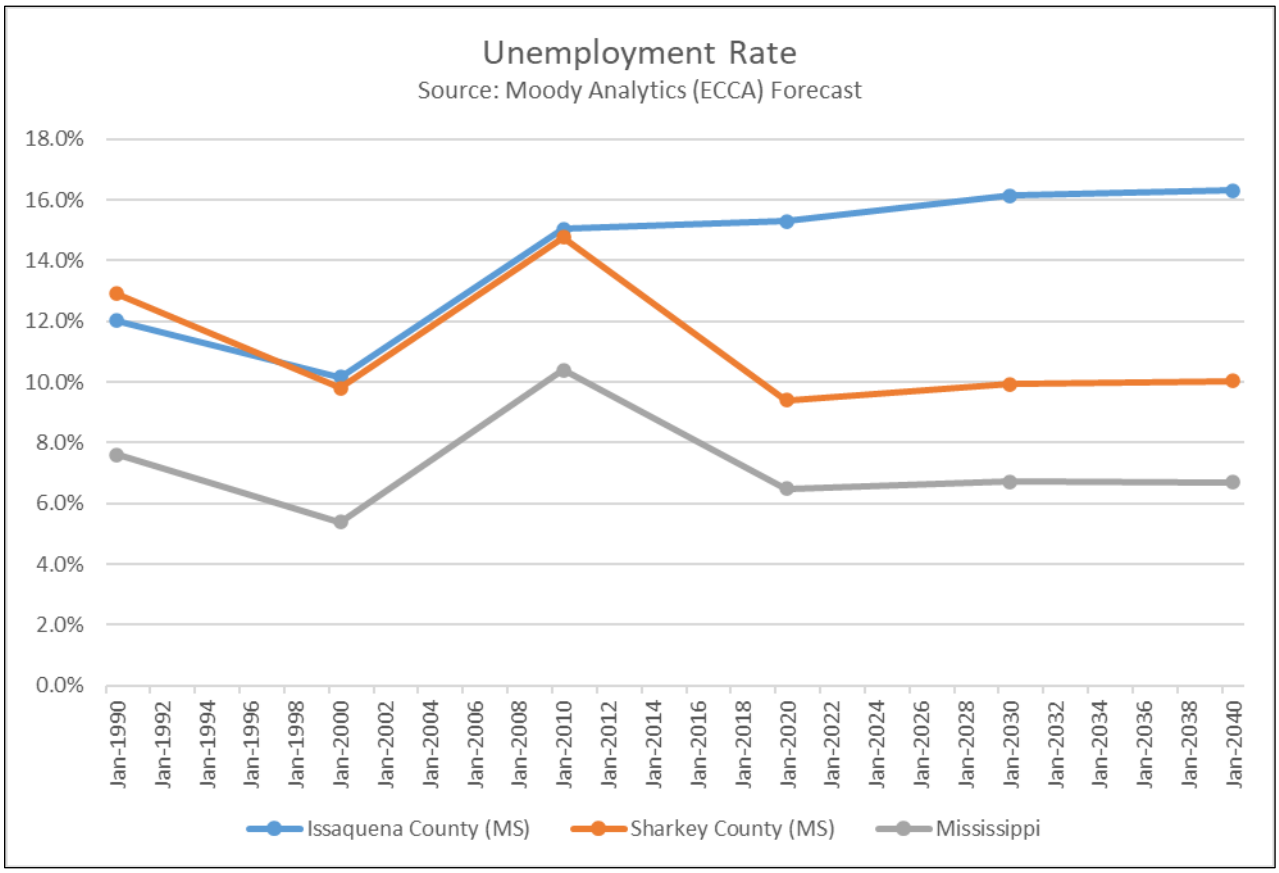

Figure 4-7. Historical Unemployment Trends and Future Projections in Issaquena and Sharkey Counties, MS, as Compared to the Overall Rate in the State of Mississippi

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 US 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. 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.

Figure 4-8 details the trends in non-farm payroll employment over the past 50 years. There is no projected data for non-farm employment in the ROI, but it can be reasonably assumed that trends in employment will continue over the next 50 years.

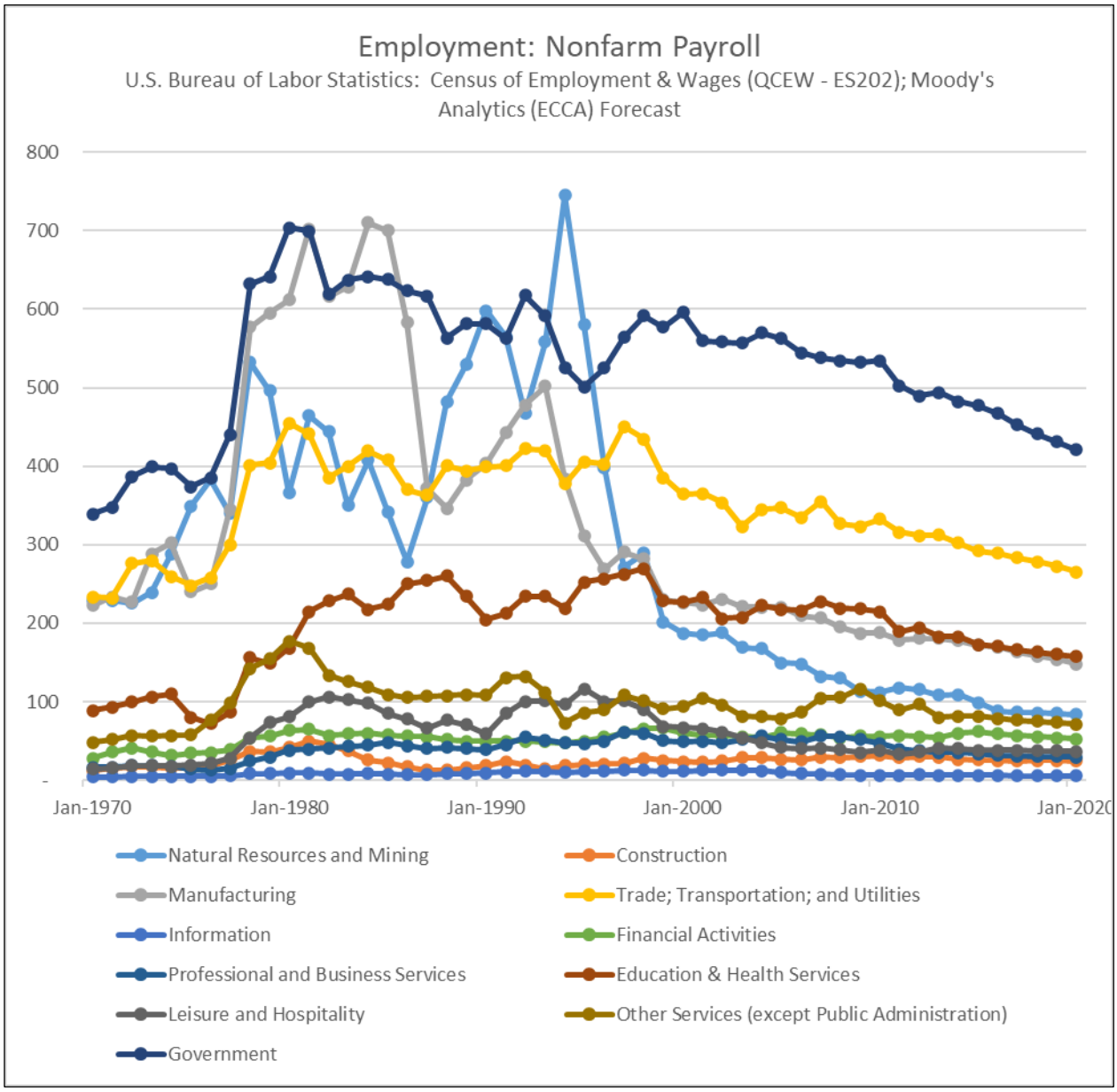

Figure 4-8. Historical Non-farm Payroll Employment Trends

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 provide 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.

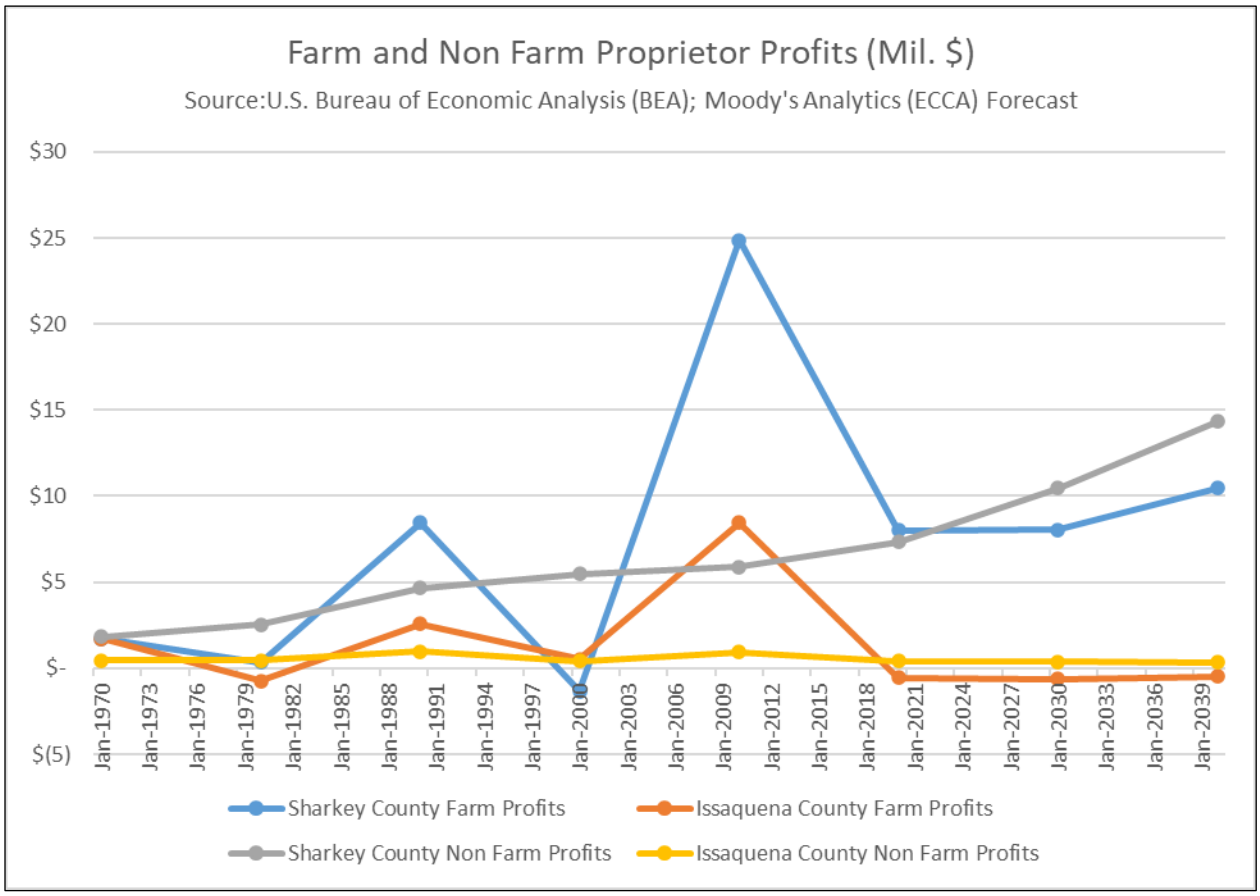

Figure 4-9. Historical Farm and Non-farm Proprietor Profit Trends and Future Projections in Issaquena and Sharkey Counties, MS

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 available data it can be assumed 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.

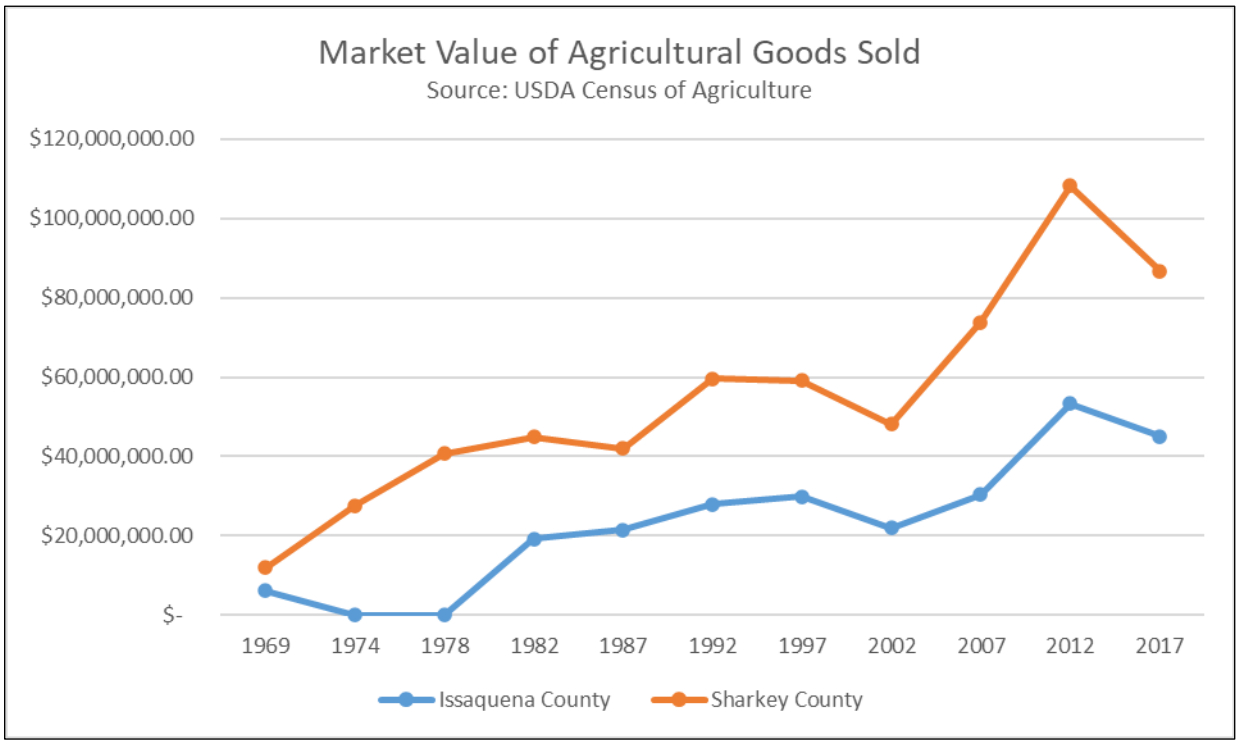

Figure 4-10. Historical Value of Agricultural Goods Trends and Future Projections in Issaquena and Sharkey Counties, MS

Land in Farms

The amount of acreage in farms (Figure 4-11)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. 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.

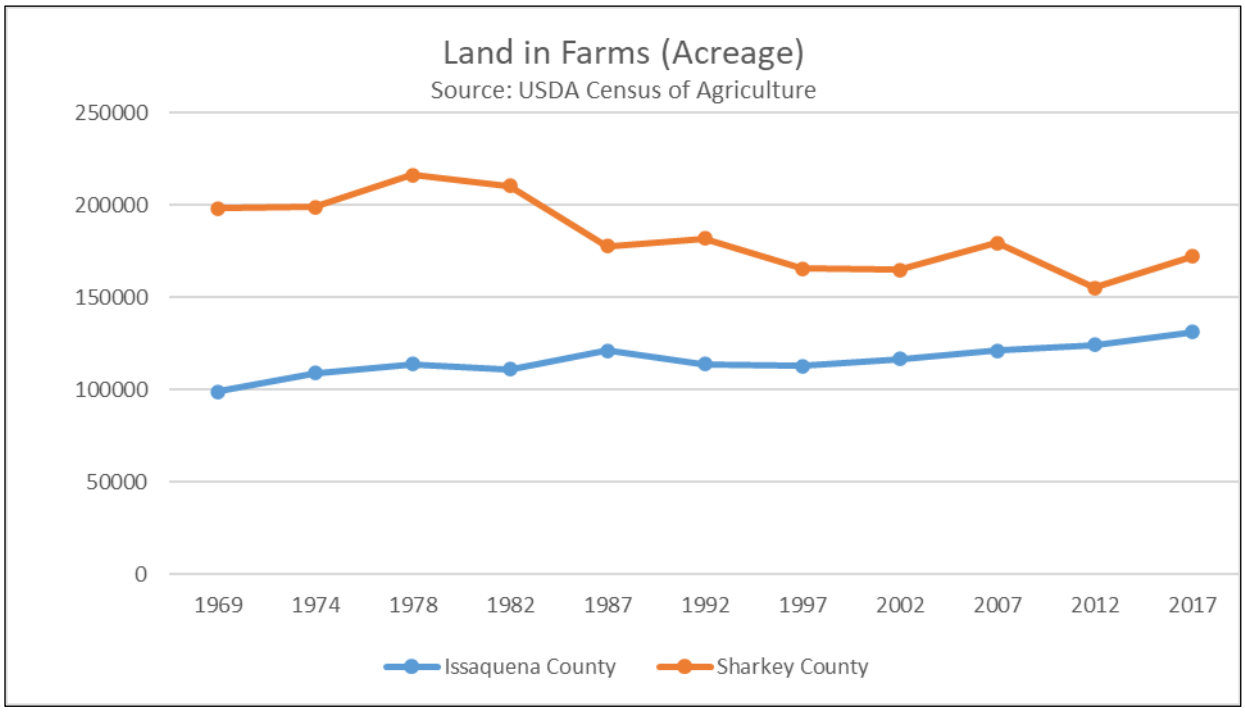

Figure 4-11. Historical Farmland Acreage Trends in Issaquena and Sharkey Counties, MS

4.2.1.2 Environmental Justice

Executive Order 14096 defines environmental justice (EJ) as the just treatment and meaningful involvement of all people, regardless of income, race, color, national origin, Tribal affiliation, or disability, in agency decision-making and other Federal activities that affect human health and the environment so that people:

- are fully protected from disproportionate and adverse human health and environmental effects (including risks) and hazards, including those related to climate change, the net impacts of environmental and other burdens, and the legacy of racism or other structural or systemic barriers; and
- have equitable access to a healthy, sustainable, and resilient environment in which to live, play, work, learn, grow, worship, and engage in cultural and subsistence practices."

EJ is institutionally significant because of Executive Order (EO) 12898 of 1994 which is supplemented by EO 14096 of 2023, EO 14008 of 2021, and the Department of Defense's Strategy on Environmental Justice of 1995. EO 12898 directed Federal agencies to identify and address any disproportionately high and adverse human health or environmental effects of Federal actions to minority and/or low- income populations and to those populations challenged with environmental hazards. EO 14096 requires that environmental reviews analyze direct, indirect, and net effects of Federal actions on communities with environmental justice concerns; consider best available science on disparate health effects arising from exposure to environmental hazards; and provide opportunities for early and

meaningful involvement in the environmental review process by communities with environmental justice concerns potentially affected by a proposed action.

This resource is technically significant because the social and economic welfare of minority and low-income populations may be positively or adversely disproportionately impacted by the proposed actions. This resource is publicly significant because of public concerns about the just treatment and meaningful involvement of all people with respect to environmental and human health consequences of Federal laws, regulations, policies, and actions.

Below are other relevant Executive Orders and Memorandum related to Environmental Justice:

1. Executive Order 13985, Advancing Racial Equity and Support for Undeserved Communities through the Federal government, dated 20 January 2021;
2. Executive Order 13990, Protecting Public Health and the Environment and Restoring Science to Tackle the Climate Crisis, dated 20 January 2021;
3. Executive Order 14008, Tackling the Climate Crisis at Home and Abroad, dated 27 January 2021; Office of Management and Budget Memorandum M-21-28;
4. Comprehensive Documentation of Benefits in Decision Document, January 5, 2021, Issued by the Assistant Secretary of the Army (Civil Works);
5. Indian Self-Determination and Education Assistance Act, as Amended (25 U.S. Code Chapter 46) SACW Subject; Implementation of Environmental Justice and the Justice40 Initiative 2;
6. Water Resources Development Act (WRDA) of 2020, December 27, 2020;
7. Interim Implementation Guidance for the Justice40 Initiative, dated 20 July 2021; and Memorandum for Commanding General. U.S. Army Corps of Engineers Subject: Implementation of Environmental Justice and the Justice40 Initiate Dated 15 March 2022.
8. Executive Order 14096: Revitalizing Our Nation's Commitment to Environmental Justice for All, April 21, 2023.

4.2.1.2.1 EJ Outreach and Meetings

The study team, including USACE, the EPA, and the US Fish and Wildlife Service, conducted two targeted EJ engagements with residents of the affected area. The first engagement was hosted by Congressman Bennie Thompson in April 2023 and was a virtual meeting. During this engagement, the study team provided an overview of the project and answered questions from the residents, which included questions concerning their home and if it would be protected from floodwater. The second engagement was an in-person meeting and held in Vicksburg in May 2023. The study team was able to provide a more detailed description of the preferred alternative with multiple members of the EJ community. Additional EJ outreach will occur after the draft report is released. An in-person meeting is planned to be held in Rolling Rock, MS, which is an EJ community. An update will be provided in the final report.

Demographic indicators are often used as proxies for a community's health status and potential susceptibility to pollution. The Climate and Economic Justice Screening Tool (CEJST) is the dataset used in the EJ assessment to identify communities with EJ concerns, referred to as disadvantaged communities. CEJST is a result of EO 14008, which in January of 2021, was issued by President Biden. The order directed Council on Environmental Quality (CEQ) to develop a new tool. The tool has an interactive map and uses datasets that are indicators of burdens in eight categories: climate change, energy, health, housing, legacy pollution, transportation, water and wastewater, and workforce development. The tool uses this information to identify communities that are experiencing these burdens and are disadvantaged because they are overburdened and underserved. First though, a broad overview of the demographic underpinnings of the counties in YSA is provided.

Issaquena and Sharkey County, Mississippi is the study area for the flood risk management 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 (Table 4-2). 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.

Table 4-2. Census Information

Location	Total Population	White	Black	Native American	Asian	Native Hawaiian	Some Other Race	Two or More Races	Minority	Hispanic
Issaquena	1,328	521	799	0	0	0	8	0	60.2%	1.2%
Sharkey County	4,511	1,132	3,337	6	28	0	8	0	74.8%	0.1%
Hollandale (city)	2,293	377	1,903	0	0	0	9	4	83.0%	0.4%
Rolling Fork (city)	2,306	477	1,820	6	0	0	3	0	79.3%	0.0%
Mississippi	2,988,762	1,751,193	1,125,834	13,689	28,313	707	28,833	40,193	41.4%	3.0%

Source: U.S. Census Bureau, American Fact Finder, ACS 2014-2018

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 in the State of Mississippi and residents experience low educational attainment and lack health insurance (Smith et al. 1999).

Nearly 42 percent of the population in Issaquena County and 26 percent of the population in Sharkey County lives below the poverty threshold of $25,094 for a family of four (Table 4-3). 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.

Table 4-3. Population with Income Below Poverty and Percent of Population Below Poverty

Location	Total Population*	Population Having Income Below Poverty	Percent of Population Below Poverty
Issaquena County	1,328	554	41.7%
Sharkey County	4,511	1,168	25.9%
Hollandale (city)	2,293	731	31.9%
Rolling Fork (city)	2,306	602	26.1%
Mississippi	2,986,530	588,346	19.7%

*For Whom Poverty Status is Known

Source: U.S. Census Bureau ACS 2014-2018

County level data provides a broad brush overview of areas of EJ concern by reviewing low income and minority information. A more detailed review, at the Census tract level, provides even more data on areas of EJ concern by reviewing data within CEJST. CEJST is used to identify disadvantaged communities within the study area counties. Figure 4-12 shows the disadvantaged communities within the YSA and these areas are the focus of the EJ assessment.

