# APPENDIX 21
PUBLIC INVOLVEMENT AND COORDINATION

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A21-1 NOTICE OF INTENT
DEPARTMENT OF DEFENSE

Department of the Army, Corps of Engineers

Notice of Intent To Prepare Supplement II to the Final Environmental Impact Statement, Mississippi River and Tributaries (MR&T) Project, Mississippi River Mainline Levees and Channel Improvement

AGENCY: Army Corps of Engineers, DoD.

ACTION: Notice of Intent.

SUMMARY: The U.S. Army Corps of Engineers ("USACE"), Memphis District, Vicksburg District, and the New Orleans District, is announcing its intent to prepare SEIS II to the Final Environmental Impact Statement, Mississippi River and Tributaries (MR&T) Project, Mississippi River Mainline Levees and Channel Improvement of 1976 (1976 EIS), as updated and supplemented by Supplement No. 1, Mississippi River and Tributaries Project, Mississippi River Mainline Levees and Channel Improvement of 1976 (1976 EIS), to cover construction of remaining authorized work on the Mississippi River mainline levees (MRL) feature. The public is invited to attend the scoping meeting.

FOR FURTHER INFORMATION CONTACT: Direct questions about the NEPA process to Mr. Mike Malsom by mail at Inland Environment Team, Environment and Resources Branch, Planning and Environmental Division, USACE-Mobile, Post Office Box 2288, Mobile, AL 36628–0001.

The USACE will hold five public scoping meetings during the months of July and August as part of its preparation to conduct the water supply storage reallocation study and update the WCMs for the Alabama Power Company’s Weiss and Logan Martin reservoirs in the ACT River Basin. The public is invited to attend the scoping meetings, which will provide information on the study process and afford interested parties the opportunity to submit to USACE input about their issues and concerns regarding that process. Each of the public scoping meetings will be presented in an open house format, allowing time for participants to review specific information and to provide comments either on forms available at the meeting or to a court reporter on-site at the meeting.

Curtis M. Flakes,
Chief, Planning and Environmental Division.

[FR Doc. 2018–14975 Filed 7–12–18; 8:45 am]
MR&T PDF Flowline.” The Mississippi River mainline levees protect the lower Mississippi River Valley against the PDF by confining flow to the leved channel, except where it enters backwater areas, overflows several levees designed to overtop and fill tributary basins, or is intentionally diverted into four floodway areas. (A figure which depicts the PDF in cubic feet per second for the lower Mississippi River and its tributaries as set forth in SEIS I will be available for review at the Project website.) The MR&T Project functions as a system and provides flood risk reduction across portions of seven states: Illinois, Missouri, Kentucky, Tennessee, Arkansas, Mississippi, and Louisiana (a map of the area will be available on the Project website). The MR&T System includes an extensive levee system; floodways to divert excess flows past critical reaches; channel improvement and stabilization features to protect the integrity of flood risk management measures and to ensure proper alignment and depth of the navigation channel; and a system of reservoirs to regulate flows and backwater areas to provide storage during extreme events. The integrity of the levee system is also bolstered by construction of additional features such as berms, drainage trenches, drainage blankets, and relief wells, and tributary basin improvements including levees, headwater reservoirs, and pumping stations that expand flood risk management coverage and improve drainage into adjacent areas within the alluvial valley.

Through evaluation of information and data obtained from levee inspections, seepage analyses, research, studies, and engineering assessments, USACE has concluded that certain levee reaches are not at Project design grade due to effects from various changed conditions, including, but not limited to consolidation of levee materials, subsidence, and changes in river conditions and in survey datum over time. Additionally, advances in geotechnical mapping, data collected from recent high water events, and subsequent seepage analyses that have taken place since the finalization of SEIS I, have revealed the need for additional seepage control measures and the construction of other authorized Project features to facilitate structural integrity and stability of the MRL feature of the MR&T Project. As a result, in October of 2017, USACE completed an engineering risk assessment and programmatic review of the MRL based on the 1973 Refined MR&T Flowline Study. The assessment showed that the integrity of the MRL levee system was at risk because numerous levee reaches are not currently constructed to the pass the PDF due to either height or seepage deficiencies. Based on the results, USACE has determined that SEIS II is necessary to formulate alternatives, identify significant resources, assess the direct, indirect, and cumulative impacts to the significant resources, develop mitigation measures, and evaluate and select a recommended plan.

2. Proposed Action. The Proposed Action is the construction of necessary additional authorized MRL Project features (e.g., levee enlargements; stability berms, underseepage controls such as berms, relief wells, cutoffs, riverside blankets and pit fills; and erosion protection such as slope paving), to improve sections of deficient MRL levees in order to provide the required PDF protection. The Proposed Action, and associated evaluations, does not include reformulation of the MRL feature. Measures to manage flood risk reduction along the mainline levee system from decadum, Missouri to Head of Passes, Louisiana, include but are not limited to, raising and widening portions of the levee to the authorized design grade and cross-sections, stabilizing floodwalls, and seepage control (e.g. berms, relief wells, and cutoff trenches).

3. Alternatives. SEIS II will evaluate an array of site specific alternatives, including the No-Action alternative, with a focus to avoid and minimize reasonably foreseeable adverse effects from construction of necessary additional authorized MRL Project features. Alternatives include evaluations of measures, or combination of measures, along with evaluation of locations of borrow areas that avoid and minimize reasonably foreseeable adverse effects. Potential alternatives may include flood risk reduction measures such as raising and widening portions of the levee to the authorized design grade and cross-sections, installing or stabilizing floodwalls, levee setbacks, and various seepage control measures such as berms and cutoffs. Other alternatives will be developed through the scoping process based on public input. Additionally, SEIS II will identify measures to avoid, offset, or minimize impacts to resources where feasible.

4. Scoping. Scoping is the National Environmental Policy Act (NEPA) process utilized for determining the range of alternatives and significant issues to be addressed in SEIS II. USACE invites full public participation to promote open communication on the issues surrounding the Proposed Action. The public will be involved in the scoping and evaluation process through advertisements, notices, and other means. Project information will also be available on the Project website at: http://www.mvk.usace.army.mil/MRLSEIS/. All individuals, organizations, NGOs, affected Indian tribes, and local, state, and Federal agencies that have an interest are urged to participate in the scoping process. The purpose of this Notice is to obtain suggestions and information that may inform the scope of the issues and range of alternatives to be evaluated in SEIS II, as well as to provide notice and request public input on the reasonably foreseeable effects to natural and cultural resources.

This Notice of Intent commences the formal public scoping comment period which shall continue through October 1, 2018. Scoping is the NEPA process utilized for seeking public involvement in determining the range of alternatives and significant issues to be addressed in SEIS II. USACE invites full public participation to promote open communication in the public scoping phase and invites interested parties to identify potential issues, concerns, and reasonable alternatives that should be considered in SEIS II.

In order for public comments to be recorded for inclusion in the Administrative Record and be considered in the SEIS II development process, members of the public, interested persons and entities must submit their comments to USACE by mail, email, or verbally at the Scoping Meeting(s). Written comments submitted for consideration are due no later than October 1, 2018. Written comments may be submitted: (1) To USACE at public scoping meetings; (2) by regular U.S. Mail mailed to: U.S. Army Corps of Engineers, ATTN: EVMN-PDC-UDC, 167 North Main Street, Room B-202, Memphis, Tennessee 38103-1894; and (3) by email to: MRL-SEIS-2@usace.army.mil. Please include your name and return address on the first page of your written comments. All personally identifiable information (for example, name, address, etc.) voluntarily submitted by a commenter may be publicly accessible. Do not submit confidential business information or otherwise sensitive or protected information. All timely received comment letters will be accessible on the Project website at http://www.mvk.usace.army.mil/MRLSEIS/.
5. Public Scoping Meetings: Public scoping meeting(s) will be held at various locations within the Project Area during approximately July or August of 2018 to present information to the public and to receive comments from the public. The date(s), time(s), and location(s) of the scoping meeting(s) will be publicly announced in advance by USACE on the Project website at: http://www.mvk.usace.army.mil/ MRLSEIS/, and in any other forms deemed appropriate once those dates, times, and locations are determined by USACE. Notices of the public scoping meetings will also be sent by USACE through email distribution lists, posted on the Project website, and mailed to public libraries, government agencies, and interested groups and individuals. Scoping meeting dates and locations will also be advertised in local newspapers. Interested parties unable to attend the scoping meetings can access additional information on SEIS II at: http://www.mvk.usace.army.mil/ MRLSEIS/.

6. Potentially Significant Issues. SEIS II will analyze the reasonably foreseeable impacts on the human and natural environment resulting from the Proposed Action. The scoping, public involvement, and interagency coordination processes will help identify and define the range of potential significant issues that will be considered. Important resources and issues evaluated in SEIS II could include, but are not limited to, the direct, indirect, and cumulative effects on aquatic resources; bottomland hardwoods; wetlands; waterfowl; wildlife resources; water quality; cultural resources; geology and soils including agricultural land and prime and unique farmland; hydrology and hydraulics; air quality; threatened and endangered species and their critical habitat; socioeconomic; environmental justice; recreation; and cumulative effects of related projects along the MRL. USACE will also consider issues identified and comments made throughout scoping, public involvement, and interagency coordination. USACE expects to better define the issues of concern and the methods that will be used to evaluate those issues through the scoping process.

7. Availability. The current SEIS II development schedule anticipates the release of the draft of SEIS II by USACE for public review and comment in 2020. After it is published, USACE will hold public comment meetings to present the results of studies and identification of a recommended plan, to receive comments, and to address questions concerning the draft SEIS II. Dated: June 27, 2018. Michael C. Derosier, Colonel, U.S. Army, Commander and District Engineer.

DEPARTMENT OF EDUCATION

Applications for New Awards; Personnel Development To Improve Services and Results for Children With Disabilities—Associate Degree Preservice Program Improvement Grants To Support Personnel Working With Young Children With Disabilities

AGENCY: Office of Special Education and Rehabilitative Services, Department of Education.

ACTION: Notice.

SUMMARY: The Department of Education is issuing a notice inviting applications for new awards for fiscal year (FY) 2018 for Personnel Development to Improve Services and Results for Children with Disabilities—Associate Degree Preservice Program Improvement Grants to Support Personnel Working with Young Children With Disabilities.

AGENCY: Office of Special Education and Rehabilitative Services, Department of Education.

ACTION: Notice.

SUMMARY: The Department of Education is issuing a notice inviting applications for new awards for fiscal year (FY) 2018 for Personnel Development to Improve Services and Results for Children with Disabilities—Associate Degree Preservice Program Improvement Grants to Support Personnel Working with Young Children With Disabilities.


ADDRESSES: For the addresses for obtaining and submitting an application, please refer to our Common Instructions for Applicants to Department of Education Discretionary Grant Programs, published in the Federal Register on February 12, 2018 (83 FR 6003) and available at www.gpo.gov/fdsys/pkg/FR-2018-02-12/pdf/2018-02558.pdf.


If you use a telecommunications device for the deaf (TDD) or a text telephone (TT), call the Federal Relay Service (FRS), toll free, at 1–800–877–8339.

SUPPLEMENTARY INFORMATION:

Full Text of Announcement

I. Funding Opportunity Description

Purpose of Program: The purposes of this program are to (1) help address State-identified needs for personnel in special education, early intervention, related services, and regular education to work with children, including infants and toddlers, with disabilities; and (2) ensure that those personnel have the necessary skills and knowledge, derived from practices that have been determined through scientifically based research and experience, to be successful in serving those children.

Priorities: In accordance with 34 CFR 75.105(b)(2)(v), the absolute and competitive preference priorities are from allowable activities specified in the statute (see sections 662 and 681 of the Individuals with Disabilities Education Act (IDEA); 20 U.S.C. 1462 and 1481).

Absolute Priority: For FY 2018 and any subsequent year in which we make awards from the list of unfunded applications from this competition, this priority is an absolute priority. Under 34 CFR 75.105(c)(3), we consider only applications that meet this priority.

This priority is:

Associate Degree Preservice Program Improvement Grants To Support Personnel Working With Young Children With Disabilities

Background

The mission of the Office of Special Education and Rehabilitative Services (OSERS) is to improve early childhood, educational, and employment outcomes and raise expectations for all people with disabilities, their families, their communities, and the Nation.

The purpose of this priority is to fund eight Associate Degree Preservice Improvement Grants and improve the quality of existing associate degree programs so that associate degree-level personnel are well prepared to work with infants, toddlers, preschool, and early elementary school children ages birth through 8 (young children) with disabilities and their families in inclusive early childhood programs and elementary schools. Associate degree-level personnel play critical roles in the development and learning of all young children, including young children with disabilities, as child care providers, preschool teachers, assistant teachers, and paraprofessionals. In these roles, associate degree-level personnel can use evidence-based (as defined in this notice) practices (EBPs) to meaningfully include young children with disabilities in early childhood programs and classrooms, individualize interventions and accommodations, collect data to monitor progress, and collaborate with other professionals. In elementary schools, paraprofessionals are often...

Edward P. Lambert.
Chief, Environmental Compliance Branch, Regional Planning and Environmental Division South.

[FR Doc. 2018–18723 Filed 8–28–18; 8:45 am] BILING CODE 3720–58–P

DEPARTMENT OF ENERGY

[FE Docket No. 13–147–LNG]

Change in Control; Delfin LNG, LLC

AGENCY: Office of Fossil Energy, DOE.

ACTION: Notice.

