MEMORANDUM OF AGREEMENT
BETWEEN THE U.S. ARMY CORPS OF ENGINEERS,
THE U.S. ENVIRONMENTAL PROTECTION AGENCY AND
THE U.S. FISH AND WILDLIFE SERVICE CONCERNING
THE YAZOO BACKWATER WATER MANAGEMENT PLAN
MONITORING AND ADAPTIVE MANAGEMENT PLAN

November 25, 2024

I. Introduction

a. Authority and Purpose

The Yazoo Basin, Yazoo Backwater, Mississippi Project was authorized by Section 3 of the *Flood Control Act* of 1941 and subsequently amended by the *Flood Control Acts* of 1944 and 1965 to provide flood protection to five subareas of the Yazoo Backwater Area. The authorized work includes levees, water control structures, a connecting channel and pump stations. Much of this work was completed in the 1970s. The Yazoo Backwater Area Water Management Project includes the remaining pump station and additional features.

The U.S. Army Corps of Engineers, the U.S. Environmental Protection Agency and the U.S. Fish and Wildlife Service enter into this Memorandum of Agreement to establish procedures regarding efficient and effective coordination in the development, review, approval and oversight of monitoring and adaptive management plans for the Project.[1]

The Project's Final Environmental Impact Statement describes three important compliance components, or Analyses,[2] to assess potential changes to hydrology and the ecosystem that could result from Project implementation: (1) mapping and remotely monitoring inundation extent; (2) groundwater well installation and monitoring;[3] and (3) supplemental low-flow groundwater well installation and monitoring. The results of these long-term monitoring efforts will be used to inform adaptive management decisions regarding ongoing implementation of water management and compensatory mitigation efforts in the Yazoo Backwater Study Area, or YSA.

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[1] This MOA assumes that the USACE will issue a Record of Decision compliant with the *Endangered Species Act*, the *Clean Water Act* and the *National Environmental Policy Act*.

[2] The USACE monitoring commitments associated with pondberry are thoroughly outlined in the USFWS' Biological Opinion [dated Nov 8, 2024]. As such, pondberry-specific monitoring, as well as adaptive management to reduce incidental take, are not discussed herein.

[3] The referenced groundwater wells extend approximately 2 feet below the ground surface. These well sites were designed to collect long term soil saturation data in forested wetland sites and adjacent to known pondberry colony sites. These wells were not designed to collect groundwater fluctuation data associated with the Mississippi River Alluvial Aquifer which can range from 60 feet to 120 feet below the ground surface of the YBA. The data collection from this monitoring effort should not be used as a tool to assess groundwater depletion in the Aquifer.

The agencies have entered into this MOA in light of the nationally significant natural resources and species anticipated to be impacted by the proposed Project, and the complexity of the Project's monitoring and adaptive management components.

b. Applicable Laws and Regulations

This MOA is established consistent with the following statutes, regulations and policies.

1. Section 3 of the *Flood Control Act* of 1941, as amended by the *Flood Control Acts* of 1944 and 1965.
2. *Clean Water Act* Section 404 (33 U.S.C. 1344).
3. Environmental Protection Agency, *Clean Water Act Section* 404(b)(1) Guidelines for Specification of Disposal Sites for Dredged or Fill Material (40 C.F.R. Part 230).
4. Memorandum of Agreement between the Department of the Army and the Environmental Protection Agency Concerning the Determination of Mitigation under the *Clean Water Act* Section 404(b)(1) Guidelines (February 6, 1990).
5. *National Environmental Policy Act* (42 U.S.C. 4321 et seq.).
6. Council on Environmental Quality, Regulations for Implementing the Procedural Provisions of the *National Environmental Policy Act* (40 C.F.R. Parts 1500-1508).
7. *Fish and Wildlife Coordination Act* (16 U.S.C. 661 et seq.).
8. *Endangered Species Act* of 1973, as amended, (16 U.S.C. 1531 et seq.).
9. Section 906 of the *Water Resources Development Act* of 1986, as amended (33 U.S.C. 2283).
10. Section 2036(c) of the *Water Resources Development Act* of 2007, as amended (33 U.S.C. 2317b).
11. Department of the Army, Implementation Guidance for Section 1162 of the *Water Resources Development Act* of 2016 and Section 1040 of the *Water Resources Reform and Development Act* of 2014, Fish and Wildlife Mitigation (Section 906 of the *Water Resources Development Act* of 1986, as Amended (33 U.S.C. 2283)) (March 25, 2019).
12. Engineering Regulation 1105-2-100, Planning Guidance Notebook, Appendix C.
13. Department of the Army, Implementation Guidance for Section 1163 of the *Water Resources Development Act* of 2016, Wetlands Mitigation (March 8, 2019).
14. Fish and Wildlife Service Mitigation Policy (88 Fed. Reg. 31000, 2023).
15. *Endangered Species Act* Compensatory Mitigation Policy (88 Fed. Reg. 31000, 2023).