Only a small portion of the study area is not part of a census tract identified as disadvantaged and includes the area around Eagle Bend and the area just north of Redwood, both in Warren County. Total population of the study area census tracts is 30,556 while 24,478 are within a disadvantaged community tract or 80 percent of the study area population resides within a disadvantaged community. Note that census tracts can extend beyond the study area boundary and in these cases, the entire tract population is included in the total study area population.

A vast majority of the YSA is home to residents and business who live and work in disadvantaged communities which are identified by CEQ's CEJST (CEJST criteria described below). Of the approximately 30,500 people living in census tracts in the Yazoo EJ Study Area (note that some of the tracts extend beyond the study area boundary), 80 percent are in disadvantaged communities. The majority of residents are low-income and minority. The per capita income is less than $19,000 per year. For household incomes, 25 percent earn less than $15,000 per year and 16 percent earn under $25,000 and 30 percent earn between $25,000 and $50,000 with 71 percent of the total households earning under $50,000 per year. Slightly less than 20 percent of the total population is over 65. (EPA 2019). For 2017, 22 percent of households within Mississippi Congressional District 2, which encompasses the potentially affected area, received Supplemental Nutrition Assistance Program (SNAP) benefits (USDA 2017). Just over 87 percent of households receiving SNAP identified as Black or African American, 57 percent housed at least one child under the age of 18, and 60.3 percent had incomes below the poverty line (USDA 2017).

A large employer in the region is the farming industry in the study area of Issaquena and Sharkey Counties. Substantial loss of farm jobs in Issaquena and Sharkey Counties

occurred between 1980 and 2000. Since 1980, farm jobs as a percent of total county ntmployment went from 35.1 percent to 16.8 percent in Sharkey County, and from 66.1 percent to 36.2 percent for Issaquena County. Opportunities for farm employment to those who live in the study area decreased, accordingly.

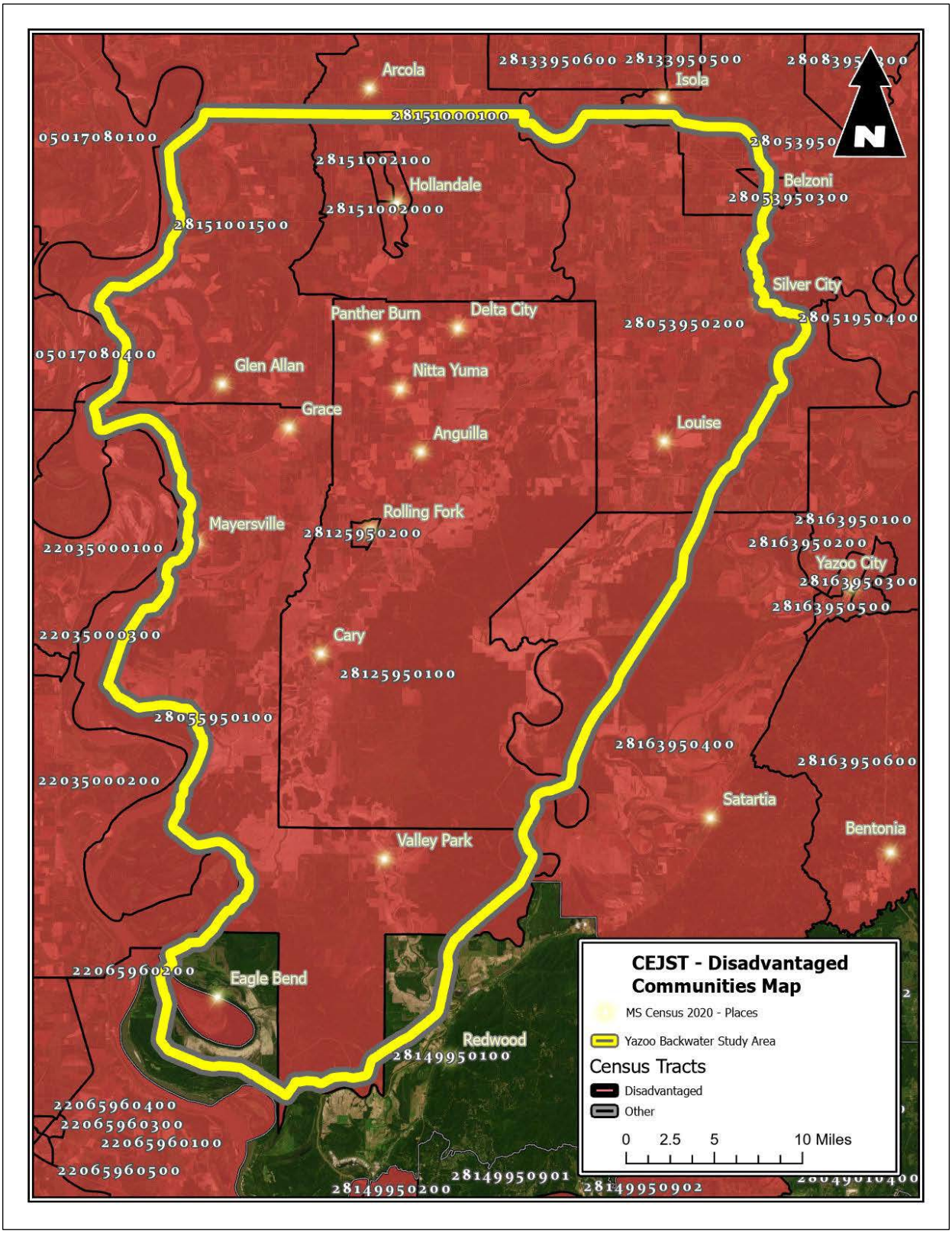

Figure 4-12. YSA, Disadvantaged Community Census Tracts

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 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 of the National Register of Historic Places (NRHP) database, the Mississippi Department of Archives and History (MDAH), online Mississippi Historic Resources Inventory Historic Resources Inventory Map (MDAH Website), historic aerial photography, historic map research, and a review of cultural resources survey reports to collect data pertaining to cultural resources identified within the YSA as well as within and adjacent to the proposed borrow area, pump, and supplemental low flow groundwater well locations (Tables 4-4 through 4-7). 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 NRHP properties situated within the YSA 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 is contained in Appendix F-1 - Cultural Resources (Tables A-8 through A-13). In summary, approximately 1,254 cultural resources were identified in the YSA (Tables 4-4 and 4-6), 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 4-5 and 4-7). Of this total, only nine archaeological sites fall at or below the 90-foot Elevation. These resources were identified and recorded primarily as a result of Section 106 compliance studies in addition to private and avocational efforts (Table 4-4).

Table 4-4. Known Archaeological Resources within the YSA

Yazoo Study Area (YSA)			
County	**Total No. Sites**	**Eligible Sites**	**NRHP-Listed Sites**
Humphreys	129	26	3
Issaquena	126	29	3
Sharkey	192	39	5
Warren	13	2	0
Washington	232	24	1
Yazoo	100	6	2
TOTALS	**792**	**126**	**14**
County	**Unevaluated Sites**	**Ineligible Sites**	**Sites below 90-ft Elevation**
Humphreys	55	45	0
Issaquena	41	53	5
Sharkey	40	108	2
Warren	5	6	0
Washington	102	105	1
Yazoo	41	51	1
TOTALS	**284**	**368**	**9**

Table 4-5. Known Archaeological Resources within and Adjacent to the Proposed Borrow Area, Pump, and Supplemental Low Flow Groundwater Wells

Borrow Area, Pump, and Supplemental Low Flow Relief Wells			
County	**Total No. Sites**	**Eligible Sites**	**NRHP-Listed Sites**
Bolivar	62	24	0
Coahoma	21	10	1
Issaquena	1	1	0
Warren	11	3	1
Washington	24	4	1
TOTALS	**119**	**42**	**3**
County	**Unevaluated Sites**	**Ineligible Sites**	**Sites below 90-ft Elevation**
Bolivar	10	28	0
Coahoma	6	4	0
Issaquena	0	0	0
Warren	7	0	0
Washington	4	15	0
TOTALS	**27**	**47**	**0**

Table 4-6. Known Archaeological Resources within the YSA

Yazoo Study Area (YSA)			
County	**Historic Districts**	**NRHP-Listed Sites**	**Mississippi Landmarks**
Humphreys	0	0	0
Issaquena	0	2	0
Sharkey	0	1	1
Warren	0	0	0
Washington	1	17	0
Yazoo	0	0	0
TOTALS	**1**	**20**	**1**
County	**Unevaluated Properties**	**Non-Extant**	**Total No. Properties**
Humphreys	13	13	26
Issaquena	28	11	41
Sharkey	82	47	131
Warren	1	4	5
Washington	13	49	80
Yazoo	13	7	20
TOTALS	**150**	**131**	**303**

Table 4-7. Known Standing Structures within and Adjacent to the Proposed Borrow Area, Pump, and Supplemental Low Flow Groundwater Wells

Borrow Area, Pump, and Supplemental Low Flow Relief Wells			
County	**Historic Districts**	**Register-Listed Properties**	**Mississippi Landmarks**
Bolivar	0	1	0
Coahoma	0	1	0
Issaquena	0	0	0
Warren	0	2	0
Washington	0	1	0
TOTALS	**0**	**5**	**0**
County	**Unevaluated Properties**	**Non-Extant**	**Total No. Properties**
Bolivar	19	6	26
Coahoma	2	8	11
Issaquena	0	0	0
Warren	4	3	9
Washington	12	1	14
TOTALS	**37**	**18**	**60**

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 National 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 332 such resources within the YSA and near project locations in Washington County, 321 in Sharkey County, 168 in Issaquena County, 155 in Humphreys County, 120 in Yazoo County, 88 in Bolivar County, 38 in Warren County, and 32 in Coahoma County. For more details regarding Cultural Resources in the YSA, see Appendix F-1 - Cultural Resources.

4.2.1.5 Recreation Resources

A vast array of recreational resources is available in the YSA, which includes approximately 926,000 acres of which approximately 449,000 acres are lands within the 100- year flood frequency. There are 14 Federal and/or State-managed unique recreation areas within the YSA and 3 adjacent Federally managed areas which include parks, natural areas, historic sites, fish and wildlife areas, scenic areas, and trails. Of the 14 unique public recreation areas listed within the YSA, 29 percent are Federally managed, and 71 percent are State–managed. At least 36 percent of these areas provide one or more boat-launch access points. 32 percent of these areas offer consumptive recreation opportunities while 100

percent 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.

The source of the information in Table 4-8 can be found at the websites for each managing agency listed where applicable. An inventory was collected during April 2024 through GIS reference, website reference, and aerial imagery. The inventory is an accurate representation of recreation resources available at the time. Recreation resources within the YSA is not limited to this list.

Table 4-8. Inventory of Recreational Resources

County	Name of Public Area	Size (acres)	Managing Agency	Consumptive Recreation	Non-consumptive Recreation	Boat Launch	Notes
National Wildlife Refuge (NWR)							
Sharkey, HumphreysYazoo, Washington	Theodore Roosevelt NWR	6,000	U.S. Fish & Wildlife Service (USFWS)	No	No	No	Closed to the public yet involved in active land acquisition and will someday offer educational and interpretive information
Yazoo	Panther Swamp NWR	40,000	U.S. Fish & Wildlife Service (USFWS)	Fishing and Hunting	Hiking, Wildlife Observation, Photography, Boating, Environmental Education	Yes	Largest of the seven refuges that make up the Theodore Roosevelt NWR Complex
Washington	Yazoo NWR	13,036	U.S. Fish & Wildlife Service (USFWS)	Fishing and Hunting	Hiking, Wildlife Observation, Photography, Environmental Education	No	Managed as part of the Theodore Roosevelt NWR Complex
Washington	Holt Collier NWR	2,200	U.S. Fish & Wildlife Service (USFWS)	Fishing and Hunting	Hiking, Wildlife Observation, Photography, Environmental Education	No	Managed as part of the Theodore Roosevelt NWR Complex. Much of the property was agricultural land and reforested when it was acquired by USFWS.
Holmes (adjacent to YSA)	Hillside NWR	15,000	U.S. Fish & Wildlife Service (USFWS)	Fishing and Hunting	Hiking, Wildlife Observation, Photography, Environmental Education	Yes	Managed as part of the Theodore Roosevelt NWR Complex. Land was used by USACE to capture sediment from the Yazoo Basin Headwater area. Land was transferred to USFWS in 1975.
Holmes (adjacent to YSA)	Morgan Brake NWR	7,400	U.S. Fish & Wildlife Service	Fishing and Hunting	Hiking, Wildlife Observation,	Yes	Managed as part of the Theodore Roosevelt NWR Complex. Approximately 1,110 acres of former

County	Name of Public Area	Size (acres)	Managing Agency	Consumptive Recreation	Non-consumptive Recreation	Boat Launch	Notes
			(USFWS)		Photography, Environmental Education		agricultural lands are actively managed for migratory birds.
Leflore and Holmes (adjacent to YSA)	Mathews Brake NWR	2,418	U.S. Fish & Wildlife Service (USFWS)	Fishing and Hunting	Hiking, Wildlife Observation, Photography, Environmental Education	Yes	Managed as part of the Theodore Roosevelt NWR Complex. Reforested from agriculture land in the early 1990s. the brake provides habitat for waterfowl.
National Forest							
Sharkey and Issaquena	Delta National Forest	60,000	U.S. Forest Service (USFS)	Fishing and Hunting	Primitive Camping, Wildlife Observation, Multi-use Trails, Photography, Outdoor Education, Boating	Yes	Blue Lake Recreation Area, Little Sunflower River Recreation Area, primitive camping and multiple use trails compose the recreation program at Delta National Forest. Areas of Delta are co-managed by Sunflower WMA and MDWFP. Susceptible to backwater flooding.
Wildlife Management Area (WMA)							
Issaquena	Howard Miller WMA	2,400	Mississippi Department of Wildlife, Fisheries, & Parks (MDWFP)	Waterfowl Hunting	Wildlife Observation	No	Is a former agricultural field tract that is managed for quality waterfowl hunting. 420 acres is permanent wildlife sanctuary. Susceptible to backwater flooding
Yazoo	Lake George WMA	8,383	Mississippi Department of Wildlife, Fisheries, & Parks (MDWFP)	Hunting	Wildlife Observation	Yes	Is a tract of regenerated bottomland hardwood forest owned by USACE. Deer and small game hunting is outstanding and waterfowl opportunities exist when flood water is retained. Susceptible to backwater flooding.
Washington	Leroy Percy WMA	1,642	Mississippi Department of Wildlife, Fisheries, & Parks (MDWFP)	Fishing and Hunting	Hiking, Wildlife Observation	No	One of two WMAs in Mississippi located on a State Park. Small game and archery only for deer hunting. WMA is not commonly susceptible to backwater flooding.
Warren and Issaquena	Mahannah WMA	12,695	Mississippi Department of Wildlife, Fisheries, & Parks (MDWFP)	Fishing and Hunting	Camping, Hiking, Wildlife Observation	No	Is bottomland hardwoods, agriculture fields, hardwood reforestation, and waterfowl impoundments. 1,486 acres are open agriculture fields managed explicitly for waterfowl. Susceptible to backwater flooding.

County	Name of Public Area	Size (acres)	Managing Agency	Consumptive Recreation	Non-consumptive Recreation	Boat Launch	Notes
Washington	Muscadine Farms WMA	3,013	Mississippi Department of Wildlife, Fisheries, & Parks (MDWFP)	Waterfowl and small game Hunting	Wildlife Observation	No	1,400 acres of retired catfish ponds managed for moist-soil waterfowl habitat. 1,400 acres of replanted trees open for small game hunting.
Warren and Issaquena	Phil Bryant WMA	18,000	Mississippi Department of Wildlife, Fisheries, & Parks (MDWFP)	Fishing and Hunting	Hiking, Wildlife Observation, Canoeing, Nature Photography, Camping	No	Formerly known as Steele Bayou WMA and is broken into 4 hunting units. Susceptible to backwater flooding.
Issaquena	Shipland WMA	3,642	Mississippi Department of Wildlife, Fisheries, & Parks (MDWFP)	Fishing and Hunting	Primitive Camping, Wildlife Observation	No	One of two WMAs in the Mississippi batture lands and susceptible to extensive flooding. Deer hunting is popular followed by small game and waterfowl.
Sharkey	Sunflower WMA	60,000	Mississippi Department of Wildlife, Fisheries, & Parks (MDWFP)	Fishing and Hunting	Camping, Hiking, Wildlife Observation	Yes	Is bottomland hardwood forest with stands of various ages located in Delta National Forest. 5,200 acres of managed water retention for better hunting habitat and hunting opportunities in addition to Greentree reservoirs. Susceptible to backwater flooding.
Sharkey	Twin Oaks WMA	5,847	Mississippi Department of Wildlife, Fisheries, & Parks (MDWFP)	Hunting	Camping, Hiking, Wildlife Observation	No	5,383 acres bottomland hardwoods managed for hunting, Greentree reservoirs encompass 500 acres and are purposely flooded for wintering waterfowl habitat. Susceptible to backwater flooding.
State Parks							
Washington	Leroy Percy State Park	2,270	Mississippi Department of Wildlife, Fisheries, & Parks (MDWFP)	Fishing	Hiking, Wildlife Observation, Canoeing, Nature Photography, Camping, Disc Golf, Picnic Area, Playground, Nature Trail	Yes	Park is not commonly susceptible to backwater flooding. Hunting is allowed within featured WMA only.

USFWS data source: https://www.fws.gov/refuges/?ref=topbar

USFS data source: www.fs.usda.gov/

MDWFP data source: http://www.mdwfp.com/

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 (Tables 4-9 and 4-10).

Table 4-9. Federally-Managed Recreation Projects Between 1965 – 2011

Name	Agency	State
Vicksburg National Military Park	NPS	Mississippi
Delta National Forest	USFS	Mississippi
Panther National Wildlife Refuge	USFWS	Mississippi

Source: https://www.lwcfcoalition.com/map-of-lwcf

Table 4-10. State & Local Recreation Projects Between 1965 – 2011

State	County	Grant ID Element	Grant Element Title	Grant Sponsor	Fiscal Year	Amount
Louisiana	Madison	760	Wright Elementary Ballfield	Madison Parish School Board	1990	$15,328.50
Louisiana	Madison	760	Tallulah Park	Town of Tallulah	1990	$9,766.19
Mississippi	Humphreys	393	Humphreys County Park	Humphreys County	1986	$25,150.00
Mississippi	Issaquena	490	Issaquena County Park	Issaquena County Board of Supervisor	1991	$24,906.70
Mississippi	Sharkey	252	Rolling Fork City Park	Town Of Rolling Fork	1977	$61,900.69
Mississippi	Sharkey	87	Rolling Fork Recreational Parks	Town Of Rolling Fork	1971	$43,734.75
Mississippi	Warren	201	Vicksburg - Hall's Ferry Park	City Of Vicksburg	1975	$200,000.00
Mississippi	Warren	361	Kings Ballfield	Warren County	1984	$40,000.00
Mississippi	Warren	476	Vicksburg-Halls Ferry Phase Iii	City Of Vicksburg	1990	$20,000.00
Mississippi	Warren	624	Hall's Ferry Park-Tennis Court Expansion Project	City Of Vicksburg	2014	$100,000.00
Mississippi	Warren	295	Vicksburg - Cedar Grove Park	City Of Vicksburg	1979	$100,000.01
Mississippi	Warren	592	Vicksburg Art Park	City Of Vicksburg	2004	$150,000.00
Mississippi	Warren	258	Warren County Recreation Complex	Warren County	1978	$317,595.32
Mississippi	Warren	371	Vicksburg Hall Ferry	City Of Vicksburg	1984	$50,000.00

State	County	Grant ID Element	Grant Element Title	Grant Sponsor	Fiscal Year	Amount
			Phase Ii			
Mississippi	Warren	527	Vicksburg Community Park	City Of Vicksburg	1995	$30,000.00
Mississippi	Warren	600	Vicksburg River Front Park	City Of Vicksburg	2006	$150,000.00
Mississippi	Washington	42	Leroy Percy Camping Project	Dept. Of Wildlife, Fish. & Parks	1969	$18,889.67
Mississippi	Washington	357	Greenville Parks Improvement	City Of Greenville	1984	$20,000.00
Mississippi	Washington	65	Paul Love, Jr. Rec. Area	Washington County	1970	$29,581.50
Mississippi	Washington	121	Hollandale Park Project	City Of Hollandale	1972	$38,143.70
Mississippi	Washington	305	Greenville Exercise Trails	City Of Greenville	1980	$15,000.00
Mississippi	Washington	392	Leroy Percy State Park-Cabin	Dept. Of Wildlife, Fish. & Parks	1986	$34,999.99
Mississippi	Washington	398	Washington County Park	Washington County	1986	$50,000.00
Mississippi	Washington	2	Winterville Mound Project	Dept. Of Wildlife, Fish. & Parks	1966	$42,795.21
Mississippi	Washington	57	Deerfield Park	Washington County	1970	$43,131.30
Mississippi	Washington	89	Greenville Municipal Golf Course	City Of Greenville	1971	$46,349.00
Mississippi	Washington	394	Leland City Park	City Of Leland	1986	$25,000.00
Mississippi	Washington	423	Greenville Park Additions	City Of Greenville	1986	$9,640.76
Mississippi	Washington	74	Deer Creek Recreation Park	Washington County	1971	$34,428.50
Mississippi	Washington	99	Leroy Percy Road Project	Dept. Of Wildlife, Fish. & Parks	1972	$7,003.00
Mississippi	Washington	238	Greenville Swimming Pools	City Of Greenville	1977	$244,150.00
Mississippi	Yazoo	245	Yazoo City Urban Parks	City Of Yazoo	1977	$182,999.97
Mississippi	Yazoo	169	Yazoo City Recreation Park	City Of Yazoo	1974	$32,950.00

Source: https://www.lwcfcoalition.com/map-of-lwcf

4.2.1.6 Aesthetics (Visual Resources)

Environmental assessments and impact statements for USACE studies focus on significant environmental considerations as recognized by technical, institutional and public sources. The Visual Resources Assessment Procedure (VRAP) provides a method to evaluate visual

resources affected by USACE 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.
- Publicly 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 YSA'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 YSA 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 YSA. Noise within the YSA 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 YSA include everyday vehicular traffic along nearby roadways which is typically between 50 and 60 dBA at 100 feet.

Therefore, the noise level within the YSA is generally maintained at below an acceptable level.

4.2.1.8 Air Quality

The air quality of the YSA 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. Principal sources of air pollutants in the counties include industries, agricultural operations, and emissions from internal combustion engines.

4.2.1.8.1 Greenhouse Gas

The CEQ's, CEQ-2022-0005, on 9 January 2023, introduced the interim guidance on Greenhouse Gas (GHG) and how agencies are able to compute GHG and the social cost for their projects. The components that are analyzed within GHG are Carbon dioxide (CO2), Methane (CH4), and Nitrous Oxide (N20). Primary sources of CO2 can be natural sources like decomposition of organic material and anthropogenic sources like burning of fossil fuel (Carbon Dioxide 101, 2023). For CH4, emissions can come from a variety anthropogenic process including flora and fauna sources (Crutzen etc. all, 1986). For N20, majority of the point source revolves around agricultural processes: fertilization (Nitrous Oxide Emissions, 2023). For GHG, CO2 is the primary contributor to GHG and climate change, followed by CH4 and N20. Figure 4-13 outlines the total U.S. emissions of 2021 showing that over 75 percent of GHG is CO2 (Overview of Greenhouse, 2023).