SUMMARY: The Office of Fossil Energy (FE) of the Department of Energy (DOE) gives notice of receipt of a Notice of Change in Control Through Indirect Equity Ownership Changes (Notice), filed July 10, 2018 by Delfin LNG, LLC (Delfin LNG) in FE Docket No. 13–147–LNG. The Notice describes changes to the corporate structure and ownership of Delfin LNG. The Notice was filed under section 3 of the Natural Gas Act (NGA).

DATES: Protests, motions to intervene or notices of intervention, as applicable, and written comments are to be filed using procedures detailed in the Public Comment Procedures section no later than 4:30 p.m., Eastern time, September 13, 2018.

 ADDRESSES: Electronic Filing by email: fergas@hq.doe.gov.


 Hand Delivery or Private Delivery Services (e.g., FedEx, UPS, etc.): U.S. Department of Energy (FE–34), Office of Regulation and International Engagement, Office of Fossil Energy, Forrestal Building, Room 3E–042, 1000 Independence Avenue SW, Washington, DC 20585.


A21-2 PUBLIC SCOPING

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Corps schedules public scoping meetings for Mississippi River mainline levees supplemental environmental impact statement

VICKSBURG, Miss. – The U.S. Army Corps of Engineers (USACE) will host four public scoping meetings for the preparation of a supplemental environmental impact statement to address the impacts associated with the construction of remaining authorized work on the Mississippi River mainline levees of the Mississippi River and Tributaries project.

USACE issued a notice of intent to prepare Supplement II to the Final Environmental Impact Statement (SEIS II), Mississippi River and Tributaries (MR&T) Project, Mississippi River Mainline Levees and Channel Improvement and published in the Federal Register on July 13, 2018. This work is one of the major features of the MR&T Project used to provide comprehensive flood damage control and risk reduction beginning at Cape Girardeau, Missouri, to the Head of Passes, Louisiana.

SEIS II will evaluate an array of site-specific alternatives, including the no-action alternative, with a focus to avoid and minimize reasonably foreseeable adverse effects from construction of necessary additional authorized MRL project features. Alternatives will include evaluations of measures, or combination of measures, along with evaluation of locations of borrow areas that avoid and minimize reasonably foreseeable adverse effects. Potential alternatives may include flood risk reduction measures such as raising and widening portions of the levee to the authorized design grade and cross-sections, installing or stabilizing floodwalls, levee setbacks, and various seepage control measures such as, seepage berms, relief wells with the associated drainage and/or pumping plants for water conveyance, and cutoff trenches. Other alternatives will be developed through the scoping period based on public input. Additionally, SEIS II will identify measures to avoid, offset, or minimize impacts to resources where feasible.

The publication of the notice of intent in the Federal Register begins a formal public scoping comment period, which will continue through Oct. 15, 2018. The four public meetings are scheduled from 7-9 p.m. as follows:

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

Public scoping meetings will present information to the public followed by a public comment period. More information about the public scoping meetings can be found at the following website: [http://www.mvk.usace.army.mil/MRLSEIS/](http://www.mvk.usace.army.mil/MRLSEIS/). The notice of intent and other content related to the supplemental environmental impact statement are also available on the website. USACE welcomes
full public participation to promote open communication in the scoping phase and invites interested parties to identify potential issues, concerns and reasonable alternatives that should be considered.

In order for public comments to be recorded for inclusion in the Administrative Record and be considered in the SEIS II development process, members of the public, interested persons and entities must submit their comments to USACE by mail, email, or verbally at the Scoping Meeting(s). Written comments submitted for consideration are due no later than October 15, 2018 and may be submitted: (1) to USACE at public scoping meetings above; (2) by regular U.S. Mail mailed to: U.S. Army Corps of Engineers, ATTN: CEMVN-PDC-UDC, 167 North Main Street, Room B-202, Memphis, Tennessee 38103-1894; and (3) by email to: MRL-SEIS-2@usace.army.mil. Please include your name and return address on the first page of your written comments. All personally identifiable information voluntarily submitted by a commenter may be publicly accessible. Do not submit confidential business information or otherwise sensitive or protected information.

PUBLIC SCOPING MEETINGS

Mississippi River and Tributaries Project, Mississippi River Levees
Supplemental Environmental Impact Statement II

Time and Locations of Public Scoping Meetings: Four public scoping meetings will be conducted by the U.S. Army Corps of Engineers (USACE) within the study area to present information and receive comments on Supplemental Environmental Impact Statement II (SEIS II) being prepared by USACE. These public scoping meetings have been duly noticed and will be held at the following locations from 7-9 p.m.

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

Preparation of Supplement II to the 1976 Final Environmental Impact Statement: USACE is preparing a second Supplemental Environmental Impact Statement (SEIS II) to the original Final Environmental Impact Statement, Mississippi River and Tributaries (MR&T) Project, Mississippi River Mainline Levees and Channel Improvement of 1976 (1976 EIS), which will evaluate the potential impacts associated with the construction of remaining authorized work on the Mississippi River (mainline) Levees (MRL) feature of the MR&T Project. SEIS II is the second supplemental environmental impact statement for MRL work on the MR&T Project since the publication of the 1976 EIS and Supplement No. 1 to the 1976 EIS in 1998.

The MRL provides comprehensive flood damage control, protection, and risk reduction from the “Project Design Flood” (PDF) in the alluvial valley beginning at Cape Girardeau, Missouri to the Head of Passes, Louisiana. The PDF is a hypothetical flood that was developed to determine the design flood to be used in designing the MR&T levee system in the lower Mississippi River Basin, and is defined as the “greatest flood having a reasonable probability of occurrence” when the operable features of the entire MR&T Project are considered. Since the publication of the 1976 FEIS and the 1998 SEIS I, USACE has identified certain sections (reaches) of the MRL which are deficient and require the construction of major remedial measures, such as levee enlargements and seepage control measures, to contain the PDF in the lower Mississippi River Valley in an environmentally sustainable manner. SEIS II will evaluate the potential direct, indirect, and cumulative impacts for an array of proposed alternatives and plans, including the No Action
alternative, (collectively the “proposed action”) to provide the necessary flood protection against the PDF, and also consider mitigation plans and other actions to minimize environmental losses.

A Notice of Intent to prepare SEIS II was published in the Federal Register on July 13, 2018. The Draft SEIS II is scheduled to be released by USACE for public review and comment in 2020. Additional information related to SEIS II can be accessed at: http://www.mvk.usace.army.mil/MRLSEIS/.

**Purpose of Public Scoping Process:** Subsequent to the enactment of the National Environmental Policy Act (NEPA) of 1969, as amended, the Council on Environmental Quality (CEQ) was created and tasked with multiple responsibilities which include, but are not limited to, the formulation and recommendation of national policies to promote the improvement of the quality of the environment. CEQ “Regulations for Implementing the Procedural Provisions of NEPA” requires that public scoping be initiated before an environmental impact statement is prepared to identify significant issues related to the proposed action. Through the scoping process, affected federal, state, and local agencies; federally recognized Tribes; and other interested organizations and individuals, are invited to participate in the proposed action evaluation process and assist in determining the scope and depth of significant issues to be analyzed in the environmental impact statement.

USACE requests full public participation and open communication in the public scoping phase of the preparation of SEIS II and invites all interested parties to attend the scoping meetings and comment on issues, concerns, and alternatives for consideration in the preparation of SEIS II.

Written comments must be submitted no later than October 15, 2018 in order to be considered. Written comments may be submitted: (1) to USACE at public scoping meetings; (2) by regular U.S. Mail mailed to: U.S. Army Corps of Engineers, ATTN: CEMVN-PDC-UDC, 167 North Main Street, Room B-202, Memphis, Tennessee 38103-1894; and (3) by email to: MRL-SEIS-2@usace.army.mil. Please include your name and return address on the first page of your written comments. Please be advised that personally identifiable information that is contained on written comments submitted to USACE, may become a public record and publicly accessible. Therefore, do not submit confidential business information or otherwise sensitive or protected information.

**Public Scoping Meeting Agenda:** Welcoming Remarks
Project Overview
NEPA and Scoping Process
Public Comments
Closing Remarks
Lead Contacts:

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Phone: 901-544-0708

**Lead Tribal Liaison and Cultural Resources Contact**
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NEPA Coordinator
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Phone: 601-631-5678

**New Orleans District**
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Phone: 504-862-2128

NEPA Coordinator
Mark Lahare
E-mail: Mark.H.Lahare@usace.army.mil
Phone: 504-862-1344
In addition to verbal comments provided to court reporters and/or authorized USACE employees, agents, and representatives at the scoping meetings, written comments may be submitted at the scoping meeting using this form.

Written comments may also be provided to USACE by regular U.S. Mail: U.S. Army Corps of Engineers, ATTN: CEMVN-PDC-UDC, 167 North Main Street, Room B-202, Memphis, Tennessee 38103-1894, or by email to: MRL-SEIS-2@usace.army.mil.

Written comments must be submitted no later than October 15, 2018 in order to be considered by USACE. Please be advised that personally identifiable information that is contained on written comments submitted to USACE, may become a public record and publicly accessible. Therefore, please do not submit confidential business information or otherwise sensitive or protected information. You may include additional sheets of paper if necessary, for your comments.

Name: ______________________________________________________________________

Telephone number (optional): ___________________________________________________

Organization (if any): ____________________________________________________________

Address (optional): _____________________________________________________________

______________________________________________________________________________

E-mail: _______________________________________________________________________

Comments:

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Levee enlargements are conducted in locations where the existing levee is not at the authorized grade. Depending on the location of the project, these raises may occur on the landside, riverside, or straddle the existing levee section.

Urban areas typically require floodwalls rather than levees to reduce impacts to residences and businesses. These floodwalls can have stability concerns or height deficiencies that must be addressed.

Areas with recurring levee slides require measures beyond ordinary O&M repairs. In these locations, the slopes of the levee will be flattened to reduce the chances of slide recurrence.
Seepage Berms
Seepage berms are constructed on the landside of the levee using impervious soils to reinforce existing top stratum and to reduce underseepage pressure near the toe of the levee. Upon construction, berms are turfed and mowed to prevent erosion or encroachment of undesired vegetation.

Relief Wells
Relief wells are vertically installed wells consisting of a well screen surrounded by a filter material designed to prevent in-wash of foundation materials into the well. Relief Wells intercept underseepage and provide a controlled outlet for the water.

Slurry Trenches
A slurry trench is installed on the river side to a determined depth to cutoff seepage through any deep impervious layers.

Sheet Pile Cut-Off
Sheet pile cutoff is installed in the levee section to a determined depth to cutoff seepage through any shallow impervious layer and to cutoff seepage through the levee embankment. Upon completion, sheet pile is buried in the levee section.
The views, opinions and findings contained in this report are those of the authors(s) and should not be construed as an official Department of the Army position, policy or decision, unless so designated by other official documentation.
Mississippi River and Tributaries System
The Flood Control Act of 1928

After the catastrophic Flood of 1927, Congress approved “An act for the control of floods on the Mississippi River and its tributaries”. Through this historic Act, Congress instructed the Mississippi River Commission (MRC) to implement the engineering plan advanced by Major Gen. Edgar Jadwin, Chief of Engineers. The $300 million plan adopted by Congress provided for enlarging and strengthening the levees from Cape Girardeau to the Gulf of Mexico.

Modifying the Jadwin Plan

The 1928 Flood Control Act did not signify the culmination of improvement on the Mississippi River. Despite a then staggering $300 million over ten years, the Jadwin plan quickly proved inadequate to the needs of the valley for both engineering and non-engineering reasons. In the 1930s, the MRC initiated a channel rectification program designed to increase the carrying capacity of the channel. In addition, the Overton Act, passed in 1936, modified the Jadwin Plan by providing for headwater reservoirs in the Yazoo and St. Francis basins. By 1941, the Jadwin Plan had transformed into the truly comprehensive river management program known as the Mississippi River and Tributaries (MR&T) project.
Established in 1879

- Presidential appointed commission; listening, inspecting, partnering, and engineering
- Provides a connection between the public; a construction, operations and maintenance agency; and the executive branch and legislature
- Has established relationships and processes to make recommendations to the Chief of Engineers, the Administration and inform Congress
- Oversees MR&T project – Corps Districts carry out the work

Mississippi River Commission
Mississippi River and Tributaries System

An Integrated System

- 35,000-square-mile flood plain
- $15.5 billion invested
- $1 Trillion in flood damages prevented
- $234 billion in flood damages prevented in 2011
- 66.9 to 1 return on investment
- 4 million people protected
PROJECT DESIGN FLOOD
(58A - EN)
CUBIC FEET PER SECOND
SEPT 1958
# Mississippi River Levees

<table>
<thead>
<tr>
<th>Station</th>
<th>2011</th>
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Mississippi River Levees

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Construction of the MRL is approximately 79% complete. Assessment and maintenance will be required to ensure the integrity of the MRL after the project is completed.

In November 2017, USACE completed an engineering evaluation for authorized remaining work needed to complete the MRL. The evaluation addressed overtopping, seepage, slope stability, and floodwall stability.
As required by the National Environmental Policy Act (NEPA), an Environmental Impact Statement (EIS) was completed in 1976.

In the 1990’s, concerns about the environmental effects and compensatory mitigation for MRL construction activities lead to the completion of a Supplemental Environmental Impact Statement (SEIS) in 1998.

Since 1998, significant flood events have exposed critical seepage areas along the MRL, and subsequent engineering reviews have revealed numerous levee deficiencies that were not included in the 1998 SEIS.