c. Limitations

This MOA is not legally binding, does not create any contractual obligations and is not enforceable by any party. Nothing in this MOA diminishes or in any way affects the authorities of the USACE, the EPA or the USFWS under these statutes and their implementing regulations. This MOA does not create any right or benefit, substantive or procedural, enforceable by law or equity against any signatory or any of its officers, employees, or other representatives or any person. Nothing in this document obligates the agencies to expend appropriations or enter into any contract, assistance agreement, interagency agreement or incur financial obligations. Further, it is

understood that any agency action must be in accordance with applicable laws and regulations. This MOA does not apply to any person outside of the USACE, the EPA and the USFWS.

II. Roles and Responsibilities

a. Project Implementation

The USACE, Vicksburg District is the USACE entity responsible for implementing the Project, including the three Analyses described above and their associated Quality Assurance Project Plans, Analysis plans, monitoring reports and other appropriate documents. The District is responsible for effective oversight of each Analysis, though activities may be conducted in collaboration with other parties (e.g., the EPA Office of Research and Development, the USACE Engineer Research and Development Center or another entity).

b. Quality Assurance Project Plan

A QAPP describes in comprehensive detail the necessary Quality Assurance and Quality Control requirements and other technical activities that must be implemented to ensure that an environmental analysis is appropriately planned, implemented, documented and assessed consistent with USACE regulations. The District shall develop and approve a QAPP for each of the three Analyses, in coordination with the EPA and the USFWS prior to their implementation. The QAPPs will document the authority for the Analysis and copies of the approved QAPP, including any future addendums or modifications, shall be available to the agencies upon request.

c. Plan Implementation and Monitoring Reports

The FEIS describes three compliance Analyses to assess potential changes to hydrology and the ecosystem that could result from Project implementation: (1) mapping and remotely monitoring inundation extent throughout the YSA (Appendix 1); (2) the installation and monitoring of groundwater wells throughout the YSA (Appendix 2); and (3) the installation of supplemental low-flow groundwater wells to improve baseflows in headwater streams of the Big Sunflower, Upper Deer Creek and Steele Bayou Basins (Appendix 3)).

With each of the three Analyses, the District aims to collect baseline data to determine natural variability due to climate, hydric regime, seasonality, food web dynamics, forest habitat metrics and other factors associated with pre-Project conditions. Each of these Analyses would utilize existing baseline data, some of which has been collected for many years in a number of key areas of interest, and at least one additional year of baseline data would be collected prior to Project construction to establish an understanding of pre-Project conditions in the YSA; additional years of baseline data collection may be warranted and should be discussed during QAPP development. Once the pump station is constructed, pump operators may seek to activate the pumps in accordance with the Water Control Manual to reduce flood risk to communities. Therefore, baseline data collection associated with each Analysis shall be implemented no later than one year prior to the end of anticipated pump construction.

Prior to initiating the Analysis, the District will obtain concurrence from the EPA and the USFWS. These Analyses will be developed by the District in coordination with the EPA and the USFWS. Effective coordination should include regular meetings, as well as an opportunity to review and comment on draft Analysis plans and QAPPs. If an Analysis plan and/or QAPP must be revised, these document revisions will be developed and reviewed consistent with this MOA.

The District is responsible for effective oversight of Analysis implementation and monitoring, which includes identifying any potential issues with Analysis implementation and/or a need for an updated approach. To that

end, detailed monitoring reports will be conducted at time intervals appropriate for the particular Analysis type to document progress. The timing and content of each monitoring report would be established during Analysis planning and development. The District will provide the EPA and the USFWS at least 30 days to review and comment on draft monitoring reports. Each final monitoring report shall be posted on the District's Yazoo Backwater Project website. The development of monitoring reports shall continue for the life of each Analysis.