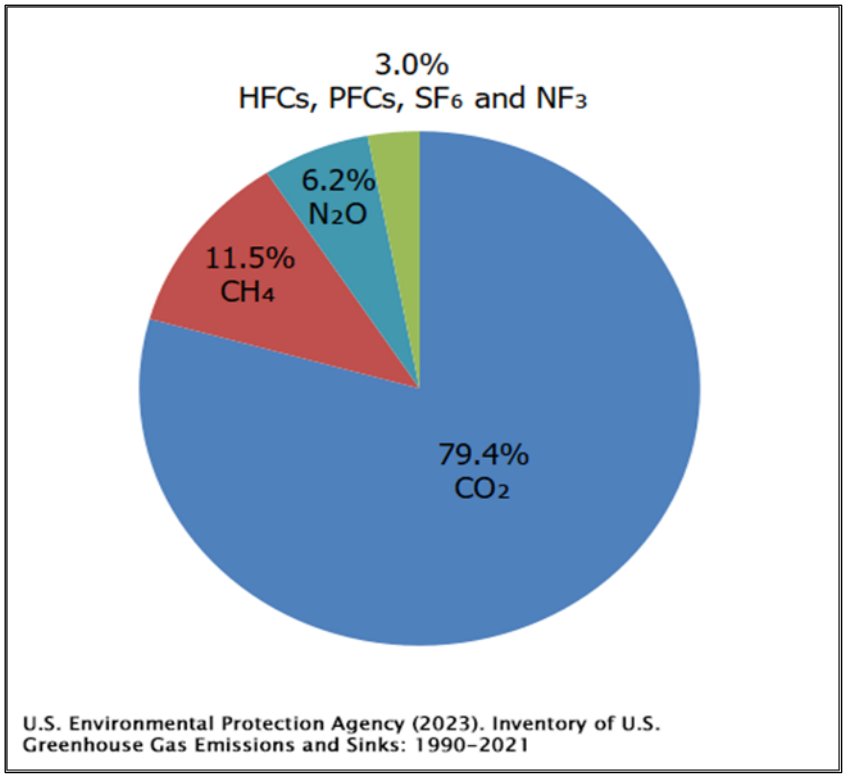

Figure 4-13. Total U.S. Emissions of Greenhouse Gasses

4.2.1.9 Hazardous, Toxic, and Radioactive Waste (HTRW)

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 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 structural features of the proposed alternative 1 and alternative 2 on 11 April 2024 (see Appendix F-2 - Hazardous, Toxic, and Radioactive Waste). These features included the Steele Bayou Pump Site and the associated borrow area. Additionally, a preliminary online record search was conducted of the pump site and borrow area associated with Alternative 2 and Alternative 3 on 10 April 2024 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. An HTRW assessment was conducted at the initial locations proposed for the low flow wells associated with Alternative 2 and Alternative 3. This assessment was completed on 1 October 2023 and shall be updated during the initial stages of design.

Given the scale and uncertainty associated with Alternative 4, no onsite assessment or records search for HTRW was performed for the structural features identified below the 98.2 feet (NGVD29) elevation. This assessment for the applicable structures which may receive flood proofing measures shall be conducted during the initial phases of design.

4.2.2 Natural Environment

4.2.2.1 Hydraulics and Hydrology

The hydrology of the YSA 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 YSA, up to a Steele Bayou water control structure riverside elevation of 107.0 feet NGVD29. The channel cutoffs lowered Mississippi River stages, which in turn lowered stages in the Yazoo River and reduced the frequency and duration of 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. The Yazoo Backwater Area has also benefited from other flood risk management features of the MR&T project that have been completed inside the YSA (internal sources). These features are shown in Figure 1-2. A more detailed description of the hydrologic setting is included in Appendix A - Engineering Report/H&H.

- 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 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 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.

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 YSA 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 NGVD29.

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, NGVD29).

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 YSA. 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, NGVD29, the gates are opened. With a rising river, the interior ponding areas could be allowed to rise to an elevation of 75.0 feet, NGVD29 per the approved water control manual. 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 NGVD29, and 70.0 feet NGVD29. The backwater project is not complete without a pump and having interior ponding to 75.0 without a pump creates an almost bank full scenario in the lower Yazoo Backwater as most top banks in the lower portion of the backwater are in the 78.0-80.0 feet range. Without a pump to evacuate ponded waters, letting water in the interior to a 75.0 feet elevation would lead to earlier flooding of homes and lands in the lower backwater. With the proposed pump in place, the interior ponding areas will be allowed to rise to 75.0 feet from the opening of Steele Bayou Structure but not higher because Eagle Lake operations call for, at certain times of the year, for the Muddy Bayou Control Structure at Eagle Lake to be opened to draw down the elevations of Eagle Lake from 76.0 feet to 75.0 feet in order to meet guidelines and purposes for Wildlife, Fisheries, and Parks. Should the Yazoo Backwater Area be higher than 75.0 feet then this operation at Muddy Bayou Control Structure could not be made due to higher stages in the river outside of Eagle Lake.

The YSA 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 6.3.1. 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. 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 106.2 feet on May 19th, just a few inches below the top of the levee. The Steele Bayou structure had a differential of 16 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 construction of the Backwater Levee, the area would have been inundated by approximately 16 additional feet of water. The Steele Bayou landside elevation of 90.0 feet (NGVD29) was the annual peak elevation for the Yazoo Backwater during 2011. The flood receded below an elevation of 80.0 feet (NGVD29) on July 19th. During this flood event, the Steele Bayou gates were closed from March 10th through April 20th and from April 22nd through July 19th. Because the Yazoo Backwater elevation exceeded 90.0 feet (NGVD29) during crop season, the proposed pumps would have been turned on during this flood event.

Th 2019 flood is an example a worst-case event. The flood began in the fall of 2018 due to an abnormally wet season. Frequent rain events from January through July, resulted in persistent, increased elevations on the Mississippi River. Additionally, an extended closure of the Steele Bayou gates further amplified flood conditions. Steele Bayou was closed five

times during 2019, with February 15th through April 1st being the longest, consecutive closure. On April 1st, the control structure was opened, allowing the Yazoo Backwater to drain slightly. However, multiple heavy rainfall events throughout May produced increases in elevation on the Mississippi River at Vicksburg and the Steele Bayou riverside, forcing the Steele Bayou gates closed. This second closure resulted in the Steele Bayou landside experiencing its primary crest at 98.2 feet (NAVD88) on May 23rd. This crest was the maximum elevation the Yazoo Backwater obtained during 2019. After the crest within the Yazoo Backwater, the Steele Bayou gates were opened, but were closed on June 7th to prevent backflow into the Yazoo Backwater. The closure of the control structure kept the Steele Bayou landside at an elevation around 97.0 feet (NAVD88), for May, June, and most of July. It was not until the third week in July when the Yazoo Backwater began to experience significant declines in elevation. Because the Steele Bayou elevation exceeded both 93.0 feet (NGVD29) during non-crop season and 90.0 feet (NGVD29) during crop season, the proposed pumps would have been turned on for a long period of time during this backwater-driven flood event.

Hydraulics and Hydrology including climate, climate change, past flood events, project features, model calibration and verification, flood frequency analysis, pump management elevations, pump capacity selection, and proposed pump operations can be found in Appendix A - Engineering Report/H&H.

4.2.2.2 Wetlands

Wetlands are an abundant and valuable resource within the YSA 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 Appendix F-3 - Wetlands). Importantly, large areas of wetlands persist within the YSA despite the changes in regional landuse and efforts to decrease the amount of water on the land that have been implemented over many decades. The following provides a general description of wetland resources in the YSA.

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 YSA are pedagogically young and can support high rates of forest and agricultural productivity. Wetland soils in the YSA are somewhat poorly to poorly drained, exhibit slopes <2 percent, 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 YSA, include Depleted Matrix, Depleted Below Dark Surface, Redox Depressions, and Stratified Layers (USDA-NRCS 2018).

Within the YSA wetland hydrology and soil temperatures above 5 °C have been documented throughout the entire year and many herbaceous and deciduous wetland plants display evidence of continued growth and (in some cases) reproduction throughout the winter. This notably includes species of interest such as Pondberry (*Lindera melissifolia*), which flowers during the winter. As a result, for the purposes of this assessment, the YSA is assumed to experience a year-round growing season based upon the observed lifecycle of wetland plants and the continuous activity of soil microbes.

Within the YSA, the extent of jurisdictional wetlands within the direct impact area (i.e., the physical footprint of the pump station) were determined by the USACE Vicksburg District Regulatory Branch. The procedures applied included both a wetland delineation and preliminary jurisdictional determination, which resulted in the determination of the acres of jurisdictional forested and agricultural wetlands that would be directly impacted by this project (see Chapter 5). The assessment of wetlands that would be indirectly affected by this project utilized a different approach. Riverine bottomland hardwood wetlands are those that occur in the 1- to 5-year floodplains (Smith and Klimas 2002) and are dependent on periodic flood pulses to exchange nutrients, sediment, and other organic and inorganic compounds. As such, any area that would be subject to potential shifts in flood inundation periods under the proposed Water Management Plan were considered within the indirect impact analysis if they 1) occurred below the elevation of 93 feet, which incorporates the entirety of the modeled 5-year floodplain, 2) exhibited any period of flood inundation at intervals of 5 years or less, and 3) were classified as any of the forested wetland or agricultural cropland aggregated cover types as described in the Wetland Appendix. Information on the extent of areas within the 93-foot elevation contour and 5-year floodplain were provided by the USACE Vicksburg District Engineering and Construction Division. Owing to the vast expanses of Riverine bottomland hardwood wetlands in the YSA (Smith and Klimas 2002), as well as the complexities associated with predicting soil saturation with certainty, it was not feasible to conduct a jurisdictional determination on all wetlands below the 5-year floodplain. Therefore, this methodology represents a conservative approach to determine indirect impacts, because it assumes that all flooded areas described above are wetlands.

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. Currently, both precipitation and backwater flooding act as major hydrologic influences for wetlands in the YSA.

A Section 404(b)(1) Evaluation has been completed for the project in compliance with the EPA guidelines (see Appendix I - Section 404(b)(1) Evaluation Report). It should be noted that the that the overall impact/ROW described in the 404 (b) (1) Evaluation Report may differ from the areas described in the draft EIS and in the Wetland Appendix – 4.1 No Action Alternative as well as the values displayed in Table 92 of the Wetland Appendix. The analysis performed for the Wetland Appendix did not benefit from the Preliminary Jurisdictional Determinations (PJD) conducted for the offsite borrow area. Furthermore, the entire 215 acres of overall ROW located at the offsite borrow area was conservatively assumed to be classified as wetland for the purpose of the assessment. The 404(b)(1) Evaluation, having the benefit of a PJD, accounted for overall wetland impacts totaling 4.75 acres instead of 215 acres. These cumulative areas for both overall impact/ROW and classified wetland types will be reconciled throughout the main report and the appendices for the final EIS.

4.2.2.3 Terrestrial Resources

Terrestrial resources within the 926,000-acre YSA are comprised of agricultural land or woody wetlands, namely bottomland hardwoods. 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 project.

The original YSA Wildlife and Endangered Plants Team consisted of subject matter experts from USACE, ERDC, USFWS, Mississippi Ecological Services Office (MSFO), and EPA. Based on an April 2023 interagency call, this Team selected a suite of species and/or taxa for assessments in the YBA (Table 4-11), with full concurrence of the species list by the USACE, USFWS, and EPA.

Table 4-11. List of Species or Taxa Selected for Assessments in the YBA (with Proposed Methods)

Species or Taxa	Proposed Methodologies
Prothonotary Warbler	Tirpak et al. 2009a
Kentucky Warbler	Tirpak et al. 2009a
Wood Thrush	Tirpak et al. 2009a
Acadian Flycatcher	Tirpak et al. 2009a
King Rail	Remotely sensed landscape data to quantify any change in emergent wetland abundance
Great Blue Heron	Visual surveys for rookeries and other roosting/foraging birds; MaxEnt modeling and Habitat Evaluation Procedures (HEP)
Shorebirds	USACE-certified shorebird migration model

4.2.2.3.1 Migratory Birds

Of the four species analyzed, as part of assessing potential impacts of the Yazoo Backwater Pumps Project on migratory landbirds, Kentucky Warbler (KEWA: *Oporornis formosus*), Prothonotary Warbler (PROW: *Protonotaria citrea*), and Wood Thrush (WOTH: *Hylocichla mustelina*) are considered *Birds of Conservation Concern* (BoCC)by the USFWS. The fourth species, the Acadian Flycatcher (ACFL: *Empidonax virescens*) is not a species identified as a BoCC; however, this species is strongly associated with bottomland hardwoods and other forested wetlands, and therefore is a good migratory species to assess the impacts of the Yazoo pump operations on forested wetlands habitat.

Habitat loss, feral and free-ranging domestic dogs and cats, pesticides, climate change, light pollution, and a variety of other stressors are all known to contribute to declines for migratory birds (Terborgh 1989, Rosenberg et al. 2019). Water resources development in many parts of the world has resulted in serious reductions in the frequency, extent, and duration in which floodplain forests are inundated, leading to significant habitat change and loss of productivity (McGinness et al. 2018). Since migratory birds that utilize forest and forested wetland habitat have experienced significant declines (Rosenberg et al. 2019), these birds are often the target beneficiaries of reforestation and BLH restoration in the MAV (Twedt et al. 2007). In addition to forest restoration, issues of forest size, landscape context, presence of forest corridors, and overall landscape configuration are important in long-term considerations for forest bird conservation.

Additional information regarding migratory birds and project related analysis can be found in the Appendix F-4 - Terrestrial Wildlife.

4.2.2.3.2 Secretive Marsh Birds

Secretive marsh birds, which include various species of bitterns, coots, gallinules, and rails, are seldom seen and infrequently heard. They often occupy freshwater and estuarine marshes and densely vegetated wetlands that are difficult to access. There are eight marsh bird species that may utilize portions of the YSA during some portions of the year. The King Rail (*Rallus elegans*) is a possible breeder in the YSA and is sensitive to alterations in hydrology. The federally threated Eastern Black Rail (*Laterallus jamaicensis*) could possibly move through the YSA during the migratory seasons. Other potential migratory marsh birds that could move through the YSA during migration include the Virginia Rail (*Rallus limicola*), Sora (*Porzana carolina*), and Yellow Rail (*Coturnicops noveboracensis*). The Clapper Rail (*Rallus longirostris*) is a year-round coastal species that is unlikely to occur in the YSA. Finally, the Purple Gallinule (*Porphyrio martinicus*) and the Common Gallinule (*Gallinula galeata*), are two marsh birds that may breed in the YSA and are year-round residents along the Gulf Coast.

The most likely impacts of the Water Management Plan within the YSA would be changes in hydrology within forested habitats which may result in potential alteration of forest structure and composition over time. Loss of mature floodplain forests could potentially have the most negative impacts on migratory birds that require varying levels of annual inundation upon the landscape to maintain habitat to meet life-history needs. Other habitats in the region

important to non-forest migratory birds, including herbaceous, pasture, old field, scrub/shrub, and agricultural lands, might also be impacted due to decreases in intermittent flooding events. These are the habitats that will likely be used by marsh birds.

Additional information regarding migratory birds and project related analysis can be found in the Appendix F-4 - Terrestrial Wildlife.

4.2.2.3.3 Great Blue Heron

The Great Blue Heron (GBHE; *Ardea herodias*) is a long-legged wading bird found throughout Mississippi (and much of North America) in freshwater wetlands, lakes and reservoirs, flooded meadows, agricultural fields, and along ditches and riverbanks (Vennesland and Butler 2020). Great Blue Herons are a good indicator species for other wading birds because they typically forage and nest in the same or similar habitats (with varying degrees of overlap) as many of the wetland-associated Pelecaniformes wading species.

The GBHE nesting period is typically February to May (Vennesland and Butler 2020). GBHE are a colonial-nesting species, and nesting colonies (heronries) can be found in mature forested habitats near suitable wetland foraging areas (Short and Cooper 1985, Vennesland and Butler 2020). In the Lower Mississippi Alluvial Valley, GBHE forage in a variety of wetland habitat types including emergent wetlands, open water (*e.g.*, ponds and edges of lakes and rivers), sloughs, flooded fields, catfish ponds, and forested wetlands (Thompson 1979, Vennesland and Butler 2020). Fish, usually 5-30 cm long (Willard 1977) typically make up the bulk of the GBHE's diet, although the species is an opportunistic feeder that will also eat amphibians, reptiles, rodents, birds, large insects, snails, and crustaceans (Vennesland and Butler 2020).

Additional information regarding migratory birds and project related analysis can be found in the Appendix F-4 - Terrestrial Wildlife.

4.2.2.3.4 Shorebirds

The YSA is located within the Mississippi Flyway and serves as a migratory stopover area for dozens of species of shorebirds during both spring and fall (Twedt et al., 1998). Most shorebirds that occur in the project area do so en route to their boreal breeding range in the spring, or on their way south to their non-breeding grounds in the autumn. High quality stopover habitat is critical to the annual survival of these species, some of which are only halfway through bi-annual migrations of over 9,000 miles when they stopover within the Mississippi Delta (Brlík et al., 2022; McDuffie et al., 2022).

Migratory shorebird habitat in the Mississippi Delta consists primarily of flooded/wet agricultural areas (pre-planting in the spring, or post-harvest in the fall), aquacultural areas including catfish farms, and the edges of water bodies, such as farm ponds and oxbow lakes. Shorebird habitat within the Yazoo Backwater Area tends to be more abundant in the spring, when heavy precipitation and rising rivers can increase the amount of moist soil on the landscape.

Common shorebird species that occur within the project area include (but are not limited to) Least Sandpiper (*Calidris minutilla*), Greater Yellowlegs (*Tringa melanoleuca*), Dunlin (*Calidris alpina*), Semipalmated Sandpiper (*Calidris pusilla*), Long-billed Dowitcher (*Limnodromus scolopaceus*), Stilt Sandpiper (*Calidris himantopus*), and Pectoral Sandpiper (*Calidris melanotos*).

Additional information regarding migratory birds and project related analysis can be found in the Appendix F-4 - Terrestrial Wildlife.

4.2.2.4 Wildlife

Lands within the YSA 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 the MAV hydrology through channelization and construction of levees and water control structures, which in turn altered the natural floodpulse cycle delivering water, nutrients, and sediment to these floodplain ecosystems (Baker et al. 1991, Gore and Shields 1995). The relative effects of too much or too little water in the YSA must be considered both over the short- and long-term as the net 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 YSA 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 percent of the Mississippi Flyway's waterfowl and 60 percent of all U.S. bird species either migrate through or winter in the MAV (LMVJV 2015). Furthermore, the 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*), Bluewinged Teal (*Spatula discors*), Northern Shoveler (*Spatula clypeata*), and Wood Duck (*Aix sponsa*).

The size of the migratory waterfowl population in the MAV is 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 32.3 million birds within North America, a 23 percent decline from the long-term average from 1955-2022 average (USFWS 2023). Within the Mississippi Flyway, the midwinter waterfowl survey by the USFWS and the states, counted on average approximately 5.9 million ducks, a decrease of nearly 12 percent over the long-term average (1955-2022) (Fronczak 2022).

Recovery of waterfowl populations can be attained using conservation efforts including extensive funding to restore both breeding and wintering habitat; expansion of the USFWS National Wildlife Refuge system; creation of the duck stamp to fund wetland restoration, and large-scale participation with non-governmental organizations such as Ducks Unlimited and Delta Waterfowl. These efforts have and will continue to play a key role in sustaining waterfowl populations. However, habitat loss as well as factors such as climate change continue to be significant threats to wildlife populations including waterfowl (Mantyka-Pringle et al. 2012). Therefore, it remains critical to protect the resources on which waterfowl are dependent.

For more details on waterfowl, see Appendix F-5 - Waterfowl.

4.2.2.6 Threatened and Endangered Species

Table 4-12 lists federally listed threatened and endangered species within the YSA that should be addressed in this EIS per USFWS. This section provides a summary of each of the listed species below. Development of the Biological Assessment in coordination with USFWS is ongoing and will be included in Appendix G of the Final EIS.

Table 4-12. Federally Listed Threatened and Endangered Species within the YSA

Species	Status	Occurrence
Pondberry (*Lindera melissifolia*)	Endangered	Known
Northern Long-Eared Bat (Myotis septentrionalis)	Endangered	Likely Low Numbers
Alligator Snapping Turtle (*Macrochelys temminckii*)	Proposed Threatened	Likely
Pallied Sturgeon (*Scaphirhynchus albus*)	Endangered	Potentially
Fat Pocketbook (*Potamilus capax*)	Endangered	Potentially

4.2.2.6.1 Pondberry (Lindera melissifolia)

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

4.2.2.6.2 Northern Long-Eared Bat (Myotis septentrionalis)

The USFWS listed the Northern Long-Eared Bat as federally threatened in 2015 and federally endangered in 2022. The 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 YSA, but in very low numbers.

4.2.2.6.3 Alligator Snapping Turtle (Macrochelys temminckii)

Alligator snapping turtles (ASTs) live in a variety of freshwater habitats from small streams to large rivers, oxbows, swamps, bayous, lakes, and canals with water clarity that ranges from clear to murky and turbid (Ernst and Lovich 2009). During high water events turtles will move out of deeper waters and channels into adjacent inundated flood plains. ASTs utilize shaded stream banks with intact riparian tree cover, an abundance of submerged logs, trees, and other in-stream structures. In bayou and swamp habitat, vegetated microhabitats, with plants such as cypress, tupelo, buttonbush, and floating aquatic vegetation. There are few known nesting locations within the YSA due to the lack of nest surveys; however, observed nesting locations in low-lying and heavily forested floodplains included eastward facing, partially open-canopy banks (caused by tree falls) approximately 1-3 m above and 2-10 m from the waterline (Ewert 1976; L. Pearson and P. Delisle, pers. obs.).

4.2.2.6.4 Pallid Sturgeon (Scaphirhynchus albus)

The Pallid sturgeon was listed as endangered by USFWS in 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 Satartia (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 1900s. 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 (M. Wagner, MDWFP pers. comm.). No recent specimens of Pallid Sturgeon have been reported from the YSA. 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.

4.2.2.6.5 Fat Pocketbook (Potamilus capax)

The fat pocketbook was listed as endangered by USFWS 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 YSA, 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.

4.2.2.6.6 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 USFWS.

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

4.2.2.7 Aquatic Resources/Fisheries

Within the 926,000-acre YSA, abundant water sources provide habitat for aquatic organisms and fish. Aquatic resources in the YSA 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 federally listed mussel species (*e.g.*, Fat Pocketbook).

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, 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.

The lack of riparian buffers on streams, rivers, and ditches in the YSA 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 associated with increased agricultural production in the YSA over the last century, low to no flow conditions are observed typically in the fall in the upper reaches of the basin (see Appendix F-6 - Aquatic Resources).

4.2.2.8 Water Quality

A detailed analysis of the water quality conditions observed in the YSA over the last several decades can be found in Appendix H - Water Quality. The following is a summary of that information.

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 6 decades.

4.2.2.8.1 Nutrients and Solids

Most water bodies in the YSA 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 listed for the Yazoo Basin include: DDT, Mercury, Metals (Other Than Mercury), Nonpriority Organics, Nutrients, Oil and Grease, Organic Enrichment/low Dissolved Oxygen, Pathogens, Pesticides, Sedimentation/siltation, Siltation, Suspended Solids, Total Toxics, and Toxaphene (EPA, 21MSWQ/MS948711; EPA, 21MSWQ/MS948311). The Mississippi River stretching from the Arkansas State line to the

Old River Control Structure listed Fecal Coliform as an impairment (EPA, LADEQWPD/ LA070101).

The mean concentrations observed for nitrogen and phosphorus coming from the YSA 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 YSA 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 phosphorus (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. The reduction of TP concentration observed as water moved from the upper to lower reaches of the Steele Bayou and Big Sunflower Basins could be attributed to 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 the 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 mg/L and 40.0 mg/L 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 mg/L 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 mg/L and 50.0 mg/L 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 mg/L 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 mg/L 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 mg/L 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 YSA 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 phosphorus 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 percent 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.