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Levee enlargements are conducted in locations where the existing levee is not at the authorized grade. Depending on the location of the project, these raises may occur on the landside, riverside, or straddle the existing levee section.
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Relief wells are vertically installed wells consisting of a well screen surrounded by a filter material designed to prevent in-wash of foundation materials into the well. Relief wells intercept underseepage and provide a controlled outlet for the water while minimizing material transport underneath the levee.
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- Ultimate Goal – Foster Good Decisions
• Notice of Intent

• 13 July 2018

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- Determine Scope of Significant Issues and Concerns
- Eliminate Issues that are Not Significant
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- Wetlands
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- Waterfowl
- Aquatic Resources
- Cultural Resources
- Endangered Species
- Agricultural Lands
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• Breakout Sessions – Oral Comments

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• All Public Scoping Comments are requested by 15 October 2018
BREAK OUT SESSIONS
SUMMARY & CLOSING THOUGHTS

• For additional information about the project, please visit
  http://www.mvk.usace.army.mil/MRLSEIS/

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• All Public Scoping Comments are requested by 15 October 2018
Scoping Meeting Summary

The first of four public scoping meetings for the proposed USACE MRL-SEIS-2 Study was conducted on 10 September 2018 at the Holiday Inn Blytheville, 1121 East Main Street, Blytheville, Arkansas 72315 from 1900-2100. Three members of the public attended the meeting, detailed below.

Jennifer Sheehan, Arkansas Game and Fish Commission

Jimmy Moody, Dyer County Little Levee Drainage District #1

Robert Stainton, The Natural Resources Investment (NRI) Group, LLC

Upon filling out a registration form, attendees received a handout summarizing the purpose of the meeting, basic project information and proposed work reaches, and contact information. Jason Dickard, USACE-MVM Project Manager, conducted a brief presentation summarizing the history of the project and potential project features. Mike Thron, USACE NEPA Coordinator, conducted a brief presentation on the purpose of NEPA and public scoping. At the conclusion of the presentations, USACE opened up the floor for oral comments. Descriptions of the comments received are included below.

There was a question on how funding works for the various work items since the proposed activities would extend for many years.

There was a question on the mitigation process and whether it was feasible to use existing mitigation banks.

There was a comment that activities below the ordinary high water (OHW) mark in the state of Arkansas require coordination with the Arkansas Commission of State Lands Office.

There was a comment that the study should look at species of state concern.

This information was provided by Mike Thron, CEMVN-PDC-U.
The views, opinions and findings contained in this report are those of the authors(s) and should not be construed as an official Department of the Army position, policy or decision, unless so designated by other official documentation.

Colonel Michael C. Derosier
Daniel Sumerall
Project Manager, Vicksburg District

Brian McPherson
NEPA Coordinator, Vicksburg District

Vicksburg, MS
11 September 2018
Mississippi River and Tributaries System
After the catastrophic Flood of 1927, Congress approved “An act for the control of floods on the Mississippi River and its tributaries”. Through this historic Act, Congress instructed the Mississippi River Commission (MRC) to implement the engineering plan advanced by Major Gen. Edgar Jadwin, Chief of Engineers. The $300 million plan adopted by Congress provided for enlarging and strengthening the levees from Cape Girardeau to the Gulf of Mexico.

The Flood Control Act of 1928

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The 1928 Flood Control Act did not signify the culmination of improvement on the Mississippi River. Despite a then staggering $300 million over ten years, the Jadwin plan quickly proved inadequate to the needs of the valley for both engineering and non-engineering reasons. In the 1930s, the MRC initiated a channel rectification program designed to increase the carrying capacity of the channel. In addition, the Overton Act, passed in 1936, modified the Jadwin Plan by providing for headwater reservoirs in the Yazoo and St. Francis basins. By 1941, the Jadwin Plan had transformed into the truly comprehensive river management program known as the Mississippi River and Tributaries (MR&T) project.

Modifying the Jadwin Plan

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Established in 1879

Presidential appointed commission; listening, inspecting, partnering, and engineering

Provides a connection between the public; a construction, operations and maintenance agency; and the executive branch and legislature

Has established relationships and processes to make recommendations to the Chief of Engineers, the Administration and inform Congress

Oversees MR&T project – Corps Districts carry out the work
Mississippi River and Tributaries System

An Integrated System

- 35,000-square-mile flood plain
- $15.5 billion invested
- $1 Trillion in flood damages prevented
- $234 billion in flood damages prevented in 2011
- 66.9 to 1 return on investment
- 4 million people protected
PROJECT DESIGN FLOOD
(58A - EN)
CUBIC FEET PER SECOND
SEPT 1958
## Mississippi River Levees

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<th>Station</th>
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Revised 27 Jan 2012
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**Legend**

- With MS River Levees: 1,792,000 Acres
- Without MS River Levees: 9,600,000 Acres
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A21-2.5.2 Meeting Summary

MR&T Project - Mississippi River Levees
Supplemental Environmental Impact Statement II
Public Scoping Meeting

Name: Angela Erves
Organization (if any): USFWS / LMRCC
Address: [Redacted]

Telephone (optional): [Redacted]
E-mail: [Redacted]

The e-mail address provided on this form will be used to notify you of future actions. Please just let us know if you would like to be contacted by a method other than e-mail.
MR&T Project - Mississippi River Levees
Supplemental Environmental Impact Statement II
Public Scoping Meeting

Name: PETER NIMROD

Organization (if any): MS LEVEE BOARD

Address: 

Telephone (optional): 

E-mail: 

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The e-mail address provided on this form will be used to notify you of future actions. Please just let us know if you would like to be contacted by a method other than e-mail.
Funding: How is this project being funded?

Project is needed: “No Action” is not an option; the project protects too many people

“Avoid and Minimize” from 1998 SEIS is working.

- Use material that is close
- Work with affected land owners for mutual benefit

Borrow Areas provide valuable habitat

- Environmental Design/Reforestation are both good
- Waterfowl management beneficial also despite larger footprint due to shallower depths

Relief Wells are advantageous due to reduction of borrow needs

Riverside/Straddle Enlargements are preferred

Flood protection is needed because we are not able to pass PDF

Recurring slides are a concern in some locations in MS

Besides T&E species, we are encouraged to consider “At-risk” species as well

Water quality of MS River oxbow lakes is concerning; numerous dead fish (likely Asian Carp) have recently been found in oxbow lakes

This information was provided by Brian McPherson, CEMVN-PDC-LDC.
MR&T MISSISSIPPI RIVER LEVEES SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT (SEIS) II
PUBLIC SCOPING MEETING

Colonel Michael N. Clancy

Nick Sims
Senior Project Manager, New Orleans District

Mark Lahare
NEPA Coordinator, New Orleans District

Baton Rouge, LA
12 September 2018

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Tonight’s Agenda

I. Welcome and meeting format
II. National Environmental Policy Act and Supplemental Environmental Impact Statement II
III. Mississippi River and Tributaries levee system
IV. Public Comment
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- Basic National Charter for Environmental Protection
- Provides Environmental Information to Public
- Ultimate Goal – Foster Good Decisions
NOTICE OF INTENT

- Notice of Intent
- 13 July 2018

Scoping

Drive, Montgomery, AL 36117, (334) 244-3614

Following the scoping meetings, individuals who have already submitted their comments should submit any new comments by August 15, 2018, by either:

• Mail to: Mr. Mike Slayton, Island Environmental Team, Island Environmental Branch, Planning and Environmental Division, USACE, Mobile, Post Office Box 2388, Mobile, AL 36602-0288.

FOR FURTHER INFORMATION CONTACT

Direct questions about the NEPA process to Mr. Mike Slayton, Island Environmental Team, Island Environmental Branch, Planning and Environmental Division, USACE, Mobile, Post Office Box 2388, Mobile, AL 36602-0288, Telephone at (251) 479-2015, 800-656-5645 (TDD) 479-2364, or email at ACT-ACDM@usace.army.mil. You may also request to be added to the mailing list for public distribution of notices, meeting announcements, and reports.

SUPPLEMENTARY INFORMATION

Additional information on the ACT River Basin study will be posted as it becomes available on the Mobile District website at http://www.usace.army.mil/

The CARAC will hold two public scoping meetings during the months of July and August as part of its preparation to conduct the water supply storage investigation and study and update the WSCs for the Alabama Power Company’s Watts Bar and Logan Martin reservoirs in the ACT River Basin. The purpose is to provide an opportunity for stakeholders to provide input by participating in the scoping process. The CARAC will also hold hearings to provide interested parties an opportunity to submit to USACE input about their interests and concerns regarding the project.

Each of the public scoping meetings will be conducted on an open house format, allowing time for preparing and delivering oral and visual presentations and an opportunity to provide comments on preliminary findings and results for the ACT River Basin study.

- Notice of Intent
- 13 July 2018

Scoping

Drive, Montgomery, AL 36117, (334) 244-3614

Following the scoping meetings, individuals who have already submitted their comments should submit any new comments by August 15, 2018, by either:

• Mail to: Mr. Mike Slayton, Island Environmental Team, Island Environmental Branch, Planning and Environmental Division, USACE, Mobile, Post Office Box 2388, Mobile, AL 36602-0288, Telephone at (251) 479-2015, 800-656-5645 (TDD) 479-2364, or email at ACT-ACDM@usace.army.mil. You may also request to be added to the mailing list for public distribution of notices, meeting announcements, and reports.

SUPPLEMENTARY INFORMATION

Additional information on the ACT River Basin study will be posted as it becomes available on the Mobile District website at http://www.usace.army.mil/

The CARAC will hold two public scoping meetings during the months of July and August as part of its preparation to conduct the water supply storage investigation and study and update the WSCs for the Alabama Power Company’s Watts Bar and Logan Martin reservoirs in the ACT River Basin. The purpose is to provide an opportunity for stakeholders to provide input by participating in the scoping process. The CARAC will also hold hearings to provide interested parties an opportunity to submit to USACE input about their interests and concerns regarding the project.

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Scoping Purpose and Importance

- Determine Scope of Significant Issues and Concerns
- Eliminate Issues that are Not Significant
Scoping Considerations

- Pertinent Studies
- Significant Resources
- Issues/Concerns
- Alternative Plans
Significant Resources

- Terrestrial Habitat
- Wetlands
- Water Quality
- Waterfowl

- Aquatic Resources
- Cultural Resources
- Endangered Species
- Agricultural Lands
WE WANT TO HEAR FROM YOU

- Oral Comments
- Written comments may be sent to one of the individuals on the handout, given to us tonight, or e-mailed to: 
  MRL-SEIS-2@usace.army.mil
Mississippi River and Tributaries Project

An Integrated System

- Consists of measures to
  - Reduce Flood Risk
  - Facilitate Navigation
  - Restore Damaged Ecosystems
- One of the Nation’s most comprehensive and successful Civil Works Projects
  - $15.5 billion invested
  - $1 Trillion in flood damages prevented
  - $234 billion in flood damages prevented in 2011
  - 66.9 to 1 return on investment
  - 4 million people protected

Levees
Channel stabilization
Tributary improvements
Floodways
The Mainline Mississippi River Levee System (MRL) extends from Cape Girardeau, MO to Head of Passes, LA and is approximately 1,610 miles in length.

Project goal is to pass the Project Design Flood (PDF) and address seepage concerns.

Construction is approximately 79% complete. Assessment and maintenance will be required to ensure the integrity of the MRL after the project is completed.

In November 2017, USACE completed an engineering evaluation for authorized remaining work needed to complete the MRL. The evaluation addressed overtopping, seepage, slope stability, and floodwall stability.
## Mississippi River Levees

![Image of Mississippi River levees](image)

<table>
<thead>
<tr>
<th>Station</th>
<th>2011</th>
<th>1927</th>
<th>1937</th>
<th>1973</th>
<th>PDF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cairo, IL 1/</td>
<td>2,100,000 C/2/3/</td>
<td>1,626,000</td>
<td>2,010,000 4/</td>
<td>1,536,000</td>
<td>2,360,000 4/</td>
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<tr>
<td>Memphis, TN</td>
<td>2,213,000 C</td>
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<td>Helena, AR</td>
<td>2,130,000 C</td>
<td>1,756,000</td>
<td>1,968,000</td>
<td>1,627,000</td>
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<tr>
<td>Arkansas City, AR</td>
<td>2,293,000 C</td>
<td>1,712,000</td>
<td>2,159,000</td>
<td>1,879,000</td>
<td>2,890,000</td>
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<tr>
<td>Vicksburg, MS</td>
<td>2,320,000 C</td>
<td>1,806,000</td>
<td>2,060,000</td>
<td>1,962,000</td>
<td>2,710,000</td>
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<tr>
<td>Natchez, MS</td>
<td>2,260,000 C</td>
<td>N/A</td>
<td>2,046,000</td>
<td>2,024,000</td>
<td>2,720,000</td>
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<tr>
<td>Red River Landing, LA</td>
<td>1,641,000 C</td>
<td>1,461,000</td>
<td>1,467,000</td>
<td>1,498,000</td>
<td>2,100,000</td>
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<tr>
<td>Baton Rouge, LA</td>
<td>1,436,000 C</td>
<td>N/A</td>
<td>1,400,000</td>
<td>1,381,000</td>
<td>1,500,000</td>
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<td>N. Orleans, LA</td>
<td>1,230,000 C/8/</td>
<td>1,360,000</td>
<td>1,342,000</td>
<td>1,248,000</td>
<td>1,250,000</td>
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<tr>
<td>Morgan City, LA 7/</td>
<td>512,000 C</td>
<td>741,000</td>
<td>493,000</td>
<td>692,000</td>
<td>920,000</td>
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<tr>
<td>Wax Lake Outlet, LA 7/</td>
<td>323,000 C</td>
<td>N/A</td>
<td>N/A</td>
<td>292,000</td>
<td>580,000</td>
</tr>
</tbody>
</table>