d. Annual Monitoring and Adaptive Management Status Report

The results of these long-term monitoring efforts will help identify Project-induced, landscape-scale changes and thereby inform adaptive management decisions regarding ongoing implementation of water management and compensatory mitigation efforts in the YSA. To ensure effective collaboration on both of these issues, the District will provide an annual monitoring and adaptive management status report to the EPA and the USFWS. The reports will summarize the status of each Analysis described in this MOA (e.g., Project Implementation phase, Analysis implementation phase, results of monitoring, identification of issues or next steps, etc.). Production of the annual monitoring and adaptive management status report will continue for the life of the Analyses, and it will be posted on the District's Yazoo Backwater Project website.

e. Dispute Resolution

In the event of a dispute, the agencies shall use their best efforts to resolve that dispute in an informal fashion through consultation and communication. In the event such measures fail to resolve the dispute, the agencies shall elevate the issue through their respective chains of command, as appropriate.

f. Information Sharing

Draft documents prepared or exchanged pursuant to this agreement may contain information subject to the Deliberative Process Privilege, the Attorney-Client Privilege, the Confidential Commercial Information Privilege or other privileges. The agencies intend to assert privileges where appropriate and subject to the limitations of the *Freedom of Information Act*, 5 U.S.C. 552 et seq, or other legal authorities. Should an agency receive a *Freedom of Information Act* or other request for information prepared or exchanged pursuant to this agreement, that agency will timely consult with the other agencies as appropriate to determine the applicability of privileges or exemptions where other agencies have equities in the requested information.

III. Effective Date and Review

This MOA shall become effective upon the date of the last signature of the agencies. This MOA will be reviewed by the agencies 10 years from the date of award of the first construction contract for the Project.

Maj. Gen. Kimberly A. Peeples
Commander
Mississippi Valley Division
U.S. Army Corps of Engineers

Jeaneanne M. Gettle
Acting Regional Administrator
Region 4
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Mike Oetker
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Appendix 1
Mapping and Remote Monitoring of Inundation Extent in the Yazoo Backwater Study Area of Mississippi

I. Background

Bottomland hardwood wetlands and other wetlands in the Yazoo Backwater Study Area, or YSA, depend upon frequent saturation and inundation to provide critical ecosystem functions and services to humans and wildlife (Wharton et al. 1982,[4] Dahl et al. 2009[5]). Yet this habitat has declined by more than 80 percent locally, primarily due to the large-scale conversion of fertile, frequently flooded land to agriculture since the late 1800s. While the Yazoo Backwater Area Water Management Project aims to provide flood risk reduction to communities in the YSA, it would simultaneously decrease the frequency and duration of flooding to aquatic resources, including bottomland hardwood wetlands.

Estimates of wetland inundation from floodwaters in the YSA are based on the best available data. The U.S. Army Corps of Engineers engineering models have described the watershed and in-channel hydrology of the system, and potential backwater flooding regimes have been approximated through Geographic Information Systems -based hydrological tools.[6] However, interpolation of watershed-scale hydrology from a limited number of field-based data points can potentially provide an incomplete understanding of watershed hydrology (e.g., wetland saturation and inundation). These uncertainties necessitate a monitoring and adaptive management plan that aims to assess potential changes to aquatic resource hydrology and the ecosystem that could result from Project implementation.

Complementary remotely sensed data that is continuous in extent will strengthen the understanding of YSA hydrology and is critical to informed decision-making and facts-based adaptive management. This Analysis proposes the use of highly refined and accurate satellite-based remote sensing products (Vanderhoof et al. 2023[7]) to: 1) validate and calibrate estimates of surface water inundation extents of existing USACE hydrology models and tools; 2) leverage field-based measurements of surface-water inundation and soil saturation with remote sensing data via machine learning models to allow for watershed-scale (i.e., beyond individual site) investigation of soil inundation and/or saturation patterns; and 3) facilitate the monitoring of existing conditions of surface water inundation and/or soil saturation, providing real-time responses to both emergent flood-extent determinations and water management decisions.

II. Approach

Details of this Analysis' proposed methods are outlined in the FEIS.[8] To ensure that this Analysis is effectively tracked and managed, a Quality Assurance Project Plan and Analysis plan will be developed, in collaboration with the U.S. Environmental Protection Agency and the U.S. Fish and Wildlife Service, prior to Project implementation to outline short-term (e.g., baseline data collection and model validation) and long-term