4.2.2.8.2 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 YSA reached or exceeded 20° 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 negative effects of reduced dissolved oxygen concentrations are further compounded when water stages in the Yazoo Basin fall below critical levels to sustain aquatic life. Light penetration and corresponding temperature increases are more likely to influence the entire water column minimizing any safe refuge in cooler, deeper waters for fish. Adequate water supply is needed to hold an adequate volume of dissolved oxygen. The dissolved oxygen saturation concentration monitored in the Steele Bayou Basin (Main Canal, Black Bayou, Grace, Low Water Bridge) rarely reached 50 percent from April to November. The water stages in the Yazoo Basin have seen a decline in seasonal flow duration (specifically for the fall) for the last several decades. The published EPA Quality Criteria for Water (1986) establishes recommended criteria for dissolved oxygen concentrations to protect aquatic life. The 1 day minimum criterion for early life stages of warmwater fish of 5.0 mg/L 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 through October. These depleted dissolved oxygen conditions for over half of the year in the YSA impose a severe impact on the overall health of the aquatic ecosystem.

Depleted dissolved oxygen concentrations were observed during many of the recent YSA 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 YSA 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 YSA 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 YSA during extended flood events.

4.2.2.8.3 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 (NTU) 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.

4.2.2.8.4 Water Flow

The main tributaries of the Steele Bayou, Deer Creek, 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 percent 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 percent duration for the 2000s was

increased to approximately 50 cfs which was largely supplemented by the flow augmentation implemented by Yazoo Mississippi Delta Joint 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 percent 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 early summer months, the more recent periods showed increased flow instead of decreased flow. This increase is due to irrigation return flow. Stream flow begins to decline to critical levels during the fall when the need for irrigation in the Yazoo Basin declines. The low flow period for flow augmentation will generally be the fall (September through November).

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, current trends in the socioeconomic categories are expected to continue as the future without project presented in Section 4.2.1.1.

Alternative 2

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. However, there would be an overall positive indirect and cumulated benefit associated with reduction in flooding and agricultural intensification to the socioeconomic resources in the YSA.

Alternative 3

Implementation of Alternative 3 would result in similar direct, indirect, and net impacts to those noted for Alternative 2.

Alternative 4 (Non-Structural)

Implementation of Alternative 4 would result in similar direct, indirect, and net impacts to those noted for Alternative 2.

5.1.2 Environmental Justice

USACE concludes, consistent with Executive Orders No.12898, 3 C.F.R.59-32, (2004) and EO 14008, that the Updated Recommended Plan as designed would benefit residents and

businesses in disadvantaged communities in the YSA in terms of lowering the flood risk to those structures in the 2019 flood extent (considered the no action condition) or 1,845 structures. Structures would be better protected by the project alternatives from the 98.2' level flood; either through acquisition and relocation or a lowering of the flood risk with the pumps in place. Table 5-1 provides a summary of the number of structures impacted for each of the FRM measures and the number affected that are residential structures and in disadvantaged communities. Approximately 291 of the 1,513 structures in the YSA that could see a lower flood risk are residential and located in disadvantaged communities while another 52 or 80 residential structures could be acquired, either through mandatory or voluntary acquisition, and relocated outside of the flood prone area.

All of the 423 residential structures in disadvantaged communities in the YSA that are impacted by the 98.2' inundation are part of the mandatory/voluntary buyout scenarios or receive some level of flood risk reduction from the pumps in place or are part of the voluntary buyout measure for the NS only plan.

Downstream impacts to EJ areas of concern are not expected to occur, with either of the alternatives operating. A more detailed explanation is provided towards the end of this section.

Other benefits of the alternatives to disadvantaged communities, including to agricultural lands and to the ecosystem, are also described in sections below.

Table 5-1. Summary of Alternative Measures Impact on Structures within the YSA, Mississippi

All Structures in Yazoo Study Area (YSA)			
Measure	**Alternative 2**	**Alternative 3**	**Alternative 4**
Mandatory Buyout	101	101	0
Voluntary Buyout	231	231	1845
Pumps FRM	1513	1513	0
Residential Structures in Disadvantaged Communities in Yazoo Study Area (YSA)			
Mandatory Buyout	52	52	0
Voluntary Buyout	80	80	423
Pumps FRM	291	291	0

There would also be agricultural benefits to the YSA, and the negative effects of extended duration flooding on aquatic resources, wildlife, and recreational resources would be dampened. Under the no action condition (2019 flood extent of 98.2 feet), the number of farmland acres inundated is estimated to be 137,926 which is the land cover category labeled "cleared." Table 3-3 provides the land cover acres impacted under the three inundation levels. With the pumps in place and the 93' level of inundation, farmed acres

inundated falls to 39,491 and at the 90' level, farm acres flooded is estimated to be 11,816 or inundation of farmland acres is reduced by 71 percent and 91 percent, respectively. The lowering of cleared land inundation is a benefit to the agricultural industry and an indirect benefit to the YSA and the disadvantaged communities' socio-economic underpinnings. For the acres continuing to be inundated, perpetual easements from willing sellers are being proposed for forest/conservation features on open land and the number of acres eligible varies dependent on the alternative with Alternative 4 offering the largest number of restoration acres. Perpetual easements could help reduce flood risk by converting the land to a use more compatible to frequent flooding.

Farming industry employment could also be positively affected due to a lowering of crop land acreage inundation, with the pumps in place. Substantial loss of farm jobs in Issaquena and Sharkey Counties occurred between 1980 and 2000. Since 1980, farm jobs as a percent of total county employment went from 35.1 percent to 16.8 percent in Sharkey County, and from 66.1 percent to 36.2 percent for Issaquena County. This period is also a period of frequent flood events. If the loss in farm jobs is related in part, to repeated crop land inundation, then with the pumps in place offering a lowering of flood risk to crop lands, farm jobs could increase or remain stable over time. Farm employment opportunities to residents in the study area (vastly an area of EJ concern) could increase if farming increases or at a minimum remains stable.

Features include installation of low flow groundwater wells. Since the fish-carrying capacity of a river system is dependent in part on the habitat quantity and quality during annual low flow conditions this alternative proposes the installation of 34 supplemental low flow groundwater wells within 30,000 feet of the Mississippi River channel and upstream of the YSA which would deliver a maximum of 5.0 cfs during traditionally low flow periods. The increased low flow aquatic habitat provided with the operational feature could significantly increase standing stock and production for many fish species. As a result, communities with EJ concerns could expect improved aquatic conditions and a higher likelihood of more opportunities for fish consumption once the 34 supplemental low flow groundwater wells are operational. The benefit of the low flow wells is due to them providing water to areas of the study that may have low water levels.

No Action Alternative

The Yazoo Backwater levee was completed in 1978, flooding events above 95 feet (NGVD29) were predicted to occur at least every 10 years (USACE 1985). During the flood of 2019, flows peaked at 98.2 feet inundating over half a million acres of land in the southern Delta from February to August.

At the 98.2-foot inundation level, approximately 1,845 structures in the YSA are located in areas that are likely to receive some level of flooding, either in or around the structure, from a 1-year to 100-year storm frequency event. These structures are shown on Figure 5-1 and are the structures that would likely be either inundated or in areas of inundation under the 98.2 feet scenario (the 2019 flood event and the no action condition).

Of the 1,845 structures located in the 98.2 feet level scenario, 909 are residential structures and 423 residential structures are in census tracts identified as disadvantaged communities or about 47 percent of residential structures.

The 2019 flood was a historic flood event due to its extent and duration. However, its occurrence was not unexpected and similar events will likely occur again.

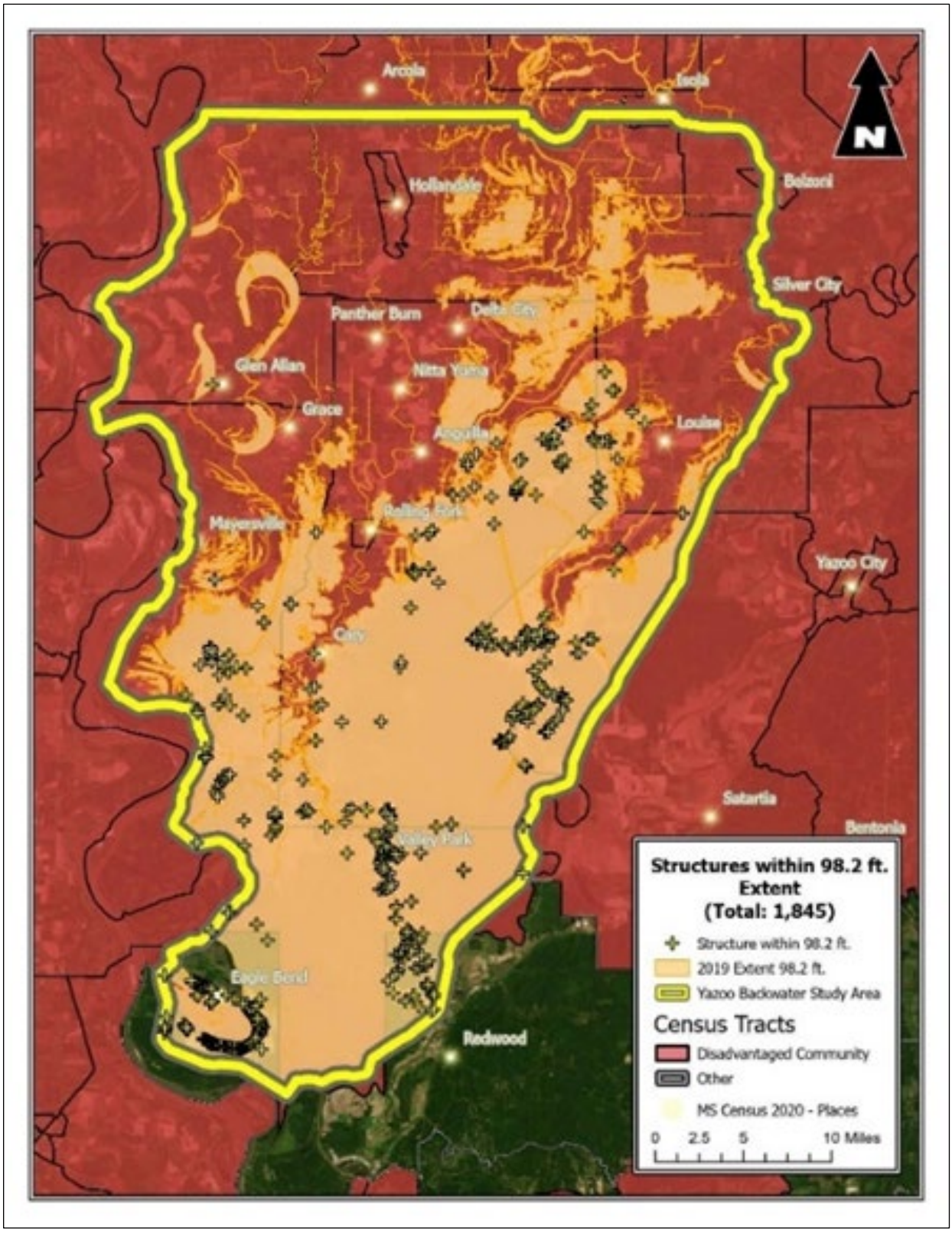

Figure 5-1. 98.2 Flood Extent, Structures and Disadvantaged Communities

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 project 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 YSA.

Alternatives 2 and 3

Under these alternatives, two different pumping operations are proposed; water levels managed at 90.0 feet during crop season (16Mar-15Oct) is Alternative 2 and up to 93.0 feet during non-crop season (16Oct-24Mar) is Alternative 3. Direct Impacts to those living in disadvantage communities include a reduction in inundation that is in or near their home or business. In order to further reduce flood risk below the pump operation elevation (*i.e.*, 90 feet), mandatory acquisition of all structures (101 Structures) is being proposed; while voluntary acquisition or floodproofing of residential and commercial properties (231) up to 93.0 feet is being proposed.

Positive impacts would accrue to those who are subject to a buyout and who would be provided financial support to be relocated to a home outside the flood prone area. area. Both alternatives would consist of a mandatory buyout of structures in the 90’ level of inundation or about 101 structures of which 55 are residential and 52 residential structures are in disadvantaged communities. The residential structures that are included in the mandatory buyout are those structures that are flooded frequently, on average every 2 years. For structures located in the 90’-93’ level inundation, a voluntary acquisition would be available which, if the owner accepts, would be relocated to outside of the flood prone area. About 231 structures are in the voluntary buyout plan, of which 95 are residential. About 80 of the residential structures are in disadvantaged community census tracts.

The buyout scenario will directly impact owners and renters in structures in disadvantaged communities. All structures roughly within the 2-year and less flood event will be acquired or about 101 structures and just over half are residential and nearly all are in disadvantaged communities. It is unknown if the residential structures in disadvantaged communities are inhabited by full-time residents or if some are camps and not occupied year-round. Although those subject to the mandatory buyout requirement would receive benefits in terms of financial assistance and relocation to an area outside the floodplain, regardless, the mandatory acquisition of structures may be a high, adverse impact to those in disadvantage communities. The residential structures that could be acquired are structures that flood frequently, and owners could benefit from being offered market value for their home and financial assistance to relocate to areas that flood less frequently. Mitigation of the impacts associated with a mandatory buyout is presented at the end of this section.

A lower flood risk for structures in the YSA that are not part of a buyout and relocation plan (mandatory or voluntary) may be the result of lowering flood levels from 98.2 to 93- or 90-foot levels. The lowering of inundation may benefit not only structures and automobiles, but also roads and agricultural land, and result in improvements in ecosystem resources. These three positive, direct impacts to EJ communities, from the with-project conditions, are presented in the following sections and include, 1) reduction in flood risk to structures, 2) reduction in flood risk to agricultural crop lands and 3) improvement in ecosystem resources.

Approximately 1,513 structures in the YSA that are not part of a buyout scenarios receive some level of flood risk reduction from the pumps lowering the level to 93 or 90 feet. About 909 of the 1,513 structures are residential and 291 are in disadvantaged communities. Lower flood risk to residents and business owners in disadvantaged communities from Alternatives 2 and 3 is a positive, beneficial impact.

Table 5-2 and Figure 5-2 show the three inundation extents, the 90' level (blue color), the 93' level (blue and pink colors) and the 98.2 feet level (blue, pink and brown colors). Under Alternatives 2 and 3, 332 structures (yellow triangles and red dots) would be inundated at the up to 5-year event or 93 feet. Alternatives 2 and 3 results in the removal of 101 highly prone, frequently flooded structures (red dots), 55 of which are residential (52 are in disadvantaged communities) and the relocation of those residents and businesses, which is discussed in the Mitigation Section at the end of this section. The voluntary buyout part of the alternatives is for those structures in the 90-93-foot inundation level and are represented by the brown triangles. The structures represented as plus signs on Figure 5-2 (1,513) are those structures that will not be in a buyout scenario that are likely to no longer flood from the 98.2-foot level event or flood considerably less.

Table 5-2. Structures in the 90-, 93-, and 98.2-foot Inundation Areas, by Structure Type, YSA, 2024

	90	**93**	**98.2**
AG	7	31	239
Commercial	5	8	26
Residential	55	150	909
Unclassified	11	31	93
Utility	23	112	578
Total	101	332	1845

*Structures may or may not be inundated, but area around the structure is, at a minimum, inundated.

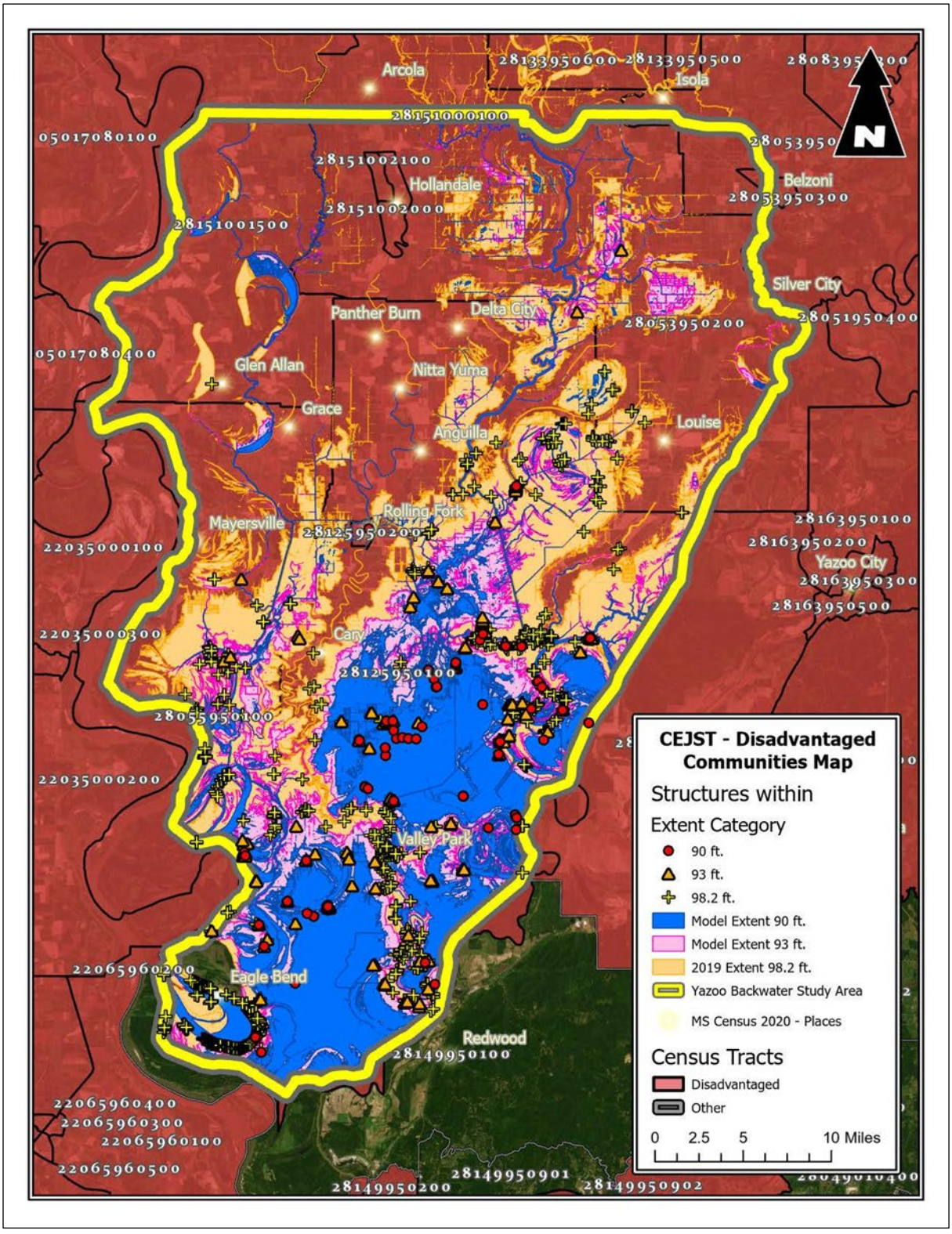

Figure 5-2. Structures within the 90 feet, 93 feet, and 98.2 feet Inundation and Disadvantaged Communities within the YSA, Mississippi

Features include installation of low flow groundwater wells. Since the fish-carrying capacity of a river system is dependent in part on the habitat quantity and quality during annual low flow conditions this alternative proposes the installation of 34 supplemental low flow groundwater wells within 30,000 feet of the Mississippi River channel and upstream of the YSA which would deliver a maximum of 5.0 cfs during traditionally low flow periods. The increased low flow aquatic habitat provided with the operational feature could significantly increase standing stock and production for many fish species and support aquatic resources by reducing hypoxia). Thirty-four supplemental low flow groundwater wells placed primarily along Highway 1 extending from near Clarksdale (Coahoma County) south to Arcola (Washington County) are proposed to augment stream flows in multiple systems within the Yazoo drainage. Supplemental flows will be conveyed during months when mean monthly discharge rates for streams in the system are at their lowest.

Indirect impacts to EJ communities may occur resulting from construction activities associated with installation of the pumps and other associated improvements of the Updated Recommended Plan. 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. EPA's EJSCREEN environmental indicator, "Traffic Proximity and Volume," shows the area to be at the 13th percentile in the state, which indicates 87 percent of the state has higher traffic volume and is not, compared to the state, an existing environmental risk. 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. Best management practices will be utilized to avoid, reduce, and contain temporary impacts to human health and safety.

Subsistence hunting, impacts associated with the non-structural reforestation feature may 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 Updated Recommended Plan. EJ communities may expect more opportunities for wildlife hunting under the with-project condition.

Positive net impacts to disadvantaged communities, 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 YSA.

Alternative 4 (Non-Structural)

Under this alternative, owners of structures that are in the 93-98.2 inundation floodplain would be offered voluntary buyout of their structures. Figure 5-3 shows the location of the 1,845 structures that are part of this alternative. Figure 5-3 shows green plus signs which represent residential structures in disadvantaged communities that comprise the NS Plan. Of the 1,845 structures in the NS plan, 909 are residential and 423 are residential structures in disadvantaged communities. **Uniform Relocation Act** (URA) benefits would be offered to those who volunteer for acquisition of their home and property and these benefits are described in the section below.

Downstream Impacts to EJ areas of Concern

The downstream impacts of the proposed pumps are broken into two interests: 1) homes and structures impacted by the 2011 Mississippi River Flood and 2) increased stages in the Mississippi River at the Vicksburg gage and further downstream. John Elfer, Warren County Emergency Management Director, confirmed in a November 27, 2023 email details of the homes in Vicksburg that were impacted from previous floods. There were several homes, specifically northeast of the Port of Vicksburg and south of the Yazoo River, that flooded during the 2011 Mississippi River flood event when the stage on the Mississippi River at the Vicksburg gage reached 57.1 feet. Mr. Elfer stated that some homes were bought out and demolished while other homes were raised. He confirmed that if a 2011 Mississippi River flood event were to occur today then there would be no flooding in this area to homes and other structures.

The Mississippi River model includes the lower part of the Yazoo River in the model. The 25,000 cfs pump flow was added to the Yazoo River during the peak of the 2011 Mississippi River flood to see the increase stage at the Vicksburg gage. The model showed a maximum of 0.40-foot increase at the Vicksburg gage due to the added flow from the Yazoo Backwater Pumps. This increase in stage played out prior to the peak of the flow getting to the Natchez gage on the Mississippi River. During the 2011 Mississippi River flood, the USGS measured 2,300,000 cfs passing the Vicksburg gage during the peak of the flood in May. Figure 2-113 shows the rating curve for the Mississippi River at Vicksburg. The points on the higher end of the rating curve are 52 feet with 1,880,000 cfs and 57 feet with 2,350,000 cfs. If the curve were linear, an increase of 94,000 cfs would equate to a 1-foot increase in the river. Likewise, a 0.50-foot increase would equate to an additional 47,000 cfs, and a 0.25-foot increase would equate to an additional 23,500 cfs in the river. According to the rating curve, an additional 25,000 cfs would equate to approximately a 0.30-foot increase in stage. This rating curve increase is a very similar increase to the 0.40-foot increase shown in the model.