C - Peak Discharge, Provisional
1/ Discharge Range at Hickman, KY
2/ Total Confluence Flow of 1,936,000 cfs measured at approximate mile 550.8 at 1400 CDT 5/02/2011 near Wickliffe, KY, prior to operation of Birds Point-New Madrid
3/ Peak Flow Measured 4 May 2011 = 1,730,000 cfs at Hickman plus 370,000 cfs flow through Birds Point-New Madrid Floodway
4/ Includes flow through Birds Point-New Madrid Floodway
5/ Project Design Flood (PDF) provides design flows for MR&T project. Prior to 2011 Flood, MR&T Project was 85% complete.
6/ Project Design Flood (PDF) provides design flows for MR&T project. Prior to 2011 Flood, MR&T Project was 85% complete. 2011 Flood Flows ~ 80-85% of MR&T PDF Flows.
7/ Reference - "Annual Maximum, Minimum, and Mean Discharges of the Mississippi River and its Outlets and Tributaries to 1953"
8/ Morgan City, LA was constructed from 1937-1942. Prior to that, Lower Atchafalaya River was the major outlet.
Levee enlargements are conducted in locations where the existing levee is not at the authorized grade. Depending on the location of the project, these raises may occur on the landside, riverside, or straddle the existing levee section.
Height Deficiency - Floodwall

Urban areas typically require floodwalls rather than levees to reduce impacts to residences and businesses. These floodwalls can have stability concerns or height deficiencies that must be addressed.
Seepage berms are constructed on the landside of the levee using impervious soils to reinforce existing top stratum and to reduce underseepage pressure near the toe of the levee. Upon construction, berms are turfed and mowed to prevent erosion or encroachment of undesired vegetation.
Seepage Concerns - Relief Wells

Relief wells are vertically installed wells consisting of a well screen surrounded by a filter material designed to prevent in-wash of foundation materials into the well. Relief wells intercept underseepage and provide a controlled outlet for the water while minimizing material transport underneath the levee.
Sheet pile cutoff is installed in the levee section to a determined depth to cutoff seepage through any shallow pervious layer and to cutoff seepage through the levee embankment. Upon completion, sheet pile is buried in the levee section.
As required by the National Environmental Policy Act (NEPA), an Environmental Impact Statement (EIS) was completed in 1976.

In the 1990’s, concerns about the environmental effects and compensatory mitigation for MRL construction activities lead to the completion of a Supplemental Environmental Impact Statement (SEIS) in 1998.

Since 1998, significant flood events have exposed critical seepage areas along the MRL, and subsequent engineering reviews have revealed numerous levee deficiencies that were not included in the 1998 SEIS.

USACE determined in March 2018 that a new SEIS would be required to address these additional items.

A Notice of Intent was issued in the Federal Register on 13 July 2018.
# Proposed Schedule MRL SEIS #2

<table>
<thead>
<tr>
<th>Milestone</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Notice of Intent Published</td>
<td>13 July 2018 (A)</td>
</tr>
<tr>
<td>Cooperating Agency Kick-off Meeting</td>
<td>30 Aug 2018 (A)</td>
</tr>
<tr>
<td>Public Scoping Meetings</td>
<td>10-13 Sept 2018</td>
</tr>
<tr>
<td>Public Scoping Period Ends</td>
<td>15 Oct 2018</td>
</tr>
<tr>
<td>Draft SEIS II Released for Public/Agency Review</td>
<td>January 2020</td>
</tr>
<tr>
<td>Final SEIS II Published &amp; Record of Decision Signed</td>
<td>July 2020</td>
</tr>
</tbody>
</table>
WE WANT TO HEAR FROM YOU

Comment period open until October 15, 2018

To comment tonight:
1. Publicly present
2. Provide to one of our three court reporters
3. Submit written comment

After tonight:
Written comments can be submitted via an email to:

MRL-SEIS-2@usace.army.mil

or by mail to:

U.S. Army Corps of Engineers
ATTN: CEMVN-PDC-UDC
167 North Main Street, Room B-202
Memphis, TN 38103-1894
## A21-2.6.2 Meeting Summary

### ATTENDANCE RECORD

**Date:** 12 September 2018

<table>
<thead>
<tr>
<th>Name</th>
<th>Organization</th>
<th>City</th>
<th>State</th>
<th>Zip</th>
<th>Email</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sara Krupa</td>
<td>LADNR</td>
<td>Baton Rouge, LA</td>
<td>70805</td>
<td></td>
<td></td>
</tr>
<tr>
<td>JFF Harris</td>
<td>LDNR</td>
<td>Baton Rouge, LA</td>
<td>70805</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brian Yarbrough</td>
<td>CERA</td>
<td>Baton Rouge, LA</td>
<td>70809</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Andrew Harrison Jr.</td>
<td>Harrison Law LLC</td>
<td>BZ</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Joey Turen</td>
<td>Ascension Parish</td>
<td>Gonzales, LA 70737</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>
U.S. Army Corps of Engineers

Public Scoping Meeting

Mississippi River & Tributaries Project,
Mississippi River Levees Supplemental
Environmental Impact Statement II

Date: September 12, 2018

Time: 7:00 p.m. – 9:00 p.m.

Location: Louisiana Department of
Environmental Quality, Room C111,
602 North 5th Street, Baton Rouge,
LA 70802

Host: U.S. Army Corps of Engineers,
New Orleans District

Reported by:

Katherine Curtis,
Certified Court Reporter
FACILITATOR: Alright, everybody; I think we’ll go ahead and get started. I’m going to try the try and true method. As soon as we begin, people will show up. I think we’ll go a little less formal than was originally planned. However, we do still want to provide all the information that we were going to and then give you time to comment. Overall, the focus is not on our presentation to you, but for us our focus is to turn the meeting over to you and get your comments, concerns and thoughts on the process. I’ll kind of get into that a little bit later. But if I can, I’d like to turn the floor over to Colonel Clancy for opening.

COLONEL CLANCY: Is there anybody in here who is not a government employee?

(Inaudible)

NEPA came along in 1970, the Environmental Impact Statement in 1976, supplement that in 1998, and now here we are; we’re about to supplement again. We have work to do on the Mississippi River levees. EIS is only concerning the Mississippi River levees.
Parameters as part of the EIS onto the work that needs to be done. We know there are sections of the levees that are deficient in height. There are sections of the levees that seep. Every time we have a flood, we discover new places that have problems. (Inaudible) the levee system on the last three couple of years, we’ll say since 2011. 2011 flood, the December of 2016 and the flood of this spring were three of the top 10 floods in the last 100 years. Every flood that brings us new surprises.

So, that’s really what we’re here to do. We’re supplementing for the second time the Environmental Impact Statement for Mississippi River levees. So, we, all three districts in the valley, can continue to work on, improve, maintain the system and bring it up to design standards.

So, I’m going to turn it over to some of our technical experts who are going to talk the specifics mixed in. Nick Simms is going to talk the specifics of what we’re planning to do on the levees and then Mark
Lahare will talk to you about the Environmental Compliance Act. And we’re here for you guys. Four folks in the room are non-(inaudible) employees. Please, if you have any questions, ask; that’s what we are here to do. Thank you.

**FACILITATOR:** Thank you, sir. Again, kind of our plan is to provide you with some information in the beginning with two short presentations. First, we’re going to have Mark Lahare talk the National Environmental Policy Act, and then we’ll follow that with Nick Simms on the Mississippi River and Tributaries Levee system itself, and then we’re going to turn it to you.

With concurrence with our speakers, unlike what we originally planned, if you have questions as we present to you, feel free to ask. I do ask though if you do ask a question or make a comment, please use a microphone because we do have court reporters that have to dictate everything we do, and we want to make sure we get everything accurately. And with that note, I’ll turn it to Mark.
MR. MARK LAHARE: Can everyone hear me okay?

Is this better or worse? It’s good? Okay.

Good evening, ladies and gentlemen. We appreciate everyone coming out tonight. My name is Mark Lahare. I am the National Environmental Policy Act Coordinator for the Mississippi River Levee Project for the New Orleans District.

Tonight, as was previously stated, we are here to discuss the preparation of the Second Supplemental Environmental Impact Statement for the Mississippi River levee feature of the Mississippi River and Tributaries Project. The purpose of the Second Supplemental Environmental Impact Statement is to address work items on the Mississippi River levee that were not originally addressed under the 1976 Mississippi River and Tributaries Environmental Impact Statement or the 1998 Supplemental Environmental Impact Statement.

A draft copy of the second supplement will be made available for public review and comment in early of January 2020.

The National Environmental Policy Act,
or NEPA, is the basic national charter for environmental compliance. One of the primary requirements of NEPA is that it directs federal agencies to rigorously evaluate the environmental impacts in any alternatives to any major federal actions that could significantly affect the quality of the human environment prior to making it in decisions.

Some of the tools through which this is accomplished are environmental (inaudible) or environmental impact statements. The overall goal of NEPA is to foster good decision making by federal agencies. And this is done through a collaborative process by working with and gathering input from federal, state and local resource agencies, federally recognized tribes, stakeholders, non-governmental organizations, interested parties and private citizens such as yourselves.

When a federal agency proposes to undertake a major federal action, one of the first requirements under NEPA is to publish a Notice of Intent in the Federal Register.
The Notice of Intent for the post project was published on Friday, July 13 of 2018. The Notice of Intent is primarily meant to provide brief background, historical information on the project, a brief overview of the action being proposed, any known significant issues or concerns associated with the project, and most importantly, and the reason we are here tonight, initiate the scoping process.

Just a side note, a web link to a copy of the Notice of Intent is available on our project website if you wish to download and review it.

So, as I said, the purpose of tonight’s meeting is to assist the Corps in identifying any significant resources, issues and concerns that you feel should be addressed in the Supplemental Environmental Impact Statement. Your input here tonight is a key asset to that process. The scoping meeting, and the one scheduled for tomorrow night at the Corps of Engineers New Orleans District headquarters building, is made to provide you with an opportunity to voice
your concerns, questions and comments on the proposed project.

So, some of the areas of consideration that may aid you in providing input to us are pertinent studies. For example, what environmental or socioeconomic studies do you think may be needed for the report. Also, are there any existing studies or pertinent information to the project that you feel should be incorporated in the report. Other topics such as significant resources, issues and concerns would be what are some of the major issues and concerns that should be analyzed. And similarly, what do you feel are the significant resources in the project area that warrant further consideration.

So, as you’re thinking about these topics tonight, please also consider how these may play a part in determining what types of alternatives should be evaluated in the report.

So, as you can see behind me, these are some of the resources within the project area that we have already identified as
being significant. Some of these are taken
from prior reports and prior studies. But it
is important to understand that this list is
in no way final. If you know of other
important resources, we ask you to please
voice those here tonight.

So, to wrap up tonight, we want to hear
from you. At the end of the overall
presentation, we will have a formal comment
period to receive oral comments on the
proposed study. And let me stress all
comments are important. And it is vital that
each of you provide your views and concerns
relative to the project. Alternatively, if
you would like to provide your written
comments as opposed to oral comments; you
may mail them to one of the individuals on
the comment cards; or you may email them to
the address listed on the contact card; or
you can detach the comment page listed as
public comment form from your handout and
hand them to any Corps personnel that is
present here tonight. We just request that
all comments associated with the scoping
process be dated no later than October 15,
Finally, before we move into the formal comment period of the meeting, I’d like to ask our Senior Project Manager, Mr. Nick Simms, to come up and discuss some of the specifics about the Mississippi River levee feature here and in the New Orleans District. Thank you.

MR. NICK SIMMS:

Thank you, Mark. Good evening. As Mark said, my name is Nick Simms. I’m the Senior Project Manager for the Mississippi River Levees in the New Orleans District Corps of Engineers.

Now, what Mark kind of went over with you is the main purpose of why we’re here. We want to hear from you; that is the main purpose of this meeting. What I’m going to go over is some background on the actual project and get into some of the specifics on the type of work that we’re actually going to do, go into some of the footprints, some of the impacts that you might see.

Now, one thing, and Mark said this but I’m going to reiterate it, nothing that we
have right now is set in stone. Nothing has
been finalized. Again, we want to get your
input and that is the main purpose of this
meeting.

So, first off, let’s go into a little
background. The Mississippi River Levee
Construction Project is a subset of the
overarching, what I call, mega project known
as the Mississippi River and Tributaries, or
MRT project. Now, the MRT project is one of
the nation’s most successful and
comprehensive projects. You see the numbers
here. It’s almost a 70 to 1 return on our
investment: one trillion in flood damages
prevented, 234 billion in flood damages
prevented in 2012 alone. So, very successful
project and it’s able to do this because
it’s part of an integrated system. And that
integrated system consists of channel
improvements, tributary improvements,
floodways and levees; which again, is the
main purpose of the supplement to the
Environmental Impact Statement and the main
reason that we’re here today.

So, the Mississippi River Levee
Construction Project consists of addressing height deficiencies and seepage concern along the main line of the Mississippi River. The Mainline Mississippi Levees run from Cape Girardeau, Missouri, down to Head of Pass, Louisiana. That’s roughly 1,600 miles of river and when you account from the East and West Bank, that’s about 2,200 miles of actual levee.