[4] Wharton et al. 1982 (USFWS): The Ecology of Bottomland Hardwood Forests of the Southeast: A Community Profile.
[5] Dahl, T.E., J. Swords and M. T. Bergeson. 2009. Wetland inventory of the Yazoo Backwater Area, Mississippi - Wetland status and potential changes based on an updated inventory using remotely sensed imagery. U.S. Fish and Wildlife Service, Division of Habitat and Resource Conservation, Washington, D.C. 30 p.
[6] USACE Final Environmental Impact Statement for the Yazoo Backwater Area Water Management Project, Appendix A-Engineering Report.
[7] Vanderhoof, M.K., Alexander, L., Christensen, J., Solvik, K., Nieuwlandt, P., Sagehorn, M. 2023. High-frequency time series comparison of Sentinel-1 and Sentinel-2 for open and vegetated water across the United States (2017-2021). Remote Sensing of Environment. 288, 113498, https://doi.org/10.1016/j.rse.2023.113498.
[8] USACE FEIS for the Yazoo Backwater Area Water Management Project, Appendix K-Monitoring and Adaptive Management Plan.

Analysis goals (e.g., monitoring and reporting results) and to appropriately maintain quality assurance/quality control requirements.

Overall, this Analysis would include scientific monitoring efforts to support and enhance adaptive management plans by providing:

- Data on the timing, frequency and extent of open and vegetated surface water extents across the YSA derived from high resolution satellite imagery at a 2-week time step, currently reaching from 2017-2023, and extended to include future years as data becomes available.
- Satellite- and engineering model-based estimates of surface water inundation to improve calibration and validation, as well as application to the USACE data products (e.g., improved 2-, 5-, 25-, 50-year flood prone extent derivation, improved estimates of agricultural and residential inundation frequency and extent, etc.).
- A machine learning and/or statistical model relating water-table monitoring well saturation and inundation to basin-wide measures of inundation, topography, soil characteristics and precipitation to identify current patterns of surface saturation and inundation. (See Appendix 2 of this MOA for details on increasing the number of monitoring wells in the YSA for enhanced statistical power.)
- Long-term monitoring of inundation patterns and wetland hydrology in response to future operational water management actions (i.e., floodgate closures and surface water pumping) in the YSA, over a period of several years or longer. (Note: the appropriate length of monitoring would be discussed during Quality Assurance Project Plan and Analysis planning and approval).

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Appendix 2
Groundwater Monitoring Wells

I. Background

Implementation of the Yazoo Backwater Area Water Management Project could decrease the duration or frequency of wetland hydroperiods and periods of flood water inundation and soil saturation more than anticipated, which necessitates a monitoring and adaptive management plan that aims to assess potential changes to aquatic resource hydrology. Hydrologic monitoring using shallow groundwater wells is effective in identifying both hydroperiod and hydropatterns within wetlands. Preliminary hydrologic studies have been completed in portions of the Yazoo Backwater Study Area, or YSA, (e.g., Berkowitz et al. 2019[9]); but the available data are not widely representative of wetlands throughout the YSA, nor do they provide robust long-term information about seasonal inundation and saturation. This Analysis aims to increase the number of monitoring sites to acquire data related to potential hydrologic changes resulting from operation of the Project, provide explanatory data related to observed changes in representative wetland function, and support decision-making related to adaptive operation of the Project if necessary.

II. Approach

Details of this Analysis' proposed methods are outlined in the FEIS.[10] To ensure that this Analysis is effectively tracked and managed, a Quality Assurance Project Plan and Analysis plan will be developed, in collaboration with the U.S. Environmental Protection Agency and the U.S. Fish and Wildlife Service, prior to project implementation to outline short-term (e.g., baseline data collection and model validation) and long-term Analysis goals (e.g., monitoring and reporting results) and to appropriately maintain quality assurance/quality control requirements.

Overall, this Analysis would include scientific monitoring efforts to support and enhance adaptive management plans by providing:

- Baseline and long-term monitoring of inundation patterns and wetland hydrology in response to future operational water management actions at over 320 locations throughout the YSA:
  - Installation and monitoring of a minimum of 120 groundwater monitoring wells.
  - Continued monitoring of over 200 existing groundwater monitoring wells.

[9] Berkowitz, J.F., D.R. Johnson, and J.J Price. 2019. Forested Wetland Hydrology in a Large Mississippi River Tributary System. Wetlands. doi:10.1007/s13157-019-01249-5.

[10] USACE FEIS for the Yazoo Backwater Area Water Management Project, Appendix K-Monitoring and Adaptive Management Plan.