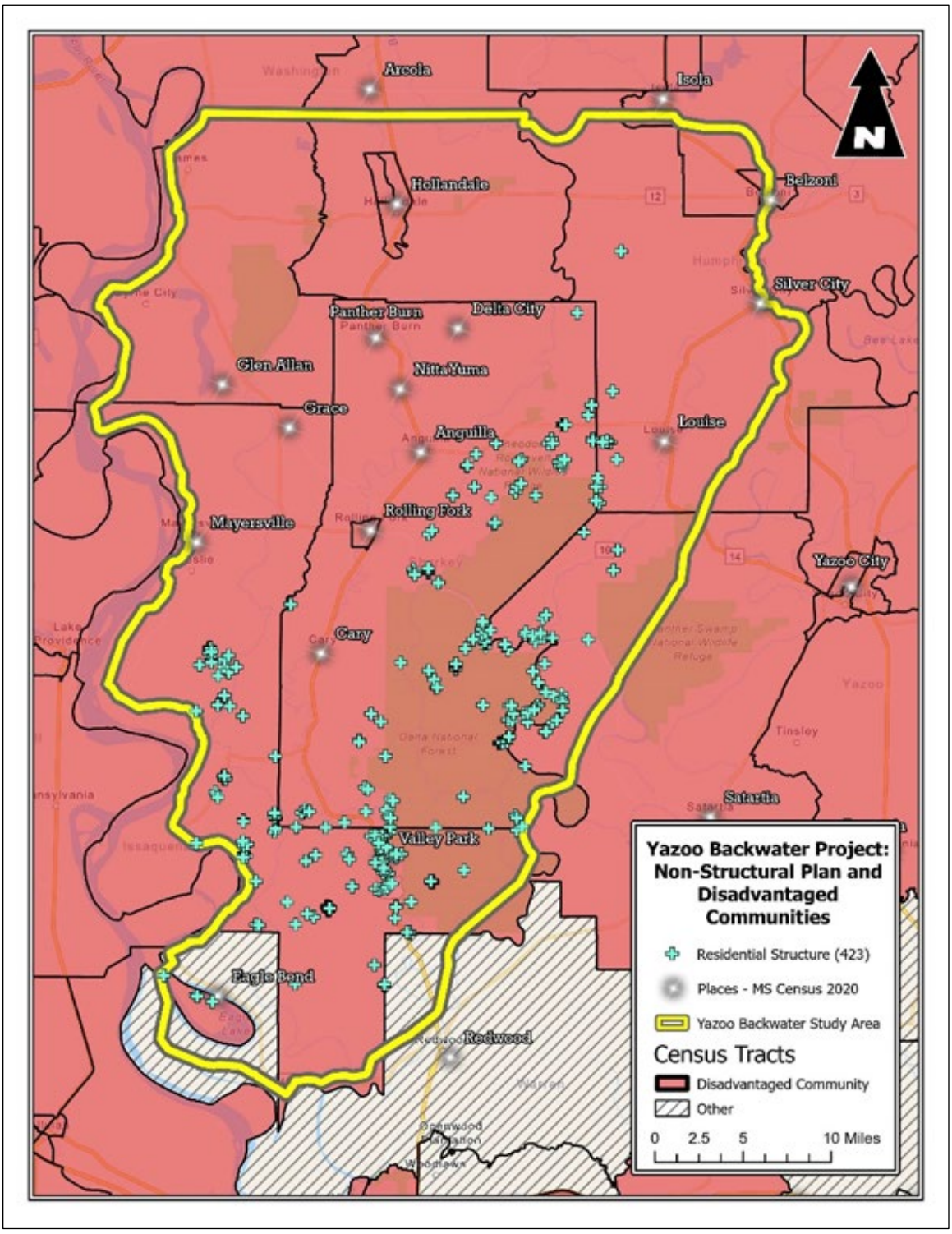

Figure 5-3. NS Plan and Disadvantaged Communities

Mitigation of Residential Structure Acquisition Impact

Uniform Relocation Act (URA) Benefits

Allowable relocation assistance funds for displaced tenants in accordance with the URA and Real Property Acquisition Policies for Federal and Federally Assisted Programs of 1970, Public Law 91-646, 84 Stat. 1984 (42 U.S.C. 4601), as amended by the Surface Transportation and Uniform Relocation Assistance Act of 1987, Title IV of Public Law 100-17, 101 Stat. 246-256. Relocation assistance for tenants may include, among other things, advisory services, eligible reasonable out-of-pocket expenses incurred during temporary displacement (e.g., moving and storage of household goods required to be removed during construction, temporary quarters, meals, etc.). Landowners whose properties are voluntarily elevated will not be eligible for benefits in accordance with URA; however, tenants of these structures may be eligible for these benefits.

Uniform Relocation Act (URA) Benefits for those Impacted by Acquisition

Mandatory Acquisition of Residential and Non-Residential Structures:

Following detailed design, it may become necessary to acquire structures for permanent evacuation of the FEMA regulated floodway. Such determination would be based on risk and performance. Relocation Assistance would apply to owner-occupants as well as tenants because participation would no longer be voluntary. Owner occupants and tenants of the residential/non-residential structure would be eligible to receive relocation benefits including advisory services and moving expenses, in accordance with 49 GFR Part 24.

Voluntary Acquisition of Residential and Non-Residential Structures:

Following detailed design, it may become necessary to offer to acquire structures for permanent evacuation of the FEMA regulated floodway. Such determination would be based on risk and performance. Relocation Assistance would not apply to owners but would be offered to tenants because participation would be voluntary. Tenants of the residential/non-residential structure would be eligible to receive relocation benefits including advisory services and moving expenses, in accordance with 49 GFR Part 24.

More details related to relocation benefits will be described in the Real Estate Plan which will be prepared during the PED phase of the project.

5.1.3 Prime and Unique Farmland

No Action Alternative

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

Alternative 2

Approximately 414 acres of land would be directly converted for construction and operation of Alternative 2 and up to approximately 11,816 acres of frequently flooded agricultural land

could be indirectly converted through forest restoration. Based on correspondence with NRCS staff, it was determined that Alternative 2 would be exempt from FPPA regulations. Therefore, Alternative 2 is not anticipated to have any significant direct or indirect impacts on prime and unique farmland, and thus 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 Alternative 2 are not deemed cumulatively considerable. Therefore, no net impacts to prime and unique farmland are anticipated as a result of the implementation of Alternative 2.

Alternative 3

Implementation of Alternative 3 would result in similar direct, indirect, and net impacts to those noted for Alternative 2.

Alternative 4 (Non-Structural)

The acquisition and reforestation of up to approximately 137,926 acres of agricultural land below 98.2 feet, the elevation at which flooding could potentially impact agricultural activities is not anticipated to result in impacts to prime and unique farmland, as such designated land is typically located at elevations above that which are subjected to flooding. Therefore, net impacts resulting from implementation of the Alternative 4 would be negligible with regards to prime and unique farmland.

5.1.4 Cultural Resources

Data pertaining to cultural resources identified within the YSA 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 spatial coverage layers depicting the various alternatives. Below are brief discussions of the analyses of these frequency events.

For the purposes of this analysis, cultural resources refer to both above (standing structures) and below ground (archaeological) resources as distributed across the entirety of the YSA. For a resource to be counted within the extent or reach of these model flood events, it must either be located fully within the plotted layer (directly impacted) or less than 200-feet from the limits of the plotted layer (indirectly impacted). These resources have been inventoried by geographical location, each enumerated by a unique trinomial designation that corresponds to its county (archaeological) or county and nearest adjacent community (standing structures). As such, it is expected those counties accounting for the larger amounts of acreage within the YSA will possess the higher counts, namely Issaquena and Sharkey counties. Additionally, the southern half of the YSA experiences greater flooding in all the flood frequency events, undoubtedly a result of the proximity of the Mississippi River and its confluence with the Yazoo River. Additionally, this analysis utilizes known data, which has been sporadically and inconsistently collected from across the YSA.

No Action Alternative

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 structural collapse from moving force of floodwaters; sewage backup and overflow leading to saturation, and related flooding contamination and damage; loss of structural integrity from hydrostatic force of standing water; and damage to utilities. These impacts would continue, likely at an ever-increasing rate given the growing intensity and frequency of natural (*i.e*. weather) and human-induced events (i.e. development).

Post-flood conditions also 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, known and unknown/unrecorded, 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. Post-flood potential for displacement and relocation of deposits/elements/materials 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. Flood waters, especially combined with torrential rain, can have catastrophic effects on buildings, infrastructure, businesses, and families. Exposure (animal, insect, vegetation), humidity, and moisture, humidity result in changes to accessibility and visibility. In fact, the entirety of the cultural landscape has the potential to be impacted in the long- and short-term historic agricultural landscape.

Additionally, as precipitation rates increase and extensive flooding becomes more frequent and pervasive, there are long-terms, net 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. Ultimately, without enacting any of the proposed features, the above conditions will persist and continue to pose greater impacts to cultural resources in proportion to the escalating intensity and frequency of flood episodes.

Alternative 2

The pump station is proposed as a means to reduce flooding in the YSA when the Mississippi River is high without draining the entire region. As such, the pump is designed to operate at specific and annual/seasonal ranges in concert with the prescribed 2-year and 5-year flood events. While there were several Register-eligible and significant cultural resources within this 1.6-kilometer (1-mile) search radius, none were located within 300 meters (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.

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 Alternative 2 (see 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 project implementation, 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. 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 are reviewing is related to other actions with … net significant impact. (40 CFR 1508.27(b)(7)). Net impacts can result from individually minor but collectively significant actions taking place over a period of time (40 CFR 1508.7). The net 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.

2-Year Flood Event (90.0 feet)

According to the flood extent GIS data, some 61 standing structures and 256 archaeological resources and have been identified across the study area in association with this flood event. The proposed well sites were excluded from this analysis given their much higher elevations (an average elevation in excess of 100 feet). Analysis focused on the principal study area in greater proximity to the proposed borrow area and pump site locations. These

numbers represent the fewest number of cultural resources impacted by these modeled flood events.

Implementing the structural feature of the project with water levels managed at the 90' elevation (crop season), the distribution of those 256 archaeological resources falling or below this elevation are as follows: Sharkey (n=79 [31 percent] and Washington (n=59 [23 percent]) Counties, respectively, together representing a combined 54 percent [n=138] of the total (Table 5-3). The remainder consist of approximately 21 percent (n=54) from Yazoo County, 15 percent (n=37) from Humphreys County, 8 percent (n=21) from Issaquena County, and 2 percent [n=6] from Warren County (see Table 5-3). These 256 archaeological resources represent nearly a third (32 percent) of the total archaeological inventory for the YSA, so the majority (n=536 [68 percent]) of archaeological resources lie above the impact zone of this flood event, meaning the potential effects and impacts from flooding would be lessened or minimized with project implementation under this operational condition.

Comparisons of these numbers against the archaeological totals in the YSA indicate that slightly over half of the total number of archaeological resources inventoried in the Yazoo County portion of the YSA(n=54 [54 percent]) are impacted by the 2-year flood event. Slightly smaller proportions of archaeological resources were impacted by the 2-year flood event for Warren (n=6 [46 percent]) and Sharkey (n=79 [41 percent]) Counties. The remainder consist of significantly smaller numbers for Humphreys (n=37 [29 percent]), Washington (n=59 [25 percent]) and Issaquena (n=21 [17 percent]) Counties, respectively (see Table 5-3). The spatial distribution of these numbers indicates archaeological resources across the central, east-central, and south/southeastern portions of the YSA are the most impacted, followed by the northeastern and northwestern, and lastly the west-central portions.

Some 536 archaeological resources lie above this elevation reach, meaning that potential flood impacts would be lessened or minimized to these archaeological resources with project implementation under this operational condition. Comparisons by county are as follows: Issaquena County (n=105 [83 percent]), Washington County (n=173 [75 percent]), Humphreys County (n=92 [71 percent]), Sharkey County (n=113 [59 percent]), Warren County (n=7 [54 percent]), and Yazoo County (n=46 [46 percent]), respectively. The spatial distribution of these numbers indicates archaeological resources across the northern and western portions of the YSA are the least impacted, followed by the central, east-central and southern portions with slightly more susceptible to impacts) (see Appendix F-1 – Cultural Resources for more detailed discussion).

Table 5-3. Archaeological Resources within the 2-year Flood Event (90.0 ft), 5-year Flood Event (93.0 ft), and 100-year Flood Event (99.1 ft)

Yazoo Study Area(YSA) - Archaeology				
County	**Within 2-yr Event**	**Within 5-yr Event**	**Within 100-yr Event**	**Average Site Elevation**
Humphreys	37	41	50	104.6
Issaquena	21	25	36	98.8
Sharkey	79	85	107	99.0
Warren	6	8	11	95.5
Washington	59	79	80	107.5
Yazoo	54	72	98	96.4
Totals	**256**	**310**	**382**	**100.3**

Implementing the structural feature of the project with water levels managed at the 90' elevation (crop season), the distribution of standing structures falling at or below this elevation are as follows: Sharkey County (n=56 [92 percent]), which is somewhat misleading given that nearly all of the inventoried standing structures are/were found in the community of Rolling Fork and inventoried in response to a devastating tornado in March of 2023 (see Table 5-4). The remaining 8 percent are spread between three of the other five counties (Yazoo [5 percent; n=3]; Issaquena [1.5 percent; n=1]; and Washington [1.5 percent; n=5]) (see Table 5-4). These 61 standing structures represent only a fifth (20 percent) of the total standing structures inventory for the YSA, so the large majority (n=242 [80 percent]) of standing structures lie above the elevation reach of this flood event, meaning that potential flood impacts would be lessened or minimized to these standing structures with project implementation under this operational condition (Cultural Appendix Figure 9) . These numbers indicate some degree of disproportional impacts to cultural resources, with a greater percentage of standing structures above the potential impact zone (80 percent) compared to archaeological resources (68 percent), though it should be cautioned that this difference may be a product of sample sizes recorded in the YSA (303 total standing structures compared to 792 archaeological resources).

Comparisons of these numbers against the standing structures in the YSA indicate that the Sharkey County portion of YSA (43 percent, n=56) is disproportionally impacted by the 2-year flood event, again an admittedly skewed sample. Such small samples account for the remaining counties, usually consisting of 2 percent or less of the total YSA assemblages by county, rendering spatial distribution analysis unwarranted (see Table 5-4). Considering the size and extent of the study area, these numbers represent small quantities compared against the total number of inventoried standing structures. Within this number, 22 are non-extant, meaning no longer standing, so that the number of historic standing structures that would qualify for mandatory acquisition equal 39 (see Appendix F-1 – Cultural Resources for a more detailed discussion).

Table 5-4. Yazoo Study Area (YSA) - Standing Structures

County	Within 2-yr Event	Within 5-yr Event	Within 100-yr Event
Humphreys	0	2	4
Issaquena	1	2	9
Sharkey	56	81	129
Warren	0	1	5
Washington	1	2	5
Yazoo	3	7	11
Totals	**61**	**95**	**163**

5-Year Flood Event (93.0 feet)

According to the flood extent GIS data, some 95 standing structures and 310 archaeological resources have been identified across the study area in association with this flood event. Analysis focused on the principal study area in greater proximity to the proposed borrow area and pump site locations. Unsurprisingly, as flood extents increase, the number of overall resources impacted across all analytical categories also increases, in roughly the same proportions.

Generally speaking, the distribution of archaeological resources associated with this flood event are nearly identical in quantity and spatial distribution compared to the preceding 2-year event. Single digit increases in overall numbers are observed in four of the six counties (Sharkey County [up 6], Humphreys and Issaquena Counties [up 4 each], and Warren County [up 2]). The only significant increases were observed in Washington County (up 20) and Yazoo County (up 18) (see Table 5-3). The increase from 256 to 310 archaeological resources indicates a slight increase from 32 to 39 percent of the total archaeological inventory for the YSA, so a slightly smaller majority (n=482 [61 percent]) of archaeological resources lie above the impact zone of this flood event and with lessened or minimized potential for effects or impacts with project implementation under this operational condition.

Some 482 archaeological resources lie above this elevation reach, meaning that flood impacts would be lessened or minimized to these archaeological resources with project implementation under this operational condition. Comparisons by county are as follows: Issaquena County (n=101 [80 percent]), Yazoo County (n=72 [72 percent]), Humphreys County (n=88 [68 percent]), Washington County (n=153 [66 percent]), Warren County (n=8 [62 percent]), and Sharkey County (n=107 [56 percent]), and respectively. The spatial distribution of these numbers indicates archaeological resources across the northern and western portions remain the least impacted, with a shift to also include the southeastern, and southwestern portions of the YSA at the same relative level. The central and southcentral portions continue to be slightly more susceptible to impacts (see Appendix F-1 – Cultural Resources for more detailed discussion).

The distribution of standing structures associated with this flood event are similar in quantity and spatial distribution though not to degree as observed with archaeological resources when compared to the preceding 2-year event data. Single digit increases in overall numbers are observed in four of the six counties (Yazoo County [up 4], Humphreys County [up 2], Warren and Washington Counties [up 1 each], and Issaquena County [unchanged]). The only significant increase was observed in Sharkey County (up 25) (see Table 5-4). The increase from 61 to 95 standing structures indicates a moderate increase from 20 to 31 percent of the total standing structure inventory for the YSA. Though still presenting a minority of the total in the YSA, it represents a significant increase from preceding numbers and a larger increase compared that observed with archaeological resources. This leaves an appreciably smaller majority (n=208 [69 percent]) of standing structures lying above the impact zone of this flood event with project implementation under this operational condition.

Implementing the structural feature of the project with water levels managed at the 93' elevation (non-crop season), the distribution of standing structures falling or below this elevation are as follows Sharkey County (n=81 [82 percent]), Yazoo County (n=7 [8 percent]), Humphreys, Issaquena, and Washington Counties (n=2 [2 percent] each), and Warren County (n=1 [1 percent]) (see Table 5-4). Discounting the 26 non-extant structures, the number of historic structures that would qualify for voluntary acquisition equals 69, nearly double the number stated for mandatory acquisition at the 90' elevation (see Appendix F-1 – Cultural Resources, Figures 2 and 4, Tables 7 and 9). These numbers still reflect some degree of disproportional impacts to cultural resources, though the gap between the two has shrunk considerably, standing structures still represent the cultural resources type with the greater of impacts: the percentage of standing structures above the potential impact zone equals 69 percent, while the percentage of archaeological resources equals 61 percent (see Appendix F-1 – Cultural Resources for more detailed discussion).

Alternative 3

Impacts from implementation of Alternative 3 would be as noted for those described for Alternative 2.

Alternative 4 (Non-Structural)

According to the flood extent GIS data, some 382 archaeological resources and 163 standing structures have been identified across the study area in association with this flood event. Unsurprisingly, the patterned increase in the overall number of resources impacted is observed across all analytical categories; as the flood extent increased in extent, so does the number of impacted resources. This pattern reflects observed and measured conditions uninfluenced by any proposed project.

The distribution of archaeological resources associated with this flood event very similar in quantity and spatial distribution compared to the preceding 2-year and 5-year events despite the increase in overall totals. Double digit increases in overall numbers were observed in three of the six counties (Yazoo County [up 26], Sharkey County [up 22], and Issaquena County [up 11]), with single digit increases in the other three counties (Humphreys County

[up 9], Warren County [up 3], and Washington County [up 1]). Significant increases were observed in Sharkey, Yazoo, and Issaquena Counties (see Table 5-3). The increase from 310 to 382 archaeological resources indicates a significant increase from 39 to 48 percent of the total archaeological inventory for the YSA, so only a slight majority (n=410 [52 percent]) of archaeological resources lie above the impact zone of this flood.

Some 410 archaeological resources lie above this elevation reach. Comparisons by county are as follows: Yazoo County (n=98 [98 percent]), Warren County (n=11 [85 percent], Issaquena County (n=90 [71 percent]), Washington County (n=152 [66 percent]), Humphreys County (n=79 [61 percent]), and Sharkey County (n=85 [44 percent]), and respectively. The spatial distribution of these numbers indicates archaeological resources across the eastern and southeastern portions remain the least impacted, followed by a shift to the western and northern portions of the YSA. The central portion continues to be most susceptible to impacts (see Appendix F-1 – Cultural Resources, Figures 1 and 3, Tables 6 and 12 for more detailed discussion). Furthermore, this flood event represents the most extensive and pervasive of the studied flood events, meaning that compared to the 2- and 5-year flood events, the 100-year flood event is the most potentially damaging to all matter of cultural resources (see Table 5-3) (see Appendix F-1 – Cultural Resources for more discussion).

The overwhelming majority of inventoried structures are noted in Sharkey County (n=129 [79 percent]), with Yazoo (n=11 [7 percent]) and Issaquena (n=9 [6 percent]) Counties accounting for the next largest areas of impact. What follows are very small numbers (3 percent or less) for the remainder of the impacted study area: Warren & Washington Counties (3 percent each) and Humphreys County (2 percent) (see Table 5-4). The increase from 95 to 163 standing structures indicates a considerably significant increase from 31 to 54 percent of the total standing structure inventory for the YSA, leaving a minority (n=140 [46 percent]) of standing structures lying above the impact zone of this flood. Discounting the 71 non-extant structures, the number of historic structures that would qualify for voluntary acquisition equals 92, 23 more structures than identified for voluntary acquisition nearly double the number stated for mandatory acquisition at the 93’ elevation. These numbers still reflect some degree of disproportional impacts to cultural resources, though the gap between the two has shifted: the percentage of standing structures above the potential impact zone equals 46 percent, while the percentage of archaeological resources equals 52 percent, representing a transition to archaeological resources as the cultural resources type with the greater number of impacts (see Appendix F-1 – Cultural Resources for more detailed discussion).

5.1.5 Recreation Resources

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

No Action Alternative

Under the No Action Alternative, project related impacts to recreational resources would not be expected.

Alternative 2

The construction and operation of the proposed structural features associated with Alternative 2 would cause some direct impacts to adjacent recreation resources (*i.e.*, fishing, hunting, birdwatching). However, these impacts are anticipated to be short-term in duration as benefits of freshwater flow into adjacent waterways and connected water bodies would accrue.

Indirect impacts associated with changing hydrology due to operations of these structural features would impact some public recreation areas. However, impacts would vary in duration with differential effects between recreation areas. While impacts for identified recreation areas would be moderate in the short-term, indirect impacts to recreation areas would be negligible over the long-term.

Net impacts associated with construction and operation of these structural features 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 of the structural features under this alternative could help alleviate some erratic hydrology. Additionally, the reestablishment of perennial flows and mitigation measures would work together to improve aquatic habitat quality and fishing.

The proposed nonstructural features of this alternative would have no impact to recreation resources, depending on the methods used.

Alternative 3

Impacts from implementation of Alternative 3 would be as noted for those described for Alternative 2.

Alternative 4 (Non-Structural)

The acquisition and reforestation of up to approximately 137,926 acres of agricultural land would be anticipated to generate benefits to recreational resources. Accordingly, net impacts resulting from implementation of the Alternative 4 would be positive with regard to a wide variety of recreational resources.

5.1.6 Aesthetics (Visual Resources)

For the Visual Impact Assessment, consideration was given to potential physical and ecological changes combined with changes to recreation, cultural and land use resources located within this report.

The forecasting of what the YSA's regional 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 what the YSA's regional landscape will look like in the 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 YSA planning documents containing information specific to desired scenic quality; 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).

The National Forests in Mississippi Land and Resource Management Plan puts forth the desired conditions for scenic quality as:

> *Scenery is natural appearing and generally consists of a mix of closed-canopy forest and parklike, semi-open woodlands, except in young regeneration areas, bogs, prairies, and wildlife openings. Signature landscapes that are unique to Mississippi national forests, such as longleaf pines and bottomland hardwoods, are found throughout the National Forests in Mississippi. Rare showcase plant communities like Buttercup Flats and Harrell Prairie provide opportunities for nature study, wildflower viewing, and photography. Primitive and semi-primitive settings provide visitors with a feeling of solitude and challenge. Facilities and constructed improvements are visually appealing and blend into the surrounding environment. (USDA 2014)*

No Action Alternative

With the no action alternative, aesthetics and visual resources would closely correspond with future land use trends regarding development and growth in the region. Ongoing operation and maintenance activities associated with existing flood control projects would impact scenic quality in the YSA. These impacts pertain to user activity and public access via Highway 61, Highway 1, and Highway 16 in the YSA, which would continue to be subject to seasonal flooding.