The purpose of the project is again seepage control and address height deficiencies. We want to build these levees up to what’s known as the Congressionally Authorized Height to convey what’s known as the project of design flood. Essentially, we want to keep the water within the banks of the Mississippi River. In a nutshell, that’s what the project is trying to do.

Now, the project right now is approximately 79 percent complete. There’s still about 500 miles of deficient levees. The project as it stands is capable of passing historic floods. We’ve seen it 2011 and in 2016. But until it is completed, the project cannot pass that Project Design
Flood. So, that is why we still have to go out there and do this additional work, to raise those 500 miles of additional levees. And again, that is the purpose of this supplement to the Environmental Impact Statement.

So, I mentioned the project design flow. I won’t spend too much time on this slide, but you can see here some of the flow rates that we’ve seen in specific events. Again, the project can pass historic floods. As you see here looking toward the middle of Baton Rouge in 2011, right at 1.4 CFS when the Project Design Flood is 1.5. So, again, the project is capable of passing it, but without significant flood (inaudible) we can’t pass that PDF until we get the rest of this work completed.

So, what you see here is a map of the levees in the New Orleans District, and this shows the areas that we currently have identified as height deficiencies and seepage deficiencies. I know it’s kind of hard to see but the red, those are height deficiencies, and the blue areas are the
seepage deficiencies. So, this is the work
that will be specified in the EIS. What
we’re going to do in these specific areas,
the footprints that we’re going to impact,
what type of work will be there. So, looking
at this map, it might be a little alarming.
It looks like none of the levees have been
worked on, but that’s certainly not the
case. Colonel mentioned this, work has been
going on for years on this project, had the
1976 EIS, supplement in 1998. What those
documents covered and what the Corps has
been working on since then is addressing the
most deficient areas and the most critical
seepage areas. So, the majority of the
deficiencies that you see here are about one
to two foot. So, it’s not as bad as it seems
when you look at this map because again the
most critical areas either have been or are
currently being addressed.

You saw the areas that are deficient
and the seepage areas. So, what type of work
will we be doing with this project that will
be documented in the Environmental Impact
Statement Supplement? Well, again, height
deficiencies and seepage deficiencies. To deal with height deficiencies, there’s really two ways to fix that. You’ve got levee enlargements or flood walls. Here, you see levee enlargements. I’m sure everyone is familiar with this. You build the levee up to, again, that Congressionally Authorized Height to convey the Project Design Flood.

The types of impacts that you’re looking at with this type of work, well, if you go up you have to go out, also. So, you could increase the footprint of the levee. It could have some impacts associated with that. In addition, you have to have the dirt or the borrow to go in and do that actual lift. So, wherever you get that borrow from you could have impact in that area, also.

The second way to address the height deficiency is a flood wall. This is more for urban areas where, again, you can’t go out because you might be confined by buildings in the area, so you put a flood wall there. The impacts are not nearly as much as the levee enlargement. You’re pretty much staying within the existing footprint, but
you could have other impacts: noise, things like that, anything associated with an urban environment. But this is the second way that we will look to address the height deficiencies with the project.

So, that covers the height deficiencies. Now, we have the seepage concerns. So, when we have a flood event the water comes up, puts pressure on the levees and you can see underseepage come through. That seepage can come through at the toe of the levee. It starts to move material. You could even have a levee failure. So, that’s why that has to be addressed. Three main ways to address that: that’s through seepage berms, relief wells or sheet pile cut-off walls. Here, you see the seepage berm very similar to the levee enlargement and what the impacts are. What you’re doing here is you’re building a berm out on a levee toe and essentially putting weight down to push that seepage out away from the toe, so you don’t get that material moving. Impacts associated with seepage berm is similar to the levee lifts. You’re expanding the
footprint; you’re going out and then wherever you get the dirt from you’re also going to have impacts associated with that.

Next way to address the seepage is through relief wells. As the name implies you are relieving the pressure here. Basically, you’re drilling a well down and you could have a controlled flow to help alleviate that seepage. The impacts with this are not as much with the actual well as they are typically drilled within the existing footprint, but that water has to go somewhere. If the existing drainage system cannot hold that water, we might have to make some drainage improvements that could expand the impact, expand the footprint and you could have some impacts associated with that, also.

And the third way to address the seepage is through a sheet pile cut-off wall. This is essentially a flood wall in reverse. You’re just going down and, as the name implies, cutting off the seepage. Impacts with this are pretty minor for the most part because, again, you’re staying
within the existing footprint. You could have the need for some minimal borrow to come put behind this wall, but the impacts with this are pretty much pretty minor.

Okay, and this last slide, again, we’ve mentioned it but history of the NEPA on the Mississippi River levee’s original Environmental Impact Statement was completed in 1976 and then the supplement in 1998. And here we are today with the second supplement to address the remaining work that we’ve identified.

In 1998, you see the number of items, the number of miles, seepage control constructions that we did. And it’s important, again, I want to really impress on you that this just identifies the most critical areas, the critical deficiencies, the critical seepage areas. You look here at the New Orleans District, you see only 12 items. That’s a little misleading. One of these items was a levee enlargement that spanned the entire region of Jefferson Parish. But again, the purpose of this is to address those most critical items. And as
you saw on the previous map, the other items
that we’ve identified, while they are
important, the deficiencies there are not
nearly as high as these are.

Schedule for the SEIS number two, as
Mark mentioned, Notice of Intent was
published in July. We had the cooperating
agency meeting kick-off about two weeks ago;
we’ve had the public scoping meetings today
and the previous nights and we have one more
tomorrow in New Orleans. And then, as Mark
mentioned, the scoping period will end on
October 15, and we’re looking to have a
draft document in January of 2020 and the
final in July of 2020.

Alright, so that ends my portion of the
presentation. Again, as we tried to relay to
you we really want to hear from you, get
your comments. So, Ricky, I’ll turn it back
over to you.

**FACILITATOR:** So, this is where we would turn
it over to you for comments. And it doesn’t
have to be comment tonight. There is
opportunity to comment up to October 15.
Tonight, if you don’t want to say it in
front of us we do have court reporters
outside as well as up front. Or you can
write a comment and send it to, or provide
it to, any Corps person here, and we’ll make
sure that it gets in the record. So, I ask
that if you have any questions, comments,
caveat for any questions we may not have the
answer, we’re very early, we’re kind of at
the kick-off of the marathon, and so we’ll
try to answer anything you have. If you have
any complaints, like that you’ve got a bone
to pick with Mark, I’ll allow that too. So,
I turn it to you guys. Does anybody have any
questions, thoughts? I really do thank you
guys for coming in.

**MR. BRIAN WASBURG:** I have a question. For
the record I do work with geologists for
CPRA; however, I am here under my own
volition tonight as a private citizen. I
find Mississippi River issues fascinating.
And one of the things I have always had a
question about are the seepage wells, the
relief wells that you had up earlier, Nick.
Is there any resource that you know of that
lists the number of, total number of relief
wells in a district or in any subdivision of that district by parish? Has there ever been any calculations of how much water goes out?

**MR. NICK SIMMS:** Well, the first part of the question, just the number of relief wells per district, I know we do have that, and we’ve actually have been going through that, documenting how many relief wells there are. As far as the flows that each of them put out, I am unaware of that, but we can check on that. I don’t know. Mark, are you aware of anything like that?

**MR. MARK LAHARE:** There’s no database that I know of.

**MR. NICK SIMMS:** Yeah, I know we know the number of wells, but as far as that data, it seems like something we may have. So, we can certainly check on that.

**MR. BRIAN WASBURG:** And I would assume that those, they can’t be more that 100 feet deep. Do you happen to know off hand what the depth of those wells are?

**MR. NICK SIMMS:** It varies. Some go 50 feet, some go 75. It really just depends on how deep that seepage is. That is really what
guides it.

**MR. BRIAN WASBURG**: Is there any thought
given to modeling, I guess, the surface run-
off of that? Because I’ve seen pretty
significant, just about 30 miles north of
here, 25 miles north of here on Pointe
Coupee on the West Bank, there’s a big run-
up. I drove past it for 15 years, 20 years,
as long as they’ve been there. And I notice
that there are often issues with the amount
of water in the ditch. And you know, just
relieving that water and making sure there’s
a proper place for it to go is probably the
biggest concern that I have about that, if I
had one to mention.

I do appreciate the mechanics of it and
what it does. That’s just one thing I’ve
always wanted to know.

**MR. NICK SIMMS**: And that is one of the
biggest concerns we have with it, too. Like
I mentioned, that water has to go somewhere.
So, we do, do the analysis; do, do the
modeling to see if the existing drainage can
handle the increase in flows. If it can’t,
then we will go in and do some improvements,
or we may even look to pump it back over the river. We’ve done that, or over the levee and back into the river; we’ve done that in certain cases also.

But yeah, that’s certainly a part of the analysis and any relief wells that are installed. We actually have another project in that area, I mean, just north of the region you’re referring to. And that’s what we’re going through right now is looking at the modeling to see where the water will go, to see how much can stay in there.

UNKNOWN SPEAKER: Nick, why don’t you speak to who is the responsible party to facilitate that drainage where we accept that water.

MR. NICK SIMMS: Yeah, that’s a good point. So, once we do turn over the project, it is on the local sponsor, which would be the levee district and that, to keep the drainage areas clean, to keep them unobstructed so that water can keep going through. There have been times, I mean, you get the trash and the dirt in there. It can clog up the systems, which kind of lead to
some of the problems that you were talking
about.

UNKNOWN SPEAKER: And then one other thing
I’ll add, is you asked about flow rates.
Flow rates are going to vary per location of
each well.
(Overlap in speakers)

MR. BRIAN WASBURG: I was just wondering if
there had been some, it seems to me there
are estimates of how much water you’re going
to need to move. There’s an estimate
somewhere of how much water is coming out of
those wells.

UNKNOWN SPEAKER: Yeah, we typically have
that. And some of the levee districts
actually keep a running tally of how much
flow is coming out of each wells per minute.

MR. BRIAN WASBURG: I’d be very interested in
looking at that information because I’ve
made some back-of-the-envelope calculations
on what I think it is, but I can talk to
y’all about it offline. Thanks for answering
the question that I had.

FACILITATOR: Do we have any other comments,
questions? I don’t want to keep anybody
longer than we do. But we will be standing around for a little while if you have any questions you want to just sit here and discuss. But unless there’s any objection I’ll go ahead and close the meeting. And if anything comes up later, feel free, we definitely urge you to send in email, by mail or anything like that. Feel free to join us tomorrow.
CERTIFICATE

I, Katherine McCartney Curtis, Certified Court Reporter, do hereby certify that the foregoing transcription of an audio recording was prepared and transcribed by me and is a true and correct transcript to the best of my ability and understanding; that the transcript has been prepared in compliance with transcript formal guidelines required by statute or by rules of the board or by the Supreme Court of Louisiana, and that I am not related to counsel or to the parties herein nor am I otherwise interested in the outcome of the matter.

______________________________________________________________
MR&T MISSISSIPPI RIVER LEVEES
SUPPLEMENTAL ENVIRONMENTAL IMPACT
STATEMENT (SEIS) II
PUBLIC SCOPING MEETING

Colonel Michael N. Clancy

Nick Sims
Senior Project Manager, New Orleans District

Mark Lahare
NEPA Coordinator, New Orleans District

New Orleans, LA
13 September 2018

“The views, opinions and findings contained in this report are those of the authors(s) and should not be construed as an official Department of the Army position, policy or decision, unless so designated by other official documentation.”
I. Welcome and meeting format

II. National Environmental Policy Act and Supplemental Environmental Impact Statement II

III. Mississippi River and Tributaries levee system

IV. Public Comment
National Environmental Policy Act (NEPA)

• Basic National Charter for Environmental Protection
• Provides Environmental Information to Public
• Ultimate Goal – Foster Good Decisions
NOTICE OF INTENT

• Notice of Intent

• 13 July 2018

• Scoping
Scoping Purpose and Importance

- Determine Scope of Significant Issues and Concerns
- Eliminate Issues that are Not Significant
Scoping Considerations

- Pertinent Studies
- Significant Resources
- Issues/Concerns
- Alternative Plans
Significant Resources

- Terrestrial Habitat
- Wetlands
- Water Quality
- Waterfowl

- Aquatic Resources
- Cultural Resources
- Endangered Species
- Agricultural Lands
WE WANT TO HEAR FROM YOU

• Oral Comments

• Written comments may be sent to one of the individuals on the handout, given to us tonight, or e-mailed to:

  MRL-SEIS-2@usace.army.mil
Mississippi River and Tributaries Project

An Integrated System

- Consists of measures to
  - Reduce Flood Risk
  - Facilitate Navigation
  - Restore Damaged Ecosystems
- One of the Nations most comprehensive and successful Civil Works Projects
  - $15.5 billion invested
  - $1 Trillion in flood damages prevented
  - $234 billion in flood damages prevented in 2011
  - 66.9 to 1 return on investment
  - 4 million people protected
Mississippi River Levees

The Mainline Mississippi River Levee System (MRL) extends from Cape Girardeau, MO to Head of Passes, LA and is approximately 1,610 miles in length.

Project goal is to pass the Project Design Flood (PDF) and address seepage concerns

Construction is approximately 79% complete. Assessment and maintenance will be required to ensure the integrity of the MRL after the project is completed.