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Appendix 3
Supplemental Low Flow Groundwater Wells

I. Background

Historically, environmental flow within the unregulated streams in the Yazoo Backwater Study Area, or YSA, has declined from the twentieth century to the twenty-first century. From 1937 through 1975, the annual minimum flow fell below 100 cubic feet per second only six times. After 1975, the annual minimum flow dramatically decreased and typically ranges between 10 and 60 cfs. The overall decline in stream baseflows and groundwater over time can be attributed to deforestation efforts, flood reduction improvements and groundwater pumping associated with land use change in the YSA (Reinecke et al. 1988,[11] Ouyang et al. 2021[12]) as well as climate change patterns (Middleton and Souter 2016[13]). The extremely low baseflows, especially during already dry periods, have been dewatering mussel beds, reducing fish diversity and impacting other sensitive environments within the Yazoo Basin (Killgore et al. 2024[14]). While fisheries impacts in regulated waters are accompanied by the requisite compensatory mitigation, implementation of the Yazoo Backwater Area Water Management Project could have unintended consequences of further reducing baseflows to headwater streams (i.e., low Strahler stream order) in the YSA by reducing the maximum extent and duration of flood inundation across the landscape, which could contribute to reduced groundwater infiltration. To address this uncertainty, as well as known historic declines in stream baseflows, the Supplemental Low Flow Well component of the Project aims to augment minimum low flows during historic low flow periods to improve the overall aquatic assemblages in the unregulated rivers of the Yazoo Basin.

II. Approach

The FEIS[15] includes proposed methods for an Analysis to evaluate the effects of the Supplemental Low Flow Well component of the Project. To ensure that this Analysis is effectively tracked and managed, a Quality Assurance Project Plan and Analysis plan will be developed, in collaboration with the U.S. Environmental Protection Agency and the U.S. Fish and Wildlife Service, prior to Project implementation to outline short-term (e.g., baseline data collection and model validation) and long-term Analysis goals (e.g., monitoring and reporting results) and to appropriately maintain quality assurance/quality control requirements.

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[11] Reinecke, K. J., Barkley, R. C., & Baxter, C. K. (1988). Potential effects of changing water conditions on mallards wintering in the Mississippi Alluvial Valley. Pages. 325–337 in and MW Weller, editor. Waterfowl in winter.

[12] Ouyang, Y., Jin, W., Leininger, T. D., Feng, G., & Yang, J. (2021). Impacts of afforestation on groundwater resource: a case study for Upper Yazoo River watershed, Mississippi, USA. Hydrological Sciences Journal, 66(3), 464–473. https://doi.org/10.1080/02626667.2021.1876235

[13] Middleton, B. A., & Souter, N. J. (2016). Functional integrity of freshwater forested wetlands, hydrologic alteration and climate change. Ecosystem Health and Sustainability, 2(1). https://doi.org/10.1002/ehs2.1200

[14] Killgore KJ, Hoover JJ, Miranda LE, Slack WT, Johnson DR and Douglas NH. 2024. Fish conservation in streams of the agrarian Mississippi Alluvial Valley: conceptual model, management actions and field verification. Front. Freshw. Sci. 2:1365691. doi: 10.3389/ffwsc.2024.1365691

[15] USACE FEIS for the Yazoo Backwater Area Water Management Project, Appendix K-Monitoring and Adaptive Management Plan.

Overall, this Analysis would include scientific monitoring efforts to support and enhance adaptive management plans by providing:

- Anticipated return of minimum baseflows (e.g., 100 cfs) in four watersheds via the incremental installation of up to 34 supplemental low flow groundwater wells strategically spaced within 30,000 feet of the Mississippi River Channel and along headwater streams of the Big Sunflower, Upper Deer Creek and Steele Bayou Basins.
    - Eleven wells in Harris Bayou and Hushpuckena River watersheds;
    - Eleven wells in the Bogue Phalia Basin watershed;
    - Five wells in the Deer Creek watershed; and
    - Seven wells in the Steele Bayou watershed [five wells in Main Canal and two wells in the upper Black Bayou (Fish Lake Bayou)].
- Anticipated benefits to aquatic assemblages in the YSA include increased wetted surface, aquatic habitat and "living space" for mussels, fishes and other aquatic invertebrates including species of special concern in the basin.
- Baseline data collection to determine the required minimum outputs for each supplemental low flow groundwater well to establish minimum historic baseflows in each watershed.
- Baseline and long-term monitoring of groundwater elevation at all sites to evaluate the impact of well usage to the aquifer.
- Baseline and long-term monitoring of fisheries and macroinvertebrate populations in response to supplemental low flow groundwater well implementation.