Alternative 2

Significant roadways within the YSA include Highway 61, Highway 1, and Highway 16. The Mississippi Delta Great River Road and Lower Mississippi Historic Scenic Byways is

composed of Highway 61 and parts of Highway 1. Highway 16 provides vehicular access to aesthetic and visual resource features in the Delta National Forest. Parts of these roads are impassable due to erratic flooding for various durations. While there are no known plans for elevating the area's flood prone roads, direct and indirect impacts to user activity and public access to aesthetic and visual resources would continue to be dependent upon hydrology. However, the proposed structural features and operations under this alternative could help alleviate some erratic hydrology. Any impacts would be negligible in intensity and duration with potential positive effects to scenic quality over time.

This alternative's nonstructural feature and resulting impacts to the YSA's scenic quality would be like those of the Nonstructural Alternative, but to a lesser degree.

Alternative 3

Impacts from implementation of Alternative 3 would be as noted for those described for Alternative 2.

Alternative 4 (Non-Structural)

The nonstructural alternative includes acquisition or floodproofing of existing potentially affected structures within the YSA. Direct and indirect impacts to visual resources would occur when a structure is acquired and removed by eliminating that view from that site. When a structure is removed and open land is created, this may be perceived as naturalistic or a void within an established community depending on aesthetic response. During floodproofing or demolition construction, adverse impacts would be minor in intensity and short in duration. For further information regarding potential impacts to the historical viewshed, refer to Cultural and Historic Resources Section in this document.

Net impacts would be the progressive direct and indirect impacts of implementing and operating the nonstructural alternative, as well as the direct and indirect impacts due to other previous, existing, and authorized projects within the region. Any anticipated net impacts would be minor in intensity and short in duration. For further information regarding potential impacts to the historical viewshed, refer to Cultural Resources Section in this document.

5.1.7 Noise

No Action Alternative

Without implementation of the action alternatives, no direct, indirect, or net impacts to noise would occur.

Alternative 2

Implementation of Alternative 2 would have impacts on noise. Direct impacts on noise would 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 5-5 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 Alternative 2.

Table 5-5. Noise Emission Levels Typical for Construction Equipment

Equipment	Typical Noise Level (dBA) 50 feet from the Sources
Pumps	81
Generator	81
Compressor	81
Pile Drivers	96
Jackhammer	88
Concrete Saw	90
Crane	81
Drill Rig Trucks	79
Drum Mixer	80
Impact Pile Driver	101
Pneumatic Tools	85
Welder/Torches	74
Warning Horn	83
Vibratory Pile Driver	101
Bulldozer	70-95
Scraper	76-98
Grader	72-92
Concrete Mixer Truck	79
Compactor	83
Concrete Pump Truck	81
Backhoe	78
Dump Truck	76
Excavator	81
Flatbed Truck	74
Front End Loader	79
Horizontal Boring Hydraulic Jacks	82
Pavement Scarifier	90
Pickup Truck	75

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 would 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 would occur but are not anticipated to be significantly different from the current noise associated with the common working environment currently existing in the YSA. 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 would 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 YSA. 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 Alternative 2 are not deemed cumulatively considerable. Therefore, no net impacts on noise are anticipated as a result of the implementation of Alternative 2.

Alternative 3

Impacts to noise resulting from the implementation of Alternative 3 would be similar to those noted for Alternative 2.

Alternative 4 (Non-Structural)

The acquisition and reforestation of up to approximately 137,926 acres of agricultural land below 98.2 feet would result in an overall reduction of noise levels within the YSA. Therefore, net impacts resulting from implementation of the Alternative 4 would be beneficial with regards to noise, attributed primarily to a reduction of agricultural activities.

5.1.8 Air Quality

No Action Alternative

With implementation of the no action alternative, no impacts to air quality would occur.

Alternative 2

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. Indirectly, the nonstructural features would improve the air quality in the area due to the removal of up to 11,816 acres of agricultural

land from production. Farming practices within the YSA 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 to decrease the long-term impacts on emissions.

Implementation of Alternative 2 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. Therefore, significant net adverse impacts are not anticipated from activities associated with Alternative 2 when considered with past, present, or reasonably foreseeable future actions.

Alternative 3

Impacts to air quality resulting from implementation of Alternative 3 would be similar to those described for Alternative 2.

Alternative 4 (Non-Structural)

Implementation of the non-structural alternative would result in substantial overall benefits to air quality. The removal of up to 137,926 acres of agricultural land from production and subsequent reforestation would remove dust, heavy exhaust from ICEs, and pollution associated with fertilizer application would no longer be generated.

5.1.8.1 Greenhouse Gas

Within this evaluation, four alternatives for this Water Management Plan and DEIS were considered for GHG emission: Alternative 1 (No Action), Alternative 2, Alternative 3, and Alternative 4. The total GHG emissions for the lifetime of the project were calculated using the type, quantity, horsepower, total hours, and associated emission factors of the equipment (i.e., equipment used during construction). In addition, usage of singular to multiples pumps within the pumpstation were calculated. The total and net social cost of greenhouse gas emissions (SC-GHG) were calculated for each project alternative by summing the individual emissions from the major greenhouse gas pollutants CO2, CH4, and N2O, and then multiplying by the social cost of each pollutant for the year in which they were generated using the tables from the Interagency Working Group on Social Cost of Greenhouse Gases (IWGSC) report as established by Executive Order 13990 to provide interim updated social costs values, with a 3 percent discount rate (IWG 2021).Social cost

(SC) was estimated using the below formula to translate the climate impact to the proposed metric of dollars.

$$SC - GHG = CO_2 * SC - CO_2 + CH_4 * SC - CH_4 + N_2O * SC - N_2O$$

Where:

$$SC - GHG = the\ social\ cost\ of\ greenhouse\ gas\ emissions\ in\ dollars =$$

$$= total\ carbon\ dioxide\ emissions\ in\ metric\ tons\ CO_2$$
$$= total\ methane\ emissions\ in\ metric\ tons\ CH_4$$
$$= total\ nitrous\ oxide\ emissions\ in\ metric\ tons\ N_2O$$
$$= social\ cost\ of\ carbon\ dioxide\ SC - CO_2$$
$$= social\ cost\ methane\ SC - CH_4$$
$$= social\ cost\ of\ nitrous\ oxide\ SC - N_2O$$

The GHG emission and the social costs were computed using NEAT version 1.1.

No Action Alternative

For Alternative 1, assumptions on the total emergency response were used to determine the potential GHG emissions. The no action assessment was based on a onetime disaster event within the projected footprint. There is a possibility that multiple events could occur within the projected footprint within one year, but for this assessment we only used one event to have a comparative analysis towards the proposed work. The total emergency response and the associated GHG emissions were computed using the available municipalities that would respond to disaster events within the proposed counties: Sheriff Department, Fire Department. General data search of state and county websites were used to generate an estimate of potential response by local municipalities. It is projected that approximately 48 vehicles would be used by the Sheriff Department and 166 vehicles would be used by the fire department. In addition to support efforts and the different Emergency response efforts, the evacuation of residential and nonresidential and the rebuilding of damaged properties were factored within the no action assessment. If Alternative 2 or 3 were not constructed, it is estimated that approximately 909 residential structures and 936 non-residential structures would be impacted. For computing GHG emissions for the No Action, evacuation of residents and business owners, emergency response to the flood event, and repair of impacted areas were evaluated. Table 5-6 outlines the proposed GHG emissions if a flood event were to occur.

Table 5-6. Total GHG Emissions (metric tons)

Emissions	CO_2	CH_4	N_2O	CO_{2eq}
Total (metric tons)	8,083	2	48	22,531

In addition to the emergency response emissions, use of farmland within the project area was taken into consideration for GHG emissions. If Alternative 2 or 3 were not constructed, normal operations would occur for the farmland. Equipment used for this particular area was taken into consideration as well as the projected timeframe of usage of the equipment per year: 10 hour days, 5 days a week, 6 months. The Table 5-7 outlines the proposed GHG emissions of annual usage of the farmland within the project area.

Table 5-7. Proposed GHG Emissions of Annual Usage

Emissions	CO_2	CH_4	N_2O	CO_{2eq}
Total (metric tons)	3	0	0	3

Alternative 2

There would be direct emissions from construction activities for The Yazoo Basin, Yazoo Backwater, Mississippi Alternative 2 and the usage of the pump station. The different components for the construction of the Alternative 2 were evaluated: Construction of Alternative 2, Floodproofing Measures, Conversion of land for mitigation (5,722 acres to 7,650 acres). For the usage of the pumpstation, a total of 14 pumps could be used in an event. The 24-hour usage of a singular pump or the 24 hour usage of 14 pumps were computed to show potential GHG emissions for one day usage.

Construction and floodproofing of Alternative 2 with 5,722 acres mitigated

Table 5-8 outlines the proposed GHG emissions for the total construction, floodproofing, and mitigation within Alternative 2.

Table 5-8. Total GHG Emissions from Alternative 2 with 5,722 acres mitigated(metric tons)

Emissions	CO_2	CH_4	N_2O	CO_{2eq}
Total (metric tons)	-230,886	207	82	-201,372

Construction and floodproofing of Alternative 2 with 7,650 acres mitigated

Table 5-9 outlines the proposed GHG emissions for the total construction, floodproofing, and mitigation within Alternative 2.

Table 5-9. Total GHG Emissions from Alternative 2 with 7,650 acres Mitigated (metric tons)

Emissions	CO_2	CH_4	N_2O	CO_{2eq}
Total (metric tons)	-311,562	276	109	-272,112

Pumpstation usage; Singular pump usage for 24 hours:

Table 5-10 outlines the proposed GHG emissions for the usage of a singular pump within the pumpstation for 24 hours. The exact annual usage of the pumpstation could vary.

Table 5-10 Total GHG Emissions from Singular Pump Usage for 24 hours (metric tons)

Emissions	CO_2	CH_4	N_2O	CO_{2eq}
Total (metric tons)	9	0	0	9

Pumpstation usage; 14 pump usage for 24 hours:

Table 5-11 outlines the proposed GHG emissions for the usage of the 14 pumps within the pumpstation for 24 hours. The exact annual usage of the pumpstation could vary.

Table 5-11 Total GHG Emissions from 14 Pump Usage for 24 hours (metric tons)

Emissions	CO_2	CH_4	N_2O	CO_{2eq}
Total (metric tons)	126	0	0	127

Alternative 3

There would be direct emissions from construction activities for The Yazoo Basin, Yazoo Backwater, Mississippi Alternative 3 and the usage of the pump station. The different components for the construction of the Alternative 3 were evaluated: Construction of Alternative 3, Floodproofing Measures, Conversion of land for mitigation (5,722 acres to 7,650 acres). For the usage of the pumpstation, a total of 14 pumps could be used in an event. The 24-hour usage of a singular pump or the 24 hour usage of 14 pumps were computed to show potential GHG emissions for one day usage.

Construction and floodproofing of Alternative 3 with 5,722 acres mitigated

Table 5-12 outlines the proposed GHG emissions for the total construction, floodproofing, and mitigation within Alternative 3.

Table 5-12. Total GHG Emissions from Alternative 3 with 5,722 acres Mitigated (metric tons)

Emissions	CO_2	CH_4	N_2O	CO_{2eq}
Total (metric tons)	-230,886	207	82	-201,372

Construction and floodproofing of Alternative 3 with 7,650 acres mitigated

Table 5-13 outlines the proposed GHG emissions for the total construction, floodproofing, and mitigation within Alternative 3..

Table 5-13. Total GHG Emissions from Alternative 3 with 7,650 acres mitigated (metric tons)

Emissions	CO_2	CH_4	N_2O	CO_{2eq}
Total (metric tons)	-311,562	276	109	-272,112

Pumpstation usage; Singular pump usage for 24 hours:

Table 5-14 outlines the proposed GHG emissions for the usage of a singular pump within the pumpstation for 24 hours. The exact annual usage of the pumpstation could vary.

Table 5-14 Total GHG Emissions from Singular pump usage for 24 hours (metric tons)

Emissions	CO_2	CH_4	N_2O	CO_{2eq}
Total (metric tons)	9	0	0	9

Pumpstation usage; 14 pump usage for 24 hours:

Table 5-15 outlines the proposed GHG emissions for the usage of the 14 pumps within the pumpstation for 24 hours. The exact annual usage of the pumpstation could vary.

Table 5-15 Total GHG Emissions from 14 pump usage for 24 hours (metric tons)

Emissions	CO_2	CH_4	N_2O	CO_{2eq}
Total (metric tons)	126	0	0	127

Alternative 4 (Non-Structural)

There would be direct emissions from non-structural activities for this Water Management Plan Alternative 4. The equipment used for Alternative 4 was provided by public sources. The data is merely an example of what GHG emissions could result from the proposed floodproofing measures. Equipment for floodproofing measures is not exact and could vary.

Flood Proofing of Alternative 4

Table 5-16 outlines the proposed GHG emissions for the Flood Proofing within Alternative 4.

Table 5-16. Total GHG Emissions from Flood Proofing (metric tons)

Emissions	CO_2	CH_4	N_2O	CO_{2eq}
Total (metric tons)	1,318	0	0	1,323

Comparison of Alternative 1, Alternative 2, Alternative 3, Alternative 4 and pump usage

The total of the four alternatives within this analysis were compared in Table 5-17. Social costs were computed for the alternatives (Table 5-18). Net comparison of the social cost was computed for the alternatives (Table 5-19).

Table 5-17. Total GHG Emissions by Project Alternative (Metric Tons)

Emission	$C0_2$	CH_4	N_2O	CO_{2e}
Alternative 1	8,086	2	48	22,534
Alternative 2 with 5,722 Acres Mitigated	-230,886	207	82	-201,372
Alternative 2 with 7,650 Acres Mitigated	-311,562	276	109	-272,112
Alternative 3 with 5722 Acres Mitigated	-230,886	207	82	-201,372
Alternative 3 with 7,650 Acres Mitigated	-311,562	276	109	-272,112
Alternative 4	1,318	0	0	1,323
Pumpstation usage; Singular pump usage for 24 hours	9	0	0	9
Pumpstation usage; 14 pump usage for 24 hours	126	0	0	127

Table 5-18. Gross Total Social Costs of Greenhouse Gases (2029 Dollars)

	$C0_2$	CH_4	N_2O	Total
Alternative 1	$1,035,368	$2,513	$1,886,544	$2,923,720
Alternative 2 with 5,722 Acres Mitigated	$(52,868,393)	$844,094	$5,982,432	$(46,041,867)
Alternative 2 with 7,650 Acres Mitigated	$(71,085,509)	$1,128,293	$7,997,172	$(61,690,044)
Alternative 3 with 5722 Acres Mitigated	$(52,868,393)	$844,094	$5,982,432	$(46,041,867)
Alternative 3 with 7,650 Acres Mitigated	$(71,085,509)	$1,128,293	$7,997,172	$(61,690,044
Alternative 4	$168,276	$81	$417	$169,224
Pumpstation usage; Singular pump usage for 24 hours	$549	-	-	$549
Pumpstation usage; 14 pump usage for 24 hours	$7,686	-	-	$7,686

Table 5-19. Net Comparison of Social Costs for Greenhouse Gases (2029 Dollars)

	Total
Alternative 1 .	$0
Alternative 2 with 5,722 Acres Mitigated	$(48,966,292)
Alternative 2 with 7,650 Acres Mitigated	$(64,884,469)
Alternative 3 with 5722 Acres Mitigated	$(48,966,292)
Alternative 3 with 7,650 Acres	$(64,884,469)

Mitigated	
Alternative 4	$(2,755,200)

5.1.9 Hazardous, Toxic, and Radioactive Waste

No Action Alternative

No direct, indirect, or net impacts to HTRW resources with the no action alternative.

Alternative 2

An HTRW assessment was performed for the structural features identified in Alternative 2. This includes the pump site for the 25,000 cubic-foot-per-second pump and the corresponding borrow area. An online environmental record search was performed using the federal government's online resources on the site areas in question. This record search did not identify any environmental records that would have an impact on this proposed action plan. A site reconnaissance of the borrow area and pump area was conducted on 8 April 2024 and 11 April 2024 respectively by MVK staff. The inspection was conducted on-foot and by vehicle around the two sites mentioned. Limited access was available at the time of the site visit to one area of the Steele Bayou Pump site due to inundation from recent heavy precipitation. A 55-gallon drum partially full of liquid was observed in the Right-of-Way (ROW) near the proposed outlet channel. No indications of distressed soil or offensive odors were detected in the immediate area. Based on the findings from the records search and site reconnaissance there is little reason to believe that HTRW will be encountered. A follow up HTRW Assessment will be conducted of the defined ROW of the pump site and the borrow area during the design phase of this project.

The environmental restoration feature associated with Alternative 2 involves the construction of thirty-four low flow wells along the banks of the headwater of the Yazoo Basin. An HTRW assessment of the proposed low flow wells sites was completed in August 2020 by MVK staff. Based on the results of this assessment there is little reason to believe that a HTRW will be encountered. A follow up HTRW assessment will be conducted at each of the finalized low flow well sites during the design phase.

Alternative 3

Conclusions for potential impacts to HTRW associated with implementation of Alternative 3 would be similar to those described for Alternative 2.

Alternative 4 (Non-Structural)

Alternative 4 addresses the flood proofing effort to protect major structures in the Yazoo Delta below 98.2 NGVD29. Due to the uncertainty associated with this alternative and the lack of ROW access, a complete HTRW assessment was not practicable. HTRW concerns that may arise include but are not limited to leaking power pole transformers, leaking external propane tanks, agricultural refueling stations for tractor or aerial application, septic tanks, automotive drums, dilapidated combustion engines, etc. A complete HTRW

assessment will be conducted for each of the structures which benefit from flood proofing measures during the early stages of design.

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 YSA. Major problems that have resulted from frequent flooding include flood damages to agricultural crops, rural residential property, timber management, and public roads and bridges. Although benefiting environmental resources, these 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 YSA, future hydrologic conditions are not expected to change and periodic flood damages will continue. With the continued 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.

Alternative 2

Alternative 2 features a 25,000 cfs pump station with a season pump on elevation of 90.0 feet during crop season and 93.0 feet during non-crop season. Crop season will extend from 16 March to 15 October. Non-crop season will extend from 16 October to 15 March of the following year. There are six gages in the project area that were used to analyze the impacts of this project plan. Table 5-20 shows the reductions in water surface elevations at those six gages for the 1997, 2009, 2019, and 2020 flood events. The reduction in stage varies at the gages throughout the YSA. The upstream most gages, Little Callao and Anguilla, will show the least impacts or reductions because these gages are more affected by headwater type flood events. While the downstream most gages, Little Sunflower and Steele Bayou, will show the greatest reduction because this area will receive the most benefit from the pump being in pace. Figures 5-4 and 5-5 show the aerial view of the reduction in flooding for the 1997 and 2019 events, respectively, due to the pump being in place. The structural feature provides considerable flood risk management benefits to both the agricultural lands and residential and non-residential structures. However, as the pump-on elevation rises from 90 feet to 93 feet, the flood risk management benefits are reduced, and fewer acres are protected by this structural feature.

Table 5-20. Alternative 2 Reduction in Water Surface Elevations at Key Gage Locations

Alternative 2 – 25,000 cfs Pump with Preferred Crop Season Dates (March 16 - Oct 15)				
Gage	Flood Year			
	1997	2009	2019	2020
	Reduction in Water Levels Compared to Without Pump Alternative (ft.)			
Steele Bayou LS	3.6	3.2	5.7	4.0
Little Sun LS	1.6	1.3	3.4	2.0
Holly Bluff	0.7	0.4	3.0	1.7
Anguilla	0.1	0.1	0.4	0.1
Little Calleo	0	0	0	0
Grace	0.1	0.1	2.0	0.9

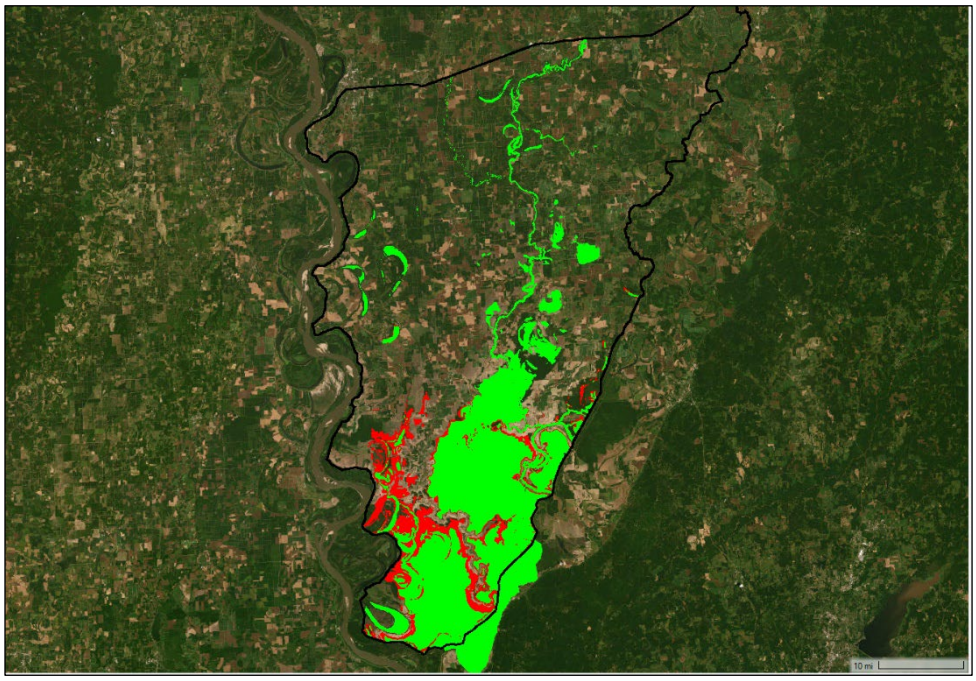

Figure 5-4. 1997 Event HEC-RAS Inundation Coverage with Alternative 1 (No Pump Station) in Red Color and Alternative 2 (25,000 cfs Pumps with Preferred Crop Season Dates) in Green Color

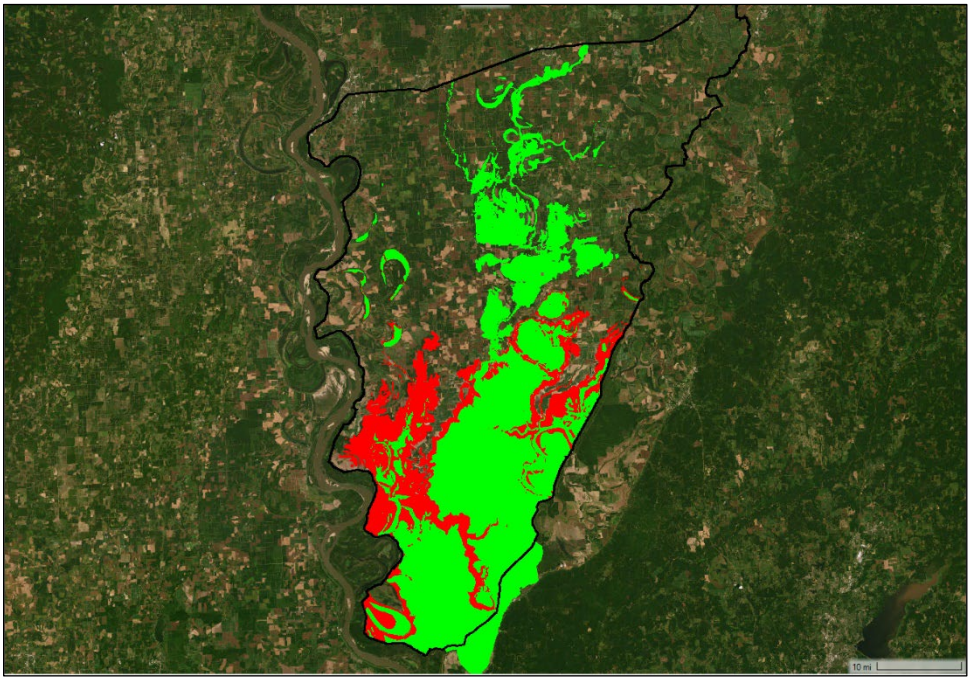

Figure 5-5. 2019 Event HEC-RAS Inundation Coverage with Alternative 1 (No Pump Station) in Red Color and Alternative 2 (25,000 cfs Pumps with Preferred Crop Season Dates) in Green Color

Alternative 3

Alternative 3 includes a 25,000 cfs pump station with a season pump on elevation of 90.0 feet during crop season and 93.0 feet during non-crop season. Crop season will extend from 25 March to 15 October. Non-crop season will extend from 16 October to 24 March of the following year. There are six gages in the project area that were used to analyze the impacts of this project plan. Table 5-21 shows the reductions in water surface elevations at those six gages for the 1997, 2009, 2019, and 2020 flood events. The reduction in stage varies at the gages throughout the YSA. The upstream most gages, Little Callao and Anguilla, will show the least impacts or reductions because these gages are more affected by headwater type flood events. While the downstream most gages, Little Sunflower and Steele Bayou, will show the greatest reduction because this area will receive the most benefit from the pump being in pace. Reduction in flooding for Alternative 3 is very similar to Figures 5-4 and 5-5. The structural feature provides considerable flood risk management benefits to both the agricultural lands and residential and non-residential structures. However, as the pump-on elevation rises from 90 feet to 93 feet, the flood risk management benefits are reduced, and fewer acres are protected by this structural feature.