In November 2017, USACE completed an engineering evaluation for authorized remaining work needed to complete the MRL. The evaluation addressed overtopping, seepage, slope stability, and floodwall stability.
## Mississippi River Levees

<table>
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<tr>
<th>Station</th>
<th>2011</th>
<th>1927&lt;sup&gt;6/&lt;/sup&gt;</th>
<th>1937&lt;sup&gt;5/&lt;/sup&gt;</th>
<th>1973</th>
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**C**: Peak Discharge, Provisional
1/ Discharge Range at Hickman, KY
2/ Total Confluence Flow of 1,936,000 cfs measured at approximate mile 550.8 at 1400 CDT 5/02/2011 near Wickliffe, KY, prior to operation of Birds Point-New Madrid
3/ Peak Flow Measured 4 May 2011 = 1,730,000 cfs at Hickman plus 370,000 cfs flow through Birds Point-New Madrid Floodway
4/ Includes flow through Birds Point-New Madrid Floodway
5/ Project Design Flood (PDF) provides design flows for MR&T project. Prior to 2011 Flood, MR&T Project was 85% complete. 2011 Flood Flows ~ 80-85% of MR&T PDF Flows.
6/ Reference - "Annual Maximum, Minimum, and Mean Discharges of the Mississippi River and Its Outlets and Tributaries to 1953"
7/ Wax Lake Outlet was constructed from 1937-1942. Prior to that, Lower Atchafalaya River was the major outlet.
8/ New Orleans Mean Daily Flow Measured at Belle Chasse in 2011, Readings at this site are tidally influenced. An instantaneous measurement of 1,320,000 cfs was made on 17 May 2012

Revised 27 Jan 2012
Levee enlargements are conducted in locations where the existing levee is not at the authorized grade. Depending on the location of the project, these raises may occur on the landside, riverside, or straddle the existing levee section.
Urban areas typically require floodwalls rather than levees to reduce impacts to residences and businesses. These floodwalls can have stability concerns or height deficiencies that must be addressed.
Seepage berms are constructed on the landside of the levee using impervious soils to reinforce existing top stratum and to reduce underseepage pressure near the toe of the levee. Upon construction, berms are turfed and mowed to prevent erosion or encroachment of undesired vegetation.
Relief wells are vertically installed wells consisting of a well screen surrounded by a filter material designed to prevent in-wash of foundation materials into the well. Relief wells intercept underseepage and provide a controlled outlet for the water while minimizing material transport underneath the levee.
Sheet pile cutoff is installed in the levee section to a determined depth to cutoff seepage through any shallow pervious layer and to cutoff seepage through the levee embankment. Upon completion, sheet pile is buried in the levee section.
Mississippi River Levees NEPA History

As required by the National Environmental Policy Act (NEPA), an Environmental Impact Statement (EIS) was completed in 1976.

In the 1990’s, concerns about the environmental effects and compensatory mitigation for MRL construction activities lead to the completion of a Supplemental Environmental Impact Statement (SEIS) in 1998.

Since 1998, significant flood events have exposed critical seepage areas along the MRL, and subsequent engineering reviews have revealed numerous levee deficiencies that were not included in the 1998 SEIS.

USACE determined in March 2018 that a new SEIS would be required to address these additional items.

A Notice of Intent was issued in the Federal Register on 13 July 2018.
# Proposed Schedule MRL SEIS #2

<table>
<thead>
<tr>
<th>Milestone</th>
<th>Date</th>
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<tr>
<td>Notice of Intent Published</td>
<td>13 July 2018 (A)</td>
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<tr>
<td>Cooperating Agency Kick-off Meeting</td>
<td>30 Aug 2018 (A)</td>
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<tr>
<td>Public Scoping Meetings</td>
<td>10-13 Sept 2018</td>
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<td>Public Scoping Period Ends</td>
<td>15 Oct 2018</td>
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<tr>
<td>Draft SEIS II Released for Public/Agency Review</td>
<td>January 2020</td>
</tr>
<tr>
<td>Final SEIS II Published &amp; Record of Decision Signed</td>
<td>July 2020</td>
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Comment period open until October 15, 2018

To comment tonight:
1. Publicly present
2. Provide to one of our three court reporters
3. Submit written comment

After tonight:
Written comments can be submitted via an email to:
MRL-SEIS-2@usace.army.mil

or by mail to:
U.S. Army Corps of Engineers
ATTN: CEMVN-PDC-UDC
167 North Main Street, Room B-202
Memphis, TN 38103-1894
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UNITED STATES ARMY CORPS OF ENGINEER
PUBLIC MEETING ON SUPPLEMENTAL EIS TO ADDRESS
MISSISSIPPI RIVER AND TRIBUTARIES PROJECT,
MISSISSIPPI RIVER LEVEES SUPPLEMENTAL ENVIRONMENTAL
IMPACT STATEMENT II

Public Scoping Meeting held on Thursday
September 13, 2018 at 7:00 p.m - 9:00 p.m. at the
United States Corps of Engineers, New Orleans District
Headquarters, located in the District Assembly Room,
7400 Leake Avenue, New Orleans, Louisiana, 70118.

REPORTED BY:

Tammy LeBlanc Joseph
Certified Court Reporter
MR. BOYETTE:

Thank you everyone. Welcome to the New Orleans District. We appreciate you coming out tonight. I see a lot of familiar faces. So, tonight is the scoping meeting and with it being a scoping meeting, our primary focus is to hear from you. We are looking for your comments, your concerns, your issues, your thoughts as we progress with the second supplemental environmental impact statement for the Mississippi River Levees.

As a, kind of an effort to make sure that we give quite a few options for providing those comments, you have multiple ways tonight that you will be able to provide. One, we do have certified court reporters that you can, at any time during the meeting, deliver your statement, dictate your statement to them. As well as, we'll have a, what I will call, a public comment portion where you would be able to present your comments to the audience or to the speakers, to us. Everything that is said tonight will be recorded by a dedicated certified court reporter.
However, we do understand that it is not always the most eager, or everybody is not always the most eager to present publically. At the front of the door we have, I'm going to call it, a comment packet that kind of outlines what we are here tonight for as well as the back page is a written comment section and you can always fill that out, provide to anyone here that works for the Corp and we will make sure that it gets in the right place.

So, those are kind of the options that will be available to you throughout the night. We will have a few presentations to start the meeting with and then we will go into the session. I'll kind of go over that a little bit more in a moment but right now I would like to turn the floor over to Colonel Michael Clancy.

**COLONEL CLANCY:**

All right. Hey, good evening everyone. I'm Colonel Mike Clancy. I'm the New Orleans District Engineer. So, we are here tonight to public meetings. Explain to the public what we are up to, to comply with the National Environmental Policy Act in a major federal action that requires an update of NEPA
So, this year, in 2018, we are celebrating the 300th anniversary of New Orleans. We've been at work on the levees in New Orleans, in particular, for 300 years. So, it's kind of a never-ending process.

The Corp got heavily involved in the Mississippi River levees after the '27 flood with the Flood Control Act of 1928 created the Mississippi River and Tributaries System. There are many components of the MR&T, the levees, spillways, the Bonnet Carre, Morganza, Channel Improvement works, other work up river, working in the Atchafalaya.

The EIS, the original EIS for the MR&T system for the Mississippi River levees was done in 1976. We worked for years under that. First supplement was done in 1998 and all the work we've done since '98 has fallen under that supplement. We are now at the point where we see the need for additional work. We will explain what that work is. We are still in the process of developing that but a combination of levee lifts to get the levees to the right designed height or seepage work. It could be cutoff
walls, bermed. Again, we will have Nick Sims, our project manager, explain some of the work we are proposing to do.

So, this is supplement number two to the Mississippi River levee EIS. For this EIS we are not working anything with the Atchafalaya, anything with the spillways, work control manuals, none of that. It's really just the Mississippi River levees.

The levees work as a system so this is a three district efforts from Memphis, Vicksburg and New Orleans district, all working together. Basically, the same design criteria for the levees up and down the river. So, this one supplement will cover all three districts and the work we are proposing to do.

I do want assure everybody that the levees are in good shape. The levee maintenance, levee work is a never ending process. Like I said, we have been at it for 300 years. We will be at it as long as humans live on the Mississippi River to help defend us against the annual flood of the river. We are going to have to do work. We acknowledge that there will be some environmental consequences and that's what
this meeting is all about. To get your input on your concerns, how you'd like us to scope this EIS.

With that, I will turn over to some of our more technical experts who can explain exactly the work we are proposing and then how the EIS supplement process will work and how the public can get involved. I think I'll be followed by Nick, huh?

MR. SIMS:
No, Mark actually.

COLONEL CLANCY:
Or Mark, okay.

MR. BOYETTE:
So, before we get to Mark, just a little, if you want to ahead and show it, by all means. Just want to give you an idea of what we are looking at tonight. Mark will deliver a presentation on the NEPA section followed by Chris -- Nick. Why am I calling you Chris Sims lately?

MR. SIMS:
(Inaudible)

MR. BOYETTE:
I know but I've been seeing your
e-mails -- followed by Nick to discuss the actual levee system themselves, what we are planning, and then we will turn it over to the public comment section where we will take your comments. I will say, we are open to questions and we will answer them in the best we can but I do want to caveat that we are very early. If this is a marathon, we are at the starter gun. And we are very early so we may not have the answers to your questions but if we do, we will definitely share. So, that this time I would like to turn it over to Mark.

MR. LAHARE:
Thank you, Ricky. Can everyone hear me okay?

(Affirmative response.)

MR. LAHARE:
All right. Good evening ladies and gentlemen. We appreciate everyone coming out tonight. My name is Mark Lahare. I am the National Environmental Policy Act Coordinator for the Mississippi River Levee Project here in the New Orleans district.

Tonight, we are here to discuss the preparation of the second supplemental
environmental statement for the Mississippi River Levee feature of the Mississippi River & Tributaries Project.

The purpose of the second supplemental environmental impact statement is to address work on the Mississippi River Levee feature that has not been previously addressed under the original 1976 Environmental Impact Statement or the 1998 Supplemental Environmental Impact Statement. A draft copy of the supplement will be made available for public review and comment in early January 2020.

The National Environmental Policy Act or NEPA is the basic national charter for environmental protection. One of the primary requirements of NEPA is that it directs federal agencies to rigorously evaluate the environmental impacts and any alternatives to any major federal action that could significantly affect the quality of human environment prior to making decisions.

Some of the tools for which this is accomplished are environmental assessments or Environmental Impact Statements. The overall goal of NEPA is to foster good decision making by
federal agencies. And this is done through a collaborative process by working with and gathering input from federal, state, and local resource agencies, stakeholders, federally recognized tribes, non-governmental organizations, interested parties and private citizens such as yourselves.

So, when a federal agency proposes to undertake a major federal action, one of the first requirements under NEPA is to publish a notice of intent in the federal register. The notice of intent for the proposed project was published on Friday, July 13, 2018. The notice of intent is primarily meant to provide background historical information to the project; a brief overview of the action being proposed; any known significant issues or concerns associated with the project; and most importantly and the reason we are here tonight, to initiate the scoping process. Just a side note, a web-link to a copy of the notice of intent is available on our project website if you wish to download and review it.

So, the purpose of tonight's meeting is to assist the Corp in identifying any significant
resources, issues and concerns that you feel should be addressed in the Supplemental Environmental Impact Statement. Your input here tonight is a key asset to that process. This scoping meeting is meant to provide you with an opportunity to voice your concerns, opinions, and comments on the proposed project.

So, some of the areas of consideration that may aid you and provide you input here tonight are, things such as pertinent studies, for example, what environmental or social economic studies do you think may be needed. Also, are there any existing studies or relative information to the project that you feel should be incorporated into the report? Other topics such as significant resources, issues and concerns would be: What are some of the major issues and concerns that should be analyzed in a report and similarly, what do you feel are the significant resources in the project area that warrant further consideration? So, as you are thinking about those topics tonight, please also consider how those may play a part in determining what types of alternative should be evaluated in the report.
As you can see behind me, these are some of the resources within the project area that we have identified as being significant. Some are taken from prior reports and previous studies but it is important to note that this list is in no way final. If you know of other resources, we ask that you please voice those here tonight. So, tonight we want to hear from you.

At the end of the overall presentation, we will have a formal comment period to receive oral comments on the proposed subject. Let me stress that all comments are important and it is vital that each of you provide your views and concerns relative to this project.

Alternatively, if you wish to provide written comments, you may mail them to one of the individuals on the contact cards in your handout, email them to the address listed on the contact card in your handout or you can detach the last two pages titled "Public Comment Form" and you can present them to any Corp personnel here tonight. We just request that all comments associated with the scoping process be dated no later than October 15, 2018.
Finally, before we move into the formal comment period of the meeting, I'd like to ask our Senior Project Manager, Mr. Nick Sims, to come up and discuss some of the specifics about the Mississippi River Levee feature here in the New Orleans District. Thank You.

MR. SIMS:

All right. Thank you, Mark. Good evening. My name is Nick Sims. I'm the Senior Project Manager for the Mississippi River Levee Construction Project here in New Orleans.

As Mark said, he just went over the NEPA scoping process for the Mississippi River Levee Construction Project. That is the main purpose of this meeting. We want to hear from you. Your input is critical to the update to the Supplemental Impact Statement.

What I'm going to go over is a little project background on the project and highlight some of the actual construction methods that we are going to use. Give you an idea of what types of impacts we might see with those construction methods.

Now, I'll reiterate it. Ricky said it, Mark said it. Nothing is set in stone at this
point. Nothing is finalized. We do want to hear from you. You are an important piece of this process.

So, first, I'll go into a little background and the Colonel touched on a majority of this but the Mississippi River Levee Construction Project is a subset of the overarching, what I'll call mega-project known as the Mississippi River & Tributaries Project. Now, this is one of the most comprehensive and successful civil works projects in the nation.

After the flood of 1927, the Flood Control Act of 1928, authorized the project to provide flood control and navigation to the lower Mississippi Valley. I mentioned it is one of most successful projects. You can see the numbers here on the slide. Over one trillion in flood damages prevented. In the 2011 flood, over two hundred and thirty four billion in damages prevented. Almost a seventy to one return on the investment. You would hard pressed to get those types of numbers on other projects. So, again, a very successful project and the reason it's so successful is because it acts an integrated system. And that system consists of channel
stabilization, tributary improvements, flood ways and levees which again, is the main purpose of this meeting today, The Mississippi River Levee Construction Project.

So, The Mississippi River Levee Construction Project looks to address height deficiencies and seepage concerns along the main stem Mississippi River levees coming from Cape Girardeau, Missouri down to Head of Passes, Louisiana. That is roughly 1600 miles up the Mississippi and when you take into account the east and Westbank, you are looking at roughly 2200 miles of levee.

The goal of the project, again, is to address seepage concerns and pass what's known as the "Project Design Flood". In its simplest terms, we are trying to build up these levees to keep the Mississippi River within their banks. The project is approximately 77% complete at this time and we still have about 500 miles of deficient levees. Now, as it stands, the project, Colonel mentioned, the levees are in good shape. The project can pass record floods which we have seen in 2011 and to a lesser extent 2016, but until the project is completed, we
cannot pass that "Project Design Flood". So, that is the reason we need to do this additional work. That is the reason we are here today to do this supplement to the Environmental Impact Statement.

I mentioned the "Project Design Flood". This table here kind of just shows you some flows that we have seen in different events. Look down here in New Orleans. In 2011, 1.2 million CSF, 1.23, the "Project Design Flood" is 1.25. So, again, the levees are in good shape. They can pass record floods but we do need to finish the project so we can pass that "Project Design Flood" if it ever comes.

So, this is a map of the levees within the New Orleans District. The red that you see here are the levees that are deficient. The blue dots, it's probably hard for you to see, but, those are the seepage concerns that we are currently tracking. So, these levee deficiencies and these seepage concerns, the work that will be done is what will be put into this Environment Impact Statement. We will go into more detail about the actual fixes that we will have for each of these projects.
You look at this map, it might look a little alarming. I know it shows a lot of the levee in red but that's really not the case. Again, the Colonel said it. The levees are in good shape. We have passed record floods. We have been doing work on this project for years now.

The work that was covered under previous environmental documents was really to address the most critically deficient areas. That work has either been completed or is ongoing. These areas that you see here, the majority of them, it's one to two foot deficiencies, a lot are even less than a foot. There are some that are more but for the most part, the most critically deficient areas have been addressed. But again, we have to address everything to complete the project, to pass that "Project Design Flood".

So, you see the areas that are deficient. I told you we have to go work on them. How will we do that work? Well, for height deficiencies, there's only two ways to address that: Levee enlargements or flood walls. Here you see the levee enlargement. It is pretty
self-explanatory. You are building up, adding material to the levee to bring it to that congressionally authorized height to pass the "Project Design Flood".

The impacts that you are looking at with this type of work, you will expand the footprint. If you go up, obviously, you have to go out. So, the footprint will expand with this type of work and you need the dirt or the barrow to that enlargement. So, where you get the dirt from, you could have some impacts with that.

The second way to address a height deficiency is a flood wall. Again, self-explanatory. But this is more of in urban area. The picture you see here is at Dumaine Street in the French Quarter. Where you can't go up and out because of houses or other buildings, you can go up with flood wall. The impacts associated with this, there less than what you would see with an enlargement but you do have other impacts. Noise, things associated with an urban environment but for the most part its much less than what you would see with the levee enlargement. So, that is how you address the height deficiencies.
Next, we will look at the seepage concerns. Just a quick run down. The river, when it comes up, is putting pressure there on the levees and you can have seepage. The water will come through under the levee, come up at levee toe, could possible move some material and you could be looking at a levee failure. So, to address that there's really three ways that we look at: Seepage berms, relief wells, or sheet pile cutoff.

The first one we are going to look at is seepage berm. Very similar to the height, to the levee enlargement that I mentioned except for you are going out with a berm. The goal here with here is you are trying to put some weight down there on the toe to push that seepage away from the toe, get it away so you don't see that movement in material. As far as the impacts associated with this type of work, very similar to the enlargement. You are going out so you're expanding the footprint and you have to get the barrow from a source. So, again, you might have associated with that.

The second type of seepage concerns are relief wells. As the name implies, you are
relieving the pressure of seepage. Essentially, you are drilling down, drilling a well and that allows for controlled flow of the seepage as it comes through. The actual drilling of the well itself, the impacts, they are particularly within the existing footprint, but that water has to go somewhere. If the existing drainage cannot handle the water that comes out, then we might have to expand the footprint to look at that.

And the third way to address seepage is a sheet pile cutoff. Essentially, it's a flood wall in reverse. You are going down at the levee toe and cutting off that seepage. You see here from the picture, impacts associated with this. Again, similar to the flood wall, you are within the existing footprint so you are not really expanding that. But you could have, you might need minimal barrow to put behind the sheet pile for stability so you could have some impasse associated with that.

So, a brief history. Again, the Colonel touched on this. The original EIS for this project was completed in 1976. It was then updated in 1998. The majority of that work, as I mentioned earlier, was to address the most
critical deficiencies. You see the number of
items here. In New Orleans, twelve items. Less
than some of the other districts but that number
is a little misleading. One of those items was a
levee lift that we did the entire reach of
Jefferson Parish that we are just finishing up
right now. There was a critical deficiency. We
got out there and did the work. There is work
ongoing still but that was really the focus of
these previous documents. Again, to address
those critical deficiencies.

And the need for the update now is
again, those 500 miles that we are seeing of
deficient levee and the seepage concerns. That's
what we will look at and that is what we will
outline in this upcoming NEPA document.

The schedule for the Supplemental
Environmental Impact Statement, Mark mentioned
Notice of Intent was published on 13 July. We
had a cooperating agency kick off meeting about
two weeks ago. Public scoping meetings, had one
in Memphis and Vicksburg earlier in the week.
Last night we were in Baton Rouge and today we
are here in New Orleans. The public scoping
period will end on October 15th and we look to
have a draft document in January of 2020 and the

So, that's the background and a little
explanation of the type of work that we are going
to be doing. But again, the focus of this
meeting is to hear from you. So, I'll turn it
back over to Ricky but that's what -- we want
your comments. We want to hear what you have to
say. We want you to be a part of this process.

MR. BOYETTE:

Thanks, Nick. Again, to reiterate, the
most important thing that we can do tonight is to
get your comments, your feedback. We want to
develop what we would consider a well informed
and appropriate processing document. There may
be things that we already do know but there may
be that one thing that we do not know or we are
not looking at and that is what we need from you
guys.

So, at this time, I'd be happy to turn
it over to you if anybody has any questions or
comments they would like to present. I will ask
if anybody does want to comment, please use the
microphone. Only because it will help with
clarity in our dictation/transcript.
MR. ROTA:

Thank you. My name is Matt Rota. I'm with the Gulf Restoration Network. And first of all, you know, we are going to be submitting more detailed comments as we go on but there are some questions.

First of all, the announcement was very light on information. Like not even like what was happening here. So, some of my comments might be out of the scope but I don't necessarily think they should be. You know, our relationship here with the levees is complex here in New Orleans. Right? We need them because they are protecting us. If we didn't have them, New Orleans wouldn't be here but also levees are one of the drivers for the coastal land laws crisis we are seeing today.

So, it's something very important. So, there are a few things that I wanted to touch on to make sure I would like to see in this, I think it's a real good opportunity, to maybe look beyond just sheet piling and protection from seepage and things like that. But first and foremost, I do want to make sure that no wetlands are impacted whenever barrow is being seeped for
lifts or for lengthening the toe and all that. Even during the hydrous New Orleans Alternative NEPA process, the Corp ended up not using wetlands for barrow and I think that is important practice. That should continue with project as well.

Also, I want to make sure no additional wetlands are enclosed by levees if any additional levees or alterations to levees are planned because as we know, the wetlands are one of our lines of defense and enclosing wetlands basically ends up killing them very often. Further, we think this an opportunity to look at the old river control structure. It is, you know, from many accounts, held together by spit and baling wire, probably a little bit more than that but it is something to be looked at. There is, look at the shoaling around there and also, looking that the 70/30 split of what water is going down the Mississippi River. What water is going down the Atchafalaya and when that is happening and also what quantity of releases are happening. Because the Atchafalaya Basin, not like a lot of the coast, is actually accreting a lot in sediment. Sedimentation is a big problem for the
crawfishermen down there and for the echo system that's down there. And so, opening the older control structure a little slower and allowing the water to come down but not as much sediment. So, I think this a great opportunity for sediment management.

Speaking of sediment management, also dredging is a huge concern and shoaling is a huge concern both for navigation. We need to make sure that the channel is deep enough for navigation interests and also so that sediment is used beneficially. And so, I think that this is an excellent opportunity to enshrine the idea of a beneficial use of sediment.

Right now the Corp goes through a cost benefit analysis and very often says it is not a benefit to use the stuff that we are dredging or we use dredges that just pick up the sediment and send it further down the river. And this is an opportunity to really look at how we are dredging the river and making sure that we are beneficially using all that sediment and not just pushing it down the river or putting it in places where is not necessarily needed.

We assume that there is going to be
some wetland mitigation during this process and we want to make sure that any wetland mitigation that needs to happen is minimized and then -- so the wetland impacts are minimized and then also that we make sure that mitigation happens near where the impact is to restore the wetland impact. So, a kind of a prime example of this would be an Atchafalaya Basin. Right now we are seeing projects that are being mitigated. You know, cypress tupelo swamp damage is being mitigated in bottomland hardwood that is no where near the impasse and isn't replacing the function. So, we want to make sure that all functions, especially in the Atchafalaya Basin, are restored and replaced. And again, it is absolutely vital for the Basin and for the Mississippi River and Tributaries Project.

Let's see. Another thing is, with mitigation, is making sure that mitigation is concurrent with the project. Projects time and time again, this is where we don't think the Corp did do a good job with the Mississippi or the New Orleans levee projects, the hydrous project where mitigation got put off well after all the construction and mitigation should be concurrent.
with construction to make sure that we are not losing temporal loss of those wetland services. So, we think it should be concurrent and not put off until the end.

And also, when you put things off to the end, often the money is not there and so, things get shirked. So, we want to make sure that we are replacing our, replacing the wetlands that we need to impact.

One other big thing in the, big elephant in the room is climate change. You know, it is authorized for a one hundred year flood which hundred year floods are happening every, you know, ten, fifteen years now it seems like. And so, making sure, taking a look at is the hundred year flood the right process we should be using and what is a true one hundred year flood. I know this has been thrown out to the Corp a bunch of times but, you know, if you want to take a look at the other extreme, the Netherlands plan for ten thousand year floods. I know that they are a nation that they can dedicate all of their resources to that but still that is a huge, huge difference and we should be looking at, looking at real impacts and what a
one hundred flood, at least, really looks like
with climate change.

Also, we want to make sure that the Corp does an environmental justice impact. I
don't think that was one of the impacts that was
listed up there. It might have been but I can't
remember. But added as a resource is
environmental justice. We, time and time again,
we see projects impacting disparately communities
of color, low-income communities and we want to
make sure that environmental impacts are not
unjustly put upon our most venerable people in
our nation.

And then just kind of, you know, we are
scoping, we are kind of spit-balling here. Is
this an opportunity for the Corp to look at
different arrangements for the river? What would
happen if we abandon some of our levees? What
would happen if we decommission some of our lower
levees? Southwest Pass is silting in all the
time. There has been a lot of talk about putting
another navigation canal. I know it's probably a
non-starter but I think this is a good
opportunity to look at, since you need to be
looking at a no build alternative. But what does
an no build alternative look like with an existing project? And maybe exploring what happens if certain levees are decommissioned and new levees are put in to minimize a sedimentation, minimize dredging and also allowing for better navigation.

So, I think I've talked enough and I will be submitting more comments before the end.

MR. SIMS:

Well, thank you. I'll try to address some of your comments. The first thing to remember is this document will deal strictly with the Mississippi River Levee Construction. So, a lot of the things that you mentioned, shoaling of the river, old river, that will not be the focus and that will not be looked at with this document.

Now, the Corp is looking at that other, doing other avenues but you won't see any of that here in this particular document. Environmental Justice, certainly that will be a part of this. You see that in there. Wetlands, the goal during construction, is avoid and minimize -- minimize and avoid. So, certainly, the intent is not to go in and take barrow from existing wetlands. I
can't tell you if there won't be any in there but that is the goal to stay away from them. We will certainly try that.

I'm drawing a blank on some of your other questions but you made a lot of good points.

MR. LAHARE:
Climate.

MR. SIMS:
Climate change will not be looked at in this. Again, the focus of this document will be just the raising of the levees and addressing seepage control.

MR. LAHARE:
But climate has to do with how high the levee should go.