Table 5-21. Alternative 3 Reduction in Water Surface Elevations at Key Gage Locations

Alternative 3 – 25 kcfs Pump with Alternative 1 Crop Season Dates (March 25 - Oct 15)				
Gage	Flood Year			
	1997	2009	2019	2020
	Reduction in Water Levels Compared to Without Pump Alternative (ft.)			
Steele Bayou LS	1.4	3.2	5.6	4.0
Little Sun LS	0.9	1.3	3.4	2.0
Holly Bluff	0.5	0.4	3.0	1.7
Anguilla	0.1	0.1	0.4	0.1
Little Calleo	0	0	0	0
Grace	0.1	0.1	2.0	0.9

Alternative 4 (Non-Structural)

The threat of flooding, from ponded interior drainage is still the primary problem in the YSA with a non-structural solution. With implementation of Alternative 4, homes will be bought and demolished or raised to an elevation where future floods would not pose a direct impact to the home. However, benefits to environmental resources and damages to agriculture crops, timber management, public roads, and bridges would still exist. Residents that stay and have their homes raised will still have to deal with the hardships of not being able to reach their homes, disruption of sanitation facilities, lines of communications, and transportation delays consisting of taking twice, or more, the amount of time to get to work, school, or critical resources like hospitals.

5.2.2 Wetlands

No Action Alternative

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

Alternative 2

Alternative 2 would cause direct impacts to wetlands. A total of 432 acres of jurisdictional wetlands were identified by the MVK within the direct impact area; 217 acres associated with the pump station and surrounding infrastructure and 215 acres of agricultural wetlands at the proposed borrow area. Implementation of Alternative 2 would result in a direct impact decrease of 1,884 Average Annual Functional Capacity Units (AAFCUs), requiring 394 acres of mitigation.

Indirect impacts to wetlands are associated with changes in flood duration levels, attributed to pump station operation, under Alternative 2; these impacts would result in a loss of 34,687

AAFCUs. The impacts, both direct and indirect cumulatively from pump implementation and operation, require establishment of an estimated 7,650 acres of reforested compensatory mitigation lands. Compensatory mitigation acreage estimates are based on a number of assumptions including that compensation would take place on lands that were historically wetlands but are currently in row-crop agriculture and have a Vtract value of at least 3,000 acres for the purposes of the HGM analysis (see Appendix F-3 - Wetlands for more details on the assumptions).

As a nonstructural component of Alternative 2, up to 11,816 acres (note, this number would be reduced to the extent that any of the 7,650 acres of compensatory mitigation takes place on frequently flooded agricultural lands) would be acquired through voluntary means and allowed to revegetate which would be expected to generate additional environmental benefits over time .

Therefore, if the pump station is completed and its compensatory mitigation is successfully implemented, net impacts resulting from the Alternative 2 would, at a minimum, be neutral with regard to wetland resources. Net impacts resulting from the Alternative 2 could potentially be positive with regards to wetlands as a result of the voluntary acquisition of agricultural lands, but the degree to which this would happen depends on a number of factors including the ultimate amount of agricultural lands acquired, their location, and the extent to which these lands develop and retain wetland characteristics absent any restoration or management.

For more details on wetlands, see Appendix F-3 - Wetlands.

Alternative 3

Direct impacts to wetlands resulting from implementation of Alternative 3 would be identical as those noted for Alternative 2. However, indirect impacts to wetlands attributed to pump station operation under Alternative 3 would result in a loss of 25,470 AAFCUs. The impacts, both direct and indirect cumulatively from pump implementation and operation, require establishment of estimated 5,722 acres of reforested compensatory mitigation lands. Compensatory mitigation acreage estimates are based on a number of assumptions including that compensation would take place on lands that were historically wetlands but are currently in row-crop agriculture and would have a Vtract value of at least 3,000 acres for the purposes of the HGM analysis (see Appendix F-3 - Wetlands for more details on the assumptions).

Similar to the nonstructural component of Alternative 2, acquisition of up to 11,816 acres; note, this number would be reduced to the extent that any of the 5,722 acres of compensatory mitigation takes place on frequently flooded agricultural lands associated with the non-structural feature would be expected to generate additional environmental benefits over time.

Therefore, if the pump station is completed and its compensatory mitigation is successfully implemented, net impacts resulting from Alternative 3 would, at a minimum, be neutral with regard to wetland resources. Net impacts resulting from Alternative 3 could potentially be

positive with regards to wetlands as a result of the voluntary acquisition of agricultural lands, but the degree to which this would happen depends on a number of factors including the ultimate amount of agricultural lands acquired, their location, and the extent to which these lands develop and retain wetland characteristics absent any restoration or management.

Alternative 4 (Non-Structural)

Although not modeled using the hydrogeomorphic approach, the acquisition and successful reforestation (i.e., using appropriate species and restoration techniques) of up to approximately 137,926 acres of agricultural land would be expected to generate large-scale benefits to environmental resources, including wetlands. Accordingly, net impacts resulting from implementation of the Alternative 4 would be positive with regard to wetland resources but the degree to which this would happen depends on a number of factors including the ultimate amount of agricultural lands acquired, their location, and the extent to which these lands develop and retain wetland characteristics.

5.2.3 Terrestrial Resources

No Action Alternative

Migratory Birds, Secretive Marsh Birds, Great Blue Heron, and Shorebirds

The no action alternative results in continued backwater flooding under future flood regimes and therefore no direct, indirect, or net impacts to terrestrial resources would occur as a result.

Alternative 2

Migratory Birds

Direct impacts would be limited to those areas used for construction of the pumping station and, in light of total habitat within the YSA, insignificant. Indirect impacts were determined using the Acadian Flycatcher (ACFL) and (Prothonotary Warbler) PROW models, on average, there was a reduction of 149 and 694 habitat units annually with Alternative 2 across the period of record for the ACFL and PROW, respectively. Habitat modeling was conducted for Kentucky Warbler (KEWA) and Wood Thrush (WOTH) in addition to the other two species that are dependent on presence of water on the landscape. However, results of this analysis do not take into account hydrology or flooding events on the landscape as these species habitat parameters within the model do not incorporate features related to water. Although, both species are ground or near-ground nesters; therefore, significant flooding events, as happened in 2019 and 2020, almost certainly eliminates breeding for that year where flood duration extends into the breeding season.

Therefore, to mitigate habitat losses associated with ACFL and PROW, reforestation of croplands that would be situated at or below the 2-year floodplain to maintain proper hydrology for the species along with other habitat parameters would offset losses in habitat units. Approximately 444 acres of BLH reforestation would be required to offset losses associated with the ACFL and 1,056 acres to offset losses associated with the PROW. (See

Appendix F-4 – Terrestrial Wildlife for more details on assumptions used in making these estimates).

Secretive Marsh Birds

The analysis predicts that there will be only minor losses in marsh bird habitat under Alternative 2. Even with the liberal definitions of useable marsh bird habitat (0-18 inches of inundation intersecting herbaceous/emergent vegetation), it is predicted a net loss of only 10.7 average daily flooded acres (although the net average daily flooded acres lost at the ideal 0-8.4 inch depth was 41.8 acres) would occur. It was determined that losses in marsh bird habitat under the alternative action were almost completely balanced by gains in habitat. Although counterintuitive, infrastructure that reduces flooding could create habitat for taxa that rely on inundation. However, water that is too deep is as unsuitable to marsh birds as dry upland, and the reduction of flooding magnitude can bring the water in some areas that are or would be temporarily flooded at >18-inch depths down to a level suitable for rails and other marsh birds. Furthermore, areas exhibiting net differences in average daily flooded acres (across years) between base and alternative scenarios would not have had differing hydrology in the majority of years over the 1978-2020 Period of Record (POR), as the pumps would have operated in just 35 percent of years over the POR under proposed pumping conditions. (See Appendix F-4 – Terrestrial Wildlife for more details on assumptions used in making these estimates).

Great Blue Heron

The availability of shallow water foraging habitat would have been unchanged under Alternative 2 in 65 percent of years analyzed in the POR. As such, between 15 March and 31 July, modeled median daily flooded acreages ≤ 18-inch depth across the POR across the entire YBA were only 59 acres less compared with no-action conditions. However, mean daily flooded acreages differed by 1,510 acres compared with no-action conditions for ≤ 18-inch-depth flooding, resulting in a loss of 714 AAHU. Mitigation acreage (reforestation of agricultural fields) to compensate for this impact range from 793 acres (if within 1 km of heronry site and 1 km of foraging habitat) to 2,805 acres (if within 10 km of heronry site and 3 km of foraging habitat). See Appendix F-4 – Terrestrial Wildlife for more details on assumptions used in making these estimates.

Shorebirds

The Shorebird Migration Model (Clark and Jordan, 2017) was used to quantify change in shorebird habitat quality between the no-action and Alternative 2 conditions. It was determined that the implementation of Alternative 2 would result in a loss of approximately 37 AAHUs relative to the no-action alternative. To compensate for this impact, approximately 43.5 HUs over the 50-year project life would be required, based on the annual loss of HUs divided by the mitigation HU/acre (0.874). Therefore, acquisition of approximately 43 acres of open land (*e.g.*, agricultural land) with water management capabilities that maintain open wet substrate with sparse vegetation would offset impacts to shorebirds. (See Appendix F-4 Terrestrial Wildlife for more details on assumptions used in making these estimates).

Alternative 3

Migratory Birds, Secretive Marsh Birds, and Shorebirds

Impacts associated with the implementation of Alternative 3 would be similar to those noted for Alternative 2.

Great Blue Heron

As noted for Alternative 2, the availability of shallow water foraging habitat would have been unchanged utilizing the Alternative 3 pump operation in 65 percent of years analyzed in the POR. As such, between 15 March and 31 July, modeled median daily flooded acreages ≤ 18-inch depth across the POR across the entire YBA were only 51 acres less compared with no-action conditions. However, mean daily flooded acreages differed by 1,482 acres compared with no-action conditions for ≤ 18-inch-depth flooding, resulting in a loss of 698 AAHU. Mitigation acreage (reforestation of agricultural fields) to compensate for this impact range from 776 acres (if within 1 km of heronry site and 1 km of foraging habitat) to 2,742 acres (if within 10 km of heronry site and 3 km of foraging habitat). See Appendix F-4 – Terrestrial Wildlife for more details on assumptions used in making these estimates.

Alternative 4 (Non-Structural)

Migratory Birds, Secretive Marsh Birds, and Great Blue Heron

Although HUs were not quantified, the acquisition and reforestation of up to approximately 137,926 acres of agricultural land would undoubtedly generate large-scale benefits to environmental resources, including terrestrial resources. Accordingly, direct, indirect, and net impacts resulting from implementation of the Alternative 4 would be positive with regard to these resources (See Appendix F-4 – Terrestrial Wildlife for more details on assumptions used in making these estimates).

Shorebirds

Although not quantified, removal of up to 137,926 acres of agricultural production would reduce potential shorebird foraging habitat. However, it is anticipated substantial amounts of agricultural land would remain within the project area. Additionally, reforestation of agricultural land would better represent historic conditions within the project area (See Appendix F-4 – Terrestrial Wildlife for more details on assumptions used in making these estimates).

5.2.4 Wildlife

No Action Alternative

No direct, indirect, or net impacts to wildlife would occur with implementation of the no action.

Alternative 2

There would be some direct impacts to wildlife associated with the construction of the pump station with Alternative 2. Removal of habitats for the pump station and borrow area would 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 Alternative 2 are anticipated to be negligible.

Additionally, indirect impacts associated with changing hydrology due to operations under Alternative 2 would impact some wildlife species. However, impacts would vary over the short- and long-term with differential effects between species (see Aquatic Resources, Terrestrial, Migratory Birds, and Waterfowl appendices).

Although, when considering implementation of the non-structural features (acquisition and revegetation of up to approximately 11,816 acres of frequently flooded agricultural land below 90-feet in elevation) in conjunction with pump construction and operation, noteworthy benefits to wildlife would accrue. Therefore, net impacts associated with implementation of Alternative 2 are anticipated to yield positive effects on wildlife over the life of the project as a result of the voluntary acquisition of agricultural lands, but the degree to which this would happen depends on a number of factors including the ultimate amount of agricultural lands acquired, their location, and the extent to which these lands revegetate absent any restoration or management.

Alternative 3

Impacts to wildlife resulting from the implementation of Alternative 3 would be similar to those noted for Alternative 2.

Alternative 4 (Non-Structural)

Although benefits were not quantified, the acquisition and reforestation of up to approximately 137,926 acres of agricultural land would be expected to generate large-scale benefits to environmental resources, including wildlife. Accordingly, net impacts to wildlife resulting from implementation of the Alternative 4 would be positive but the degree to which this would happen depends on a number of factors including the ultimate amount of agricultural lands acquired, their location, and the extent to which these lands are successfully reforested.

5.2.5 Waterfowl

No Action Alternative

The YSA currently provides an average of 202,798 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 net impacts to waterfowl.

Alternative 2

Construction of Alternative 2 would not directly impact waterfowl due to pump station location and indirect impacts would be minimal since very little pumping is performed during the winter waterfowl season (November – February).

Alternative 2 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 188-846 acres depending on the month during the winter season with forested habitats being most affected. DUD calculations estimate Alternative 2 would provide 6,368,380 DUDs during the winter waterfowl period each year. A reduction in flooded area would result from operation of Alternative 2 with a loss of, on average, of 202,798 DUDs each year (see Appendix F-5 - Waterfowl). To address these losses, mitigation calculations were based on restoring existing cropland to bottomland hardwood forest consisting of at least 50 percent 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 would require 347 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 units would require 175 acres of compensatory mitigation to address indirect impacts of Alternative 2 over the 50-year project life (Appendix F-5 - Waterfowl for more details on assumptions used in making these estimates). However, when considering acquisition and revegetation of up to approximately 11,816 acres of frequently flooded agricultural land below 90-feet in elevation through implementation of the non-structural features, significant overall benefits to waterfowl resources would be expected to occur but the degree to which this would happen depends on a number of factors including the ultimate amount of agricultural lands acquired, their location, and the extent to which these lands revegetate absent any restoration or management.

Therefore, no negative net impacts on waterfowl are anticipated as a result of the implementation of Alternative 2. See Appendix F-5 – Waterfowl for more details on these assumptions).

Alternative 3

Direct impacts to waterfowl resources associated with implementation of Alternative 3 would be similar to those noted for Alternative 2. Likewise, Alternative 3 would impact waterfowl indirectly via hydrologic alterations. Although, varying the start pump date would reduce impacts by 196,648 DUDs compared to the no-action condition. To address these losses, conversion of 338 acres agricultural fields to bottomland hardwood forest would offset indirect impacts over a 50-year project life. Conversely, mitigation through conversion of soybean fields to SHM-passively unmanaged moist soil management units would require 168 acres over the 50-year project life (See the applicable Appendix for more details on assumptions used in making these estimates). Implementation of the non-structural feature of Alternative 3, reforestation via natural succession of up to approximately 11,816 acres of frequently flooded agricultural land below 90-feet in elevation would be expected to provide

an overall benefit to waterfowl resources but the degree to which this would happen depends on a number of factors including the ultimate amount of agricultural lands acquired, their location, and the extent to which these lands revegetate absent any restoration or management.

Thus, as noted for Alternative 2, no negative net impacts on waterfowl are anticipated as a result of the implementation of Alternative 3.

Alternative 4 (Non-Structural)

Although not quantified with the waterfowl model, the acquisition and reforestation of up to approximately 137,926 acres of frequently flooded agricultural land would be expected to generate extensive benefits to environmental resources, including waterfowl. Accordingly, net impacts resulting from implementation of the Alternative 4 would be beneficial to waterfowl resources, but the degree to which this would happen depends on a number of factors including the ultimate amount of agricultural lands acquired, their location, and the extent to which these lands are successfully reforested.

5.2.6 Threatened and Endangered Species

The following analysis does not include potential impacts to the pondberry, although consultation for all listed species is ongoing for project alternatives. However no pondberry is known to occur within the direct footprint of the pump station, borrow area, or supplemental low flow groundwater well field rights-of-way. ESA coordination is ongoing and the Record of Decision would not be signed until coordination is complete.

No Action Alternative

With the no action alternative, construction and operation of the pump station and non-structural reforestation would not take place. Therefore, the impacts associated with the pump alternatives would not occur and threatened, endangered, and/or other species of concern that might potentially be present in the YSA would not experience direct, indirect, or net impacts.

Alternative 2

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 listed species 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 could be beneficial impacts associated with the nonstructural 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 net impacts to the threatened or endangered species that could occur in the vicinity of the YSA from construction of Alternative 2 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 YSA and the ability of most

listed species to avoid the area during the construction period, Alternative 2 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 net impacts to listed species or their habitat in the basin.

Based on historic data and recent surveys, there is low probability of the listed species (excluding pondberry) to occur in the YSA. Therefore, USACE has made the determination that any potential impacts that might occur would be insignificant and not likely adversely affect listed species.

Alternative 3

Impacts to, and effect determinations for, threatened and endangered species resulting from the implementation of Alternative 3 would be similar to those noted for Alternative 2.

Alternative 4 (Non-Structural)

Although potential impacts and benefits were not quantified, the acquisition and reforestation of up to approximately 137,926 acres of agricultural land with non-structural flood risk management solutions would be expected to generate large-scale benefits to environmental resources, including listed species. Therefore, it is anticipated that direct, indirect, and net impacts resulting from implementation of the Alternative 4 would be positive but the degree to which this would happen depends on a number of factors including the ultimate amount of agricultural lands acquired, their location, and the extent to which these lands are successfully reforested.

5.2.7 Aquatic Resources/Fisheries

For the aquatic resource assessment, Envirofish was used to calculate changes in the number of flooded acres for Alternatives 2 and 3 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 Alternatives 2 and 3 (see Appendix F-6 - Aquatic Resources).

No Action Alternative

With implementation of the no action alternative, aquatic resources and fish communities would continue to exist as described in Section 4 and no direct, indirect, or net impacts would be anticipated to occur.

Alternative 2

Implementation of the pumping station with associated pumping operation would result in direct, indirect, and net impacts to aquatic resources and fisheries. Direct impacts such as loss of habitat due to pump station construction would occur but would be significantly less than indirect impacts, which include alteration of the flood frequencies associated with operations under Alternative 2. Reductions in the area flooded for spawning include those

areas falling below the required 1.0 foot minimum for 8 consecutive days duration and maximum depth requirement for rearing acres is 10 feet.

When considering both direct and indirect impacts, Envirofish results suggest a reduction of an estimated 2,264 and 1,862 HUs for spawning and rearing, equivalent to a reduction of 3,969 and 3,721 Average Daily Flooded Acres, respectively. To compensate for direct and indirect impacts associate with pump implementation and operation only, 3,201 and 2,632 acres of agricultural lands would need to be reforested in the 2-year floodplain for spawning and rearing, respectively (see Appendix F-6 - Aquatic Resources for more details on assumptions used in making these estimates). However, implementation of the land acquisition non-structural feature of Alternative 2 would result in the conversion of approximately up to 11,816 acres below 90-feet in elevation within the project area from agricultural land to bottomland hardwood forest through natural succession. Additionally, a further 27,675 acres of agricultural land between the 90- and 93-foot elevations could be acquired through voluntary means and subject to reforestation. Therefore, and although not modeled with Envirofish, it is anticipated that implementation of all project features associated with Alternative 2 would result in overall benefits to aquatic resources and fisheries. Accordingly, net impacts resulting from implementation of Alternative 2 would be positive with regard to aquatic resources and fisheries but the degree to which this would happen depends on a number of factors including the ultimate amount of agricultural lands acquired, their location, and the extent to which these lands are successfully reforested.

Alternative 3

As noted with Alternative 2, implementation of Alternative 3 would result in direct, indirect, and net impacts to aquatic resources and fisheries. When considering both direct and indirect impacts of the pumping station alone, Envirofish results suggest a reduction of 2,184 and 1,748 HUs for spawning and rearing, equivalent to a reduction of 3,851 and 3,531 Average Daily Flooded Acres, respectively. To compensate for direct and indirect impacts associate with pump implementation and operation only, 3,088 and 2,470 acres of agricultural lands would need to be reforested in the 2-year floodplain for spawning and rearing, respectively (see Appendix F-6 - Aquatic Resources for more details on assumptions used in making these estimates). However, as the case with Alternative 2, implementation of the land acquisition non-structural feature for Alternative 3, the conversion of up to approximately 11,816 acres below 90-feet elevation and 27,675 acres of agricultural land between the 90- and 93-foot elevations, within the project area from agricultural land to bottomland hardwood forest would result in overall benefits to aquatic resources and fisheries. Accordingly, net impacts resulting from implementation of the Alternative 3 would be positive with regard to aquatic resources and fisheries but the degree to which this would happen depends on a number of factors including the ultimate amount of agricultural lands acquired, their location, and the extent to which these lands are successfully reforested.

Alternative 4 (Non-Structural)

Although not modeled with the Envirofish program, the acquisition and reforestation of up to approximately 137,926 acres of agricultural land would be expected to generate large-scale

benefits to environmental resources, including aquatic resources and fisheries. Accordingly, net impacts resulting from implementation of the Alternative 4 would be positive with regard to aquatic resources and fisheries, but the degree to which this would happen depends on a number of factors including the ultimate amount of agricultural lands acquired, their location, and the extent to which these lands are successfully reforested.

5.2.8 Water Quality

The implementation of Alternative 2, 3, 4 will likely require additional permitting from the Mississippi Department of Environmental Quality (MDEQ) for stormwater discharges from construction activities associated with the structural features, which include the 25,000 cfs pump, the environmental restoration low flow wells, or the flood proofing of structures. Groundwater Well permits from MDEQ will also be required for the construction of the low flow wells. The MDEQ will also require the water quality certification for any of the three action alternatives. These permitting and certification efforts shall be pursued at the initial stages of project design.

No Action Alternative

Under the no- action condition, water quality would continue to exist as described in Section 4 and no direct, indirect, or net impacts would be anticipated to occur.

Alternative 2 (March 16 Crop Season Start Date)

Dissolved Oxygen

The 25,000 cfs pump feature included in Alternative 2 would reduce the flood impacts on the area by moving water over the Yazoo Backwater levee into the Yazoo River. The construction of these pumps will help increase dissolved oxygen (DO) in the water column by minimizing the overall depth of a flood event and improving diffusion from the surface water of the interior. The combination of these effects should have an overall benefit to DO in the YSA during extended flood events. Sediment disturbance during construction of the Yazoo Backwater Pump may cause temporary increases in turbidity and nutrient levels. Temporary decreases in light penetration from localized increases in turbidity could cause reductions in photosynthesis. This could result in temporary, localized decreases in DO concentrations. Such increases would be of short duration. The DO and nutrient levels should return to preconstruction concentrations once the turbidity clears and photosynthesis rates return to normal. The full utilization of the gate operation up to 75.0 (NGVD29) at Steele Bayou – Landside of the water control structure will also have a positive benefit on water exchange between the Yazoo River surface water and the Yazoo Backwater interior pool. This effect will allow the exchange of riverine water which is subject to greater reaeration potential and high DO concentrations, with interior backwater which has historically suffered from low DO. This will also translate to greater fisheries exchange between the two basins.

Suspended Solids

During the Flood of 2011, turbidity measurements were observed to decrease at an average rate of 50 NTU's per week for the first three weeks of monitoring. This appears to slow down at around a minimal concentration of 50 Nephelometric Turbidity Units (NTU). This corresponds to the initial period of a typical flood event before the pumps would initiate pumping. For the larger flood events which correspond to a longer detention time, the operation of the Yazoo Backwater Pumps would slightly reduce the overall settling time for suspended solids in the basin. However, this would not happen before the majority of the settling had taken place. This is due to the multiple weeks that pass after the Steele Bayou water control structure and Little Sunflower water control structure close and the interior elevation reaches 90.0 or 93.0 (NGVD29) feet as prescribed by the seasonal operational pump plans associated with Alternative 2.

Nutrients

Implementation of Alternative 2 (March 16 crop season start date)would utilize a 25,000 cfs pump in the YSA and is not anticipated to increase the total loading of TP and TN to the Mississippi River. Currently, when flood conditions recede allowing the Steele Bayou and Little Sunflower structures to be opened, backwater and corresponding nutrient concentrations are routed to the Yazoo River and Mississippi River. The same movement of water is experienced during the activation of the pump. Although, the timing of the nutrient loading to the Mississippi River will be altered by a few weeks; the overall mass should remain the same.

Low Flow

The environmental restoration feature associated with Alternative 2 includes the construction of supplemental low flow groundwater well sites built in the headwaters of the two basins (Figure 5-6). These wells will help to supplement needed base flow in the major arteries of the systems allowing for year-round in-channel habitat during critical low flow periods. These well sites will likely provide a positive benefit to the overall low DO conditions observed during the warmer months. These warmer months typically coincide with the low flow periods in the primary tributaries of the two basins. The supplemental water provided should stimulate re-aeration through agitation minimizing the presence of stagnant intermittent pools in the channels. Water from the well sites will likely decrease the ambient temperature of the streams and have a positive effect on DO saturation which would be beneficial to aquatic life.

Alternative 3

Implementation of Alternative 3 would result in similar direct, indirect and net impacts resulting from implementation of Alternative 2 with regards to water quality.

Alternative 4 (Non-Structural)

The acquisition or floodproofing of residential and commercial properties up to 98.2 feet could subject the Yazoo Basin to sediment disturbance during construction activities which may cause temporary increases in turbidity and nutrient levels. However, overall nutrient mass loading to the Mississippi River from implementation should remain approximately the same as noted for existing conditions.

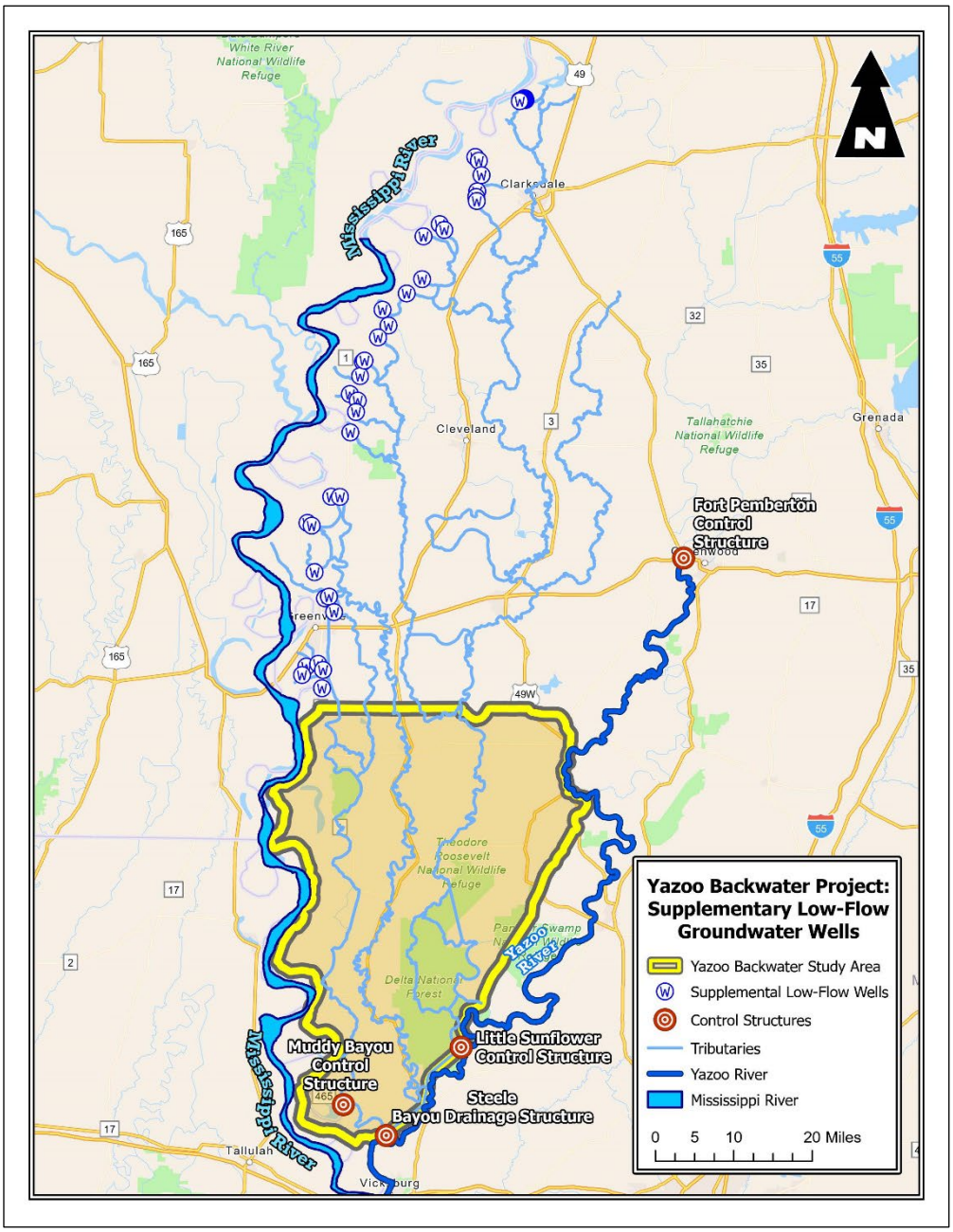

Figure 5-6. Location of Proposed Groundwater Wells

SECTION 6
Mitigation, Monitoring and Adaptive Management

6.1 COMPENSATORY MITIGATION

The authority and requirements for compensatory habitat mitigation are found in Federal laws and regulations. The legal foundation for habitat mitigation to offset unavoidable habitat losses cause by USACE water resources projects includes the Clean Water Act, the Water Resources Development Act (WRDA) of 1986, Section 906, as amended by subsequent WRDAs, the Fish and Wildlife Coordination Act and other environmental laws.

Efforts taken to avoid, minimize, rectify and or reduce habitat impacts still resulted in unavoidable impacts to fish and wildlife resources that required development of a compensatory habitat mitigation plan. The full mitigation plan (Appendix J - Compensatory Mitigation Plan) document details the work performed, including coordination and the mitigation plan formulation to develop a compensatory habitat mitigation plan to account for the highest potential impact to the environment.

The presented compensatory mitigation plan in Appendix J is only for habitats impacts from the Yazoo Backwater Area Water Management Project. Any outstanding and ongoing mitigation requirements for already constructed portions from the overarching Yazoo Basin, Yazoo Backwater, Mississippi, project are not integrated into the impacts or mitigation strategies described in this mitigation plan. The mitigation requirements for the Yazoo Backwater Management project include compensation for the unavoidable loss of habitats as follows:

- Wetlands 36,570 AAFCU*
- Aquatic Resources and Fisheries 3,969 ADFA**
- Waterfowl 2,265,567 DUD
- Terrestrial Wildlife 714 AAHU AAHU
- Shorebirds 352 AAHU

The recommended mitigation plan for the Yazoo Backwater Management Project is to pursue a combination of mitigation strategies to meet the full mitigation need and includes:

- Purchase of in-kind credits from the Ducks Unlimited (DU), Inc. Mississippi Delta In Lieu Fee Program (MSD-ILFP) (approved: 24 September 2010) located in the YSA (if they are available).*
- Purchase of In-Kind Mitigation Bank Credits located in the YSA (will only meet partial mitigation needs due to the availability of credits)*
- Construction of a YSA specific Mitigation Project *

- Management of Agricultural Area Inundation for Shorebirds

**Wetland mitigation will provide the necessary mitigation for the loss of waterfowl, aquatic resources and fisheries and terrestrial wildlife. Aquatic resource and fisheries mitigation will need to be in 2-year floodplain or below and the difference can be included up to the 5-year floodplain.*

The Final Mitigation Plan in the Final EIS will be adjusted to meet the mitigation needs required by the selected plan for the Yazoo Backwater Management Project and will be based on these same mitigation strategies (ILF credit purchases, Project Specific Mitigation Construction and/or Mitigation bank credit purchases).

For the ILF program, DU will be required to submit site-specific mitigation plans to compensate for up to 36,570 AAFCU, or approximately 7,650 acres, for review and approval. A portion of the site will need to adequately compensate for the aquatic resources and fisheries. The ILF program operator (DU) is responsible for demonstrating and reporting that the ILF program's success criteria are being met. Therefore, no specific ecological success criteria are required to be developed for this plan. A specific monitoring and adaptive management plan is also not needed as these activities are the ILF program operator's responsibility (see Implementation Guidance for Section 1163 of WRDA 2016, Wetlands Mitigation). The ILF program is also responsible for meeting financial assurance requirements and long-term management.

If further investigation determines that MSD-ILFP and or Mitigation Banks purchases are not implementable then a YSA specific mitigation project will be constructed. Up to approximately 7,650 acres is needed to offset the impacts. Twenty-one potential sites for construction were identified and investigated, 8 potential sites remain. Constructed mitigation sites would be located in the 5-year post project floodplain with portions in the 2-year post project floodplain to adequately compensate for aquatic resources and fisheries. Additional evaluation of these potential sites will continue concurrent with the investigations into Alternative 2a/b to determine the most optimal site for placement of the constructed project should a project end up needing to be constructed if Alternative 2a/b is not implementable.

Habitat assessment(s) will be completed on the specific sites utilizing the same USACE certified habitat assessment model(s) used to determine the functional impacts of the proposed action (Smith, et al. 2002, and USACE. 1991). This information will be used to determine the final site location and size. The five HGM assessment variables, that are expected to differ at the potential mitigations sites include: 1) the size of the wetland tract associated with the mitigation parcel and the surrounding area, 2) the core area of the parcel, 3) the habitat connectivity of the parcel, 4) the flood frequency of the parcel, and 5) the flood duration of the parcel. The remaining 14 variables are expected to display the same HGM variable subindex scores at all agricultural lands in the project area that would be considered for mitigation establishment. As a result, the selection of the final mitigation site and site-specific designs will be guided by the values outlined in Tables 5 through 9 of Appendix F-3 - Wetlands which establish the minimum criteria used to design the sites for

mitigation. Monitoring and Adaptive Management of any constructed mitigation sites would be in accordance with Appendix J and K.

In addition to purchase of credits from a ILF program, Mitigation Banks and or construction of wetland mitigation additional mitigation will be required to offset shorebird impacts. Numerous farmlands in the project area are managed for waterfowl during the waterfowl season, which require perimeter levees, water control devices, and water sources. A portion of these areas can be managed for shorebirds through inundation at depths that are suitable for shorebirds during the spring and fall migration periods. Likewise, additional agricultural areas could be purchased and water control devices, perimeter levees installed to allow for water management. Agricultural areas would be inundated during portions of the shorebird migratory period. Following the migratory period, the area would be planted for an agricultural commodity. Some agricultural techniques that require inundation, such as techniques for rice production may also be utilized to compensate for impacts if those techniques are complimentary to shorebird management. Approximately 403 areas of moist soil units would be required to compensate for impacts to shorebirds.

Additionally, the non-structural flood risk management feature (up to 11,816 acres of voluntary acquisition of agricultural land which would be allowed to naturally reforest) would provide environmental benefits to all resource categories. Therefore, the anticipatory ecological benefits from the nonstructural feature would be in addition to those benefits resulting from the compensatory mitigation efforts. Therefore, net impacts resulting from the Proposed Plan could potentially be positive with regards to wetlands and related environmental resources as a result of the voluntary acquisition of agricultural lands, but the degree to which this would happen depends on a number of factors including the ultimate amount of agricultural lands acquired, their location, and the extent to which these lands develop and retain wetland characteristics absent any restoration or management.

The USACE, the EPA, and USFWS are committed to a collaborative and expeditious path forward to establish a flood risk reduction solution in the YSA; in light of the regionally and nationally important significant natural resources and species involved and the complexity of required compensatory mitigation a Memorandum of Agreement is being developed to establish procedures regarding efficient and effective coordination in the development, review, approval, and oversight of the compensatory mitigation component for this Water Management Project (Project). A Compensatory Mitigation Management Team (CMMT) is being proposed which will be jointly led by the USACE, EPA and USFWS to help ensure that the Project's unavoidable impacts are effectively offset. Work for the Project will not be commenced in waters of the United States (WOTUS) until the compensatory mitigation plan has been approved through the process outlined in the Memorandum of Agreement by USACE, EPA, and USFWS and the compensatory mitigation sites and or credits have been secured. See Appendix J - Compensatory Mitigation Plan for further details.

6.2 MONITORING AND ADAPTIVE MANAGEMENT

In addition to the of Memorandum of Agreement being developed regarding Compensatory Mitigation additional Memorandums are being developed related to Pump Operations and

Monitoring and Adaptive Management of the Water management Project to establish procedures regarding efficient and effective coordination in the development, review, approval, and oversight of these plans. The YSA program to monitor and adaptively manage the impacts of pump operations is being developed and will be incorporated into the final EIS. In addition to monitoring of the pump operations, monitoring and adaptive management is being proposed related to aquatic resources and wetlands as discussed in Appendix K.

Adaptive management is a decision process that promotes flexible decision making that can adjust to uncertainties as outcomes from management actions and other events become better understood (NRC 2004). Careful monitoring of 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 its value to the USACE, is in how well it helps meet environmental, social, and economic goals; increases scientific knowledge; and reduces concerns among various stakeholders. The approach to monitor and adaptively manage resources within the YSA a is detailed in the Monitoring and Adaptive Management and Mitigation Appendix K. The plans discuss monitoring approaches and adaptive management strategies related to wetlands, bottomland hardwood habitat, aquatic biology, terrestrial resources, water quality, 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 this Water Management Plan and DEIS. These approaches would need to be conducted both within the YSA and at compensatory mitigation sites. There is substantial published data available to support establishment 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. Existing data could include both field monitoring of wells within the YSA and mitigation sites paired with remote sensing across the YSA. 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 this Water Management Plan and DEIS as detailed in Appendix K - Monitoring and Adaptive Management. Available existing data could include both field monitoring of wells within the YSA and mitigation sites and paired remote sensing across the YSA. Such pairing leverages the strengths of both approaches to better monitor existing and restored wetlands.

SECTION 7
Environmental Laws and Compliance

The relationship of this Water Management Plan to environmental protection statutes or other environmental requirements are summarized in Table 7-1. Information concerning the resources addressed under each of the laws in Table 7-1 is presented fully in previous sections of this DEIS and applicable appendices.

Table 7-1. Relationship of Proposed Plan to Environmental Protection Statuses 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, 54 U.S.C. 300101	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	**Compliance**
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
Government to Government Consultation with Indian Tribal Governments (E.O. 13175)	PC
Protecting Public Health and the Environment and Restoring Science to Tackle the Climate Crisis (E.O. 13990)	Full
State and Local Policies	**Compliance**
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

NEPA provides for an early and open process to determine the scope of issues to be addressed and identify the significant issues related to a proposed action. A total of four public engagement sessions were held on 15 February 2023, and a total of four public engagement sessions were held on 4 and 5 May 2023 at the USACE Vicksburg District office. The February 2023 sessions were held to receive input from the communities on their needs and on development of a draft preferred approach, and the May 2023 sessions were held to receive input from the communities on the draft preferred approach. In addition, roundtable sessions were held on 16 February 2023, with various individuals, groups, and organizations, including a session for community leaders, local elected officials, agricultural interests, and environmental organizations. The input gathered throughout these early engagement sessions and on the draft preferred approach was used to inform the development of information presented in the Notice of Intent (NOI). The NOI to prepare a draft EIS was published in the Federal Register (Volume 88, No. 218) on 6 July 2023. The scoping period ended on 7 August 2023 with a total of 21,011 emails and three mailed letters. Scoping identified concerns for the natural environment of the project area and hydrologic changes to communities. Multiple non-governmental organization provided comments on the project, including; 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). The public's input provided significant contribution to the formulation of alternatives for consideration.

MVK held a cooperating agency meeting on 14 September 2023 in which representatives from each of the eight cooperating agencies (USFWS, EPA, USFS, NRCS, FEMA, DOT, MDEQ, and MDWFP) attended. MVK presented a project history and background, Steele Bayou operation guidelines, previous flooding occurrences, concerns and current project status. Additionally, revised alternatives and proposed environmental analysis methodologies were discussed.

SECTION 9
Conclusion

This Water Management Plan would reduce average annual flood risk to urban and agricultural areas through a combination of structural and nonstructural flood risk management features and would minimize adverse impacts through project design. This Water Management Plan represents a balanced and implementable approach to achieving flood risk management, and minimizing aquatic and wetland impacts in the YSA.

This proposed plan contains a combination of structural, operational, nonstructural, federal memorandums of agreement, environmental enhancement, and mitigation components. This Proposed Plan includes a pump station with a maximum combined pumping capacity of 25,000 cfs, located near Steele Bayou, backwater managed at 90.0 feet during crop season and up to 93.0 feet during non-crop season. The alternatives listed throughout the DEIS, referenced as Alternative 2 and Alternative 3, contain identical components, and differ only on the crop season range shown below.

Alternative 2: Crop Season (16Mar-15Oct) and non-crop season (16Oct-15Mar)

Alternative 3: Crop season (25Mar-15Oct) and non-crop season (16Oct-24Mar)

This Water Management Plan incorporates non-structural features. To further manage flood risk below the pump operation elevation (i.e. 90 feet), mandatory acquisition of all structures (101 Structures) is being proposed; while voluntary acquisition of residential and commercial properties (231) up to 93.0 feet is being proposed. Voluntary acquisition of approximately 11,816 acres of frequently flooded agricultural land is also being proposed. Following acquisition, the agricultural land would revegetate naturally, below 90-feet in elevation. Additionally, approximately 27,675 acres of agricultural land between the 90- and 93-foot elevations could be acquired through voluntary means. Pumping station operation would provide structural flood damage reduction above elevation 93 feet and the non-structural acquisition provides flood damage reduction primarily at or below elevation 93 feet.

During potential flood-prone periods with rising Mississippi and Yazoo rivers, the operations plan for the Steele Bayou Water Control Structure (WCS) would allow free movement of water in and out of the lower Yazoo Basin up to an elevation of 75.0 feet, NGVD29 before closing the gate. This full utilization of the current Water Control Manual (1985) for the operation of Steele Bayou WCS will promote fishery species diversification. During low-water periods, the operation plan of the Steele Bayou WCS is currently operated to maintain water elevations between 68.5 and 70.0 feet, NGVD29, and this will be continued.

Adverse effects to environmental resources would result from the construction and operation of the pump station (structural feature) which would 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 pumping station construction and operation for the

Water Management Plan include impacts to wetlands, (see Appendix F-3 - Wetlands), waterfowl (see Appendix F-5 - Waterfowl), fisheries resources (reduction of spawning and rearing habitat, see Appendix F-6 - Aquatic Resources/Fisheries), and terrestrial wildlife (see Appendix F-4 - Terrestrial Wildlife). 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 pumping station associated with the Water Management Plan, compensatory mitigation requirements were calculated and estimated to be as much as the acquisition of 7,650 acres of frequently flooded agricultural lands in fee title and subsequent reforestation of these lands would offset unavoidable losses to wetland, terrestrial, waterfowl, and aquatic resources. Additionally, approximately 403 acres of moist soil units would be required to compensate for impacts to shorebirds. Also, to the extent that compensatory mitigation takes place on agricultural lands below the 90 foot elevation, this would reduce the amount of these lands subject to voluntary acquisition (currently estimated at 11,816 acres).

Furthermore, as an additional component of this Water Management Plan, 34 supplemental low flow groundwater wells would be installed along streams in the northern portion of the Yazoo area. It is estimated the supplemental low flow groundwater wells would improve flows, benefiting fish, mussels, and other ecological attributes of the YSA as well as address a range of other habitat impairments in the Big Sunflower-Steele Bayou drainage systems during the low water season (see Appendix F-6 - Aquatic Resources/Fisheries).

As stated in the Executive Summary, this Water Management Plan evaluates potential features to resolve the long standing flood risk management impacts to the community and the environment, and the DEIS serves the specific purpose of communicating the potential solutions and associated environmental impacts for public review and comment. As such, it is anticipated that additional NEPA document(s) may be developed based on refinements to design. If it is determined that additional NEPA documentation is required, USACE will work in coordination with the resource agencies to maintain NEPA compliance. Any future NEPA document(s) may include modification or improvement to mitigation, monitoring and adaptive management plans, as appropriate.

Additional Alternative 4, the Nonstructural Plan Only, is being considered and public comment is welcomed on this alternative.

To ensure the Corps has sufficient time to consider public input in the preparation of the Final EIS, comments should be submitted by email at YazooBackwater@usace.army.mil or by surface mail to Mike Renacker at U.S. Army Corps of Engineer, Vicksburg District, ATTN: CEMVK–PPMD, 4155 East Clay Street, Room 248, Vicksburg, MS 39183

SECTION 10
List of Preparers

10.1 LIST OF PREPARERS

Table 10-1 provides a list of individuals involved in preparation of the document and significant supporting information.

Table 10-1. List of Preparers

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SECTION 11
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SECTION 12
List of Acronyms and Abbreviations

AAFCUs	Average Annual Functional Capacity Units
ASTM	American Society for Testing and Materials
BMPs	Best Management Practices
CEMRC	Corps of Engineers Mississippi River Commission
CEQ	Council on Environmental Quality
CFR	Council on Environmental Quality
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
HD	House Document
HEC-RAS	Hydraulic Engineering Center – River Analysis System
HEP	Habitat Evaluation Procedure
HTRW	Hazardous, Toxic, and Radioactive Wates
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
NASS	National Agricultural Statistics Service
NEPA	National Environmental Policy Act
NGVD29	National Geodetic Vertical Datum 29
NHPA	National Historic Preservation Act
NOA	Notice of Availability
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	Right of Influence
ROW	Right-of-Way
SEIS	Supplemental Environmental Impact Statement
SHPO	State Historic Preservation Officer
TN	Total Nitrogen
TP	Total Phosphorus
TSS	Total Suspended Solids
USACE	U.S. Army Corps of Engineers
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