SPEAKER:
Nick, why don't address what Matt spoke about in climate change is the hundred year authorization and to my knowledge, that is not what the MRLs are for. Can you talk a little bit about that?

MR. SIMS:
Yeah, no, they are not, I'm kind of drawing a blank on this, Mark.
MR. LAHARE:

Yeah, so, it's not, and Kenneth, you might be able to help me out here too. So, Matt had spoken about MRLs and hundred year level of risk reduction. To my knowledge, that is not what the MR&T is designed for. It is actually Project Design Flow or flood and some of the numbers I've often heard, at least in the New Orleans area, are close to about an eight hundred year level of risk reduction. At least in the New Orleans area. Any thought on that? Okay.

Okay.

A couple other comments you brought up, beneficial use and deepening the Mississippi River. We are all over that. In terms of deepening the river, we just had the chief's report approved deepening the river to fifty feet and so we are moving forward with that with budgeting and hopefully we will get the construction on that project here as soon as dollars are available partnering with DOTD and certainly we are going to maximize beneficial use through that program as well as Louisiana Coastal area. In fact, we are going to be doing Calcasieu, not on the Mississippi but it's just
the intent of beneficial use. We are doing a Calcasieu saving. Just awarded that yesterday for more beneficial use off the Calcasieu River. And we are planning another phase off Tiger Pass to use material out of the lower Mississippi River in probably '19 assuming we partner with CPRA and Plaquemines Parish on that.

And one other point you brought up, consider different river alignments. Kind of the changing course concept. We are not actively involved in that but CPRA through, as you've tracked it, through the restore program is moving forward with that. I think it's somewhere about 9.6 million dollar. We will look at that and so, we are going to continue to partner with CPRA on that piece.

Concurrent mitigation. You referenced hydrous. I'll be happy to mention that through some of the BBA18 work, our supplemental work which is three big projects, East Baton Rouge combing west shore, we don't have that same arrangement so it is concurrent mitigation. You will be happy to know, even today, we went out on a streak to secure more mitigation for combing which we are actually ahead right now on
mitigation. So, we hope that we can continue that track record on those projects.

MR. SIMS (?):

And for this particular project it is concurrent. We continue to buy credits and everything, so, yep, that is ongoing.

MR. ROTA:

Is there anyone else who would like to submit a comment or a question? No one? Going once.

I changed it, but by all means, if anything pops up or anything that raises, I know Matt's group will be submitting a more extensive lift but if anyone, if something comes up later after the meeting, feel free to email us or send it in by October 15th.

If we have no more comments or anything, I'm going to go ahead and close the meeting but we will be around until 9:00 at least to take on that's if you have anything else.

Thank you all for coming and I appreciate it and if you need anything from us, by all means, let us know. (EOH)
REPORTER'S PAGE

I, TAMMY LeBLANC JOSEPH, Certified Court Reporter, in and for the State of Louisiana, the Officer before whom this sworn testimony was taken, do here state:

That due to the spontaneous discourse of this proceeding, where necessary, dashes (--) have been used to indicate pauses, changes in thought, and/or talkovers; that same is the proper method for a Court Reporter's transcription of a proceeding, and that dashes (--) do not indicate that words or phrases have been left out of this transcript;

That any words and/or names which could not be verified through reference material have been denote with the phrase"(phonetically spelled)."

TAMMY LeBLANC JOSEPH
Certified Court Reporter
Louisiana Lic #91118.
**C-E-R-T-I-F-I-C-A-T-E**

This certification is valid only for a transcript accomplished by my original signature and original required stamp on this page.

I, TAMMY LeBLANC JOSEPH, CCR, in and for the State of Louisiana, as the officer before whom this testimony was taken, do hereby certify that the proceedings are as hereinbefore set forth in the forgoing pages; that this testimony was reported by me in the stenograph writing method, was prepared, transcribed by me or under my personal direction and supervision; that the transcript has been prepared in compliance with the transcript format guidelines required by statute or by rules of the board, as described on the website of the board; that I have acted in compliance with the prohibition on contractual relationships, as defined by LA Code of Civil Procedure, Art 1434, and in the rules and advisory opinions of the board; that I am not related to counsel or to the parties herein, nor am I otherwise interested in the outcome of this matter.

Tammy LeBlanc Joseph, CCR
State of Louisiana
August 7, 2018

U.S. Army Corps of Engineers
ATTN: CEMVN-PDC-UDC
167 North Main Street, Room B-202
Memphis, Tennessee 38103-1894

Re: Mississippi River & Tributaries, Mississippi River Levees & Supplemental EIS – Comments of the Miami Tribe of Oklahoma

Dear Sir or Madam:

Aya, kikwehsitoole – I show you respect. My name is Diane Hunter, and I am the Tribal Historic Preservation Officer for the Federally Recognized Miami Tribe of Oklahoma. In this capacity, I am the Miami Tribe’s point of contact for all Section 106 issues.

The Miami Tribe offers no objection to the above-mentioned project at this time, as we are not currently aware of existing documentation directly linking a specific Miami cultural or historic site to the project area. However, as the portions of this project that impact Missouri and Illinois are within the aboriginal homelands of the Miami Tribe, if any human remains or Native American cultural items falling under the Native American Graves Protection and Repatriation Act (NAGPRA) or archaeological evidence is discovered during any phase of this project, the Miami Tribe requests immediate consultation with the entity of jurisdiction for the location of discovery. In such a case, please contact me at 918-541-8966 or by email at dhunter@miamination.com to initiate consultation.

The Miami Tribe accepts the invitation to serve as a consulting party to the proposed project. In my capacity as Tribal Historic Preservation Officer I am the point of contact for consultation.

Respectfully,

Diane Hunter
Tribal Historic Preservation Officer
Dear Mr. Thron,

The Osage Nation Historic Preservation Office has reviewed the attached environmental models. We have no concerns for the methods proposed by these models.

Thank you for consulting with the Osage Nation,

John Fox
Archaeologist, MS, RPA
627 Grandview Avenue, Pawhuska, OK 74056
Phone: 918-287-5274
jfox@osagenation-nsn.gov

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FYI

-----Original Message-----
From: Gibb, Heather [mailto:Heather.Gibb@dnr.mo.gov]
Sent: Friday, August 31, 2018 4:29 PM
To: Lieb, Pamela D CIV USARMY CEMVM (US) <Pamela.D.Lieb@usace.army.mil>
Subject: [Non-DoD Source] RE: Mississippi River & Tributaries, Mississippi River Levees @nd Supplemental EIS - Notice of Intent

Hello Pam,

Thank you for submitting information on the above referenced project for our review pursuant to Section 106 of the National Historic Preservation Act (P.L. 89-665, as amended) and the Advisory Council on Historic Preservation's regulation 36 CFR Part 800, which requires identification and evaluation of cultural resources.

We have reviewed the information provided concerning the above referenced project. We have no additional comments at this time, but look forward to continued consultation.

Please be advised that, as this project develops, information documenting the possible effects on historic properties should be submitted to this office for further review.

If you have any questions, please write Heather Gibb at State Historic Preservation Office, P.O. Box 176, Jefferson City, Missouri 65102 or call 573/751-7862. Please be sure to include the SHPO Log Number (046-MLT-18) on all future correspondence or inquiries relating to this project.

Heather Gibb
Review, Compliance, Records Coordinator
Missouri SHPO
PO Box 176
Jefferson City, MO 65102
573-751-7862

We'd like your feedback on the service you received from the Missouri Department of Natural Resources. Please consider taking a few minutes to complete the department's Customer Satisfaction Survey at Blockedhttps://www.surveymonkey.com/r/MoDNRsurvey. Thank you

-----Original Message-----
From: Lieb, Pamela D CIV USARMY CEMVM (US) <Pamela.D.Lieb@usace.army.mil>
Sent: Friday, August 31, 2018 1:14 PM
To: Gibb, Heather <Heather.Gibb@dnr.mo.gov>
Subject: RE: Mississippi River & Tributaries, Mississippi River Levees @nd Supplemental EIS - Notice of Intent

Hey Heather:

An email will be just fine.

Thanks!
Hello Pam,

I wanted to check in on this project. Would you prefer a formal letter of comment or will an email stating that we look forward to continued consultation for the NOI work as comment? I just want to make sure we respond in the most appropriate manner for the USACOE. Until the draft SEIS II comes out, we will not have any very specific comments.

Best,

Heather

Heather Gibb
Review, Compliance, Records Coordinator
Missouri SHPO
PO Box 176
Jefferson City, MO 65102
573-751-7862

We'd like your feedback on the service you received from the Missouri Department of Natural Resources. Please consider taking a few minutes to complete the department's Customer Satisfaction Survey at BlockedBlockedhttps://www.surveymonkey.com/r/MoDNRsurvey BlockedBlockedhttps://www.surveymonkey.com/r/MoDNRsurvey. Thank you
Dear Tribal Partners and SHPOs,

The U.S. Army Corps of Engineers (USACE), Memphis District, Vicksburg District, and the New Orleans District, is announcing its intent to prepare Supplement II (SEIS II) to the Final Environmental Impact Statement, Mississippi River and Tributaries (MR&T) Project, Mississippi River Mainline Levees and Channel Improvement of 1976 (1976 EIS), as updated and supplemented by Supplement No. 1, Mississippi River and Tributaries Project, Mississippi River Mainline Levee Enlargement and Seepage Control of 1998 (SEIS I) to the 1976 EIS, to cover construction of remaining authorized work on the Mississippi River mainline levees (MRL) feature. Over the past twenty years since the finalization of SEIS I, USACE has determined that various sections (reaches) of the mainline levee system are deficient in varying amounts, and that certain remedial measures need to be undertaken to control seepage and to raise and stabilize the deficient sections of the levee to protect the lower Mississippi River Valley against the Project Design Flood.

A Notice of Intent (NOI) is anticipated to be published in the Federal Register on this matter on FRIDAY July 13, 2018, opening the comment period lasting until October 1, 2018. For your convenience, a copy of the NOI is attached.

USACE invites full public participation to promote open communication on the issues surrounding the Proposed Action through what is referred to as the scoping process. All individuals, organizations, non-governmental organizations, affected Indian Tribes, and local, state, and Federal agencies that have an interest are urged to participate in the scoping process. Public scoping meeting(s) will be held at various locations within the Project Area during approximately late July or August of 2018 to present information and to receive comments. The date(s), time(s), and location(s) of the scoping meeting(s) will be publicly announced in advance by USACE on the Project website at: BlockedBlockedhttp://www.mvk.usace.army.mil/MRLSEIS/ , as well as through email distribution lists, mailed to public libraries, government agencies, and interested groups and individuals. Scoping meeting dates and locations will also be advertised in local newspapers. Interested parties unable to attend the scoping meetings can access additional information on SEIS II at the website listed above.

In order for public comments to be recorded for inclusion in the Administrative Record and be considered in the SEIS II development process, members of the public, interested persons and entities must submit their comments to USACE by mail, email, or verbally at the Scoping Meeting(s). Written comments submitted for consideration are due no later than October 1, 2018. Comments and questions about SEIS II should be submitted to USACE by email to: MRL-SEIS-2@usace.army.mil; or by regular mail to: U.S. Army Corps of Engineers, ATTN: CEMVN-PDC-UDC, 167 North Main Street, Room B-202, Memphis, Tennessee 38103-1894. For additional information, including but not limited to a copy of SEIS I and the 1976 EIS, please visit the project website.

The current SEIS II development schedule anticipates the release of the draft of SEIS II by USACE for public review and comment in 2020. After it is published, USACE will hold public comment meetings to present the results of studies and identification of a recommended plan, to receive comments, and to address questions concerning the draft SEIS II.

Respectfully,

Edward P. Lambert
Chief, Environmental Compliance Branch
Regional Planning and Environmental Division South U.S. Army Corps of Engineers
October 11, 2018

U.S. Army Corps of Engineers  
Attn: CEMVN-PDC-UDC  
c/o Mike Thron, NEPA Coordinator  
167 North Main Street, Room B-202  
Memphis, TN 38103-1894

Via e-mail:  
MRL-SEIS-2@usace.army.mil  
John.M.Thron@usace.army.mil  
Daniel.C.Sumerall@usace.army.mil

Re:  Mississippi River & Tributaries Project, Mississippi River Levees  
Supplemental Environmental Impact Statement II

Dear Mr. Thron:

I am Peter Nimrod, Chief Engineer for the Board of Mississippi Levee Commissioners, and I have the privilege of presenting this statement as part of the U.S. Army Corps of Engineers public scoping meeting in preparation of Supplement II to the Final Environmental Impact Statement (SEIS II) for the Mississippi River Mainline Levees of the MR&T Project. The Board of Mississippi Levee Commissioners was established in 1865 and is comprised of 7 elected commissioners representing the counties of Washington, Bolivar, Sharkey, Issaquena, and parts of Humphreys and Warren counties. The Mississippi Levee Board is responsible for 212 miles of levees and 350 miles of interior streams.

From 1865 until the 1927 Flood the Mississippi Levee Board was responsible for the design, construction and maintenance of the levee to protect the Lower Mississippi Delta. Following the devastating 1927 Flood, Congress passed the 1928 Flood Control Act which established the Mississippi River & Tributaries (MR&T) Project and set up the U.S. Army Corps of Engineers to design and construct levee enlargement projects. The Mississippi Levee Board is the local sponsor and we provide right-of-way for Corps projects and we maintain the completed levee projects.

Following the 1973 Flood, the Corps of Engineers evaluated the performance of the Mainline Mississippi River Levee system and they discovered that there were areas along the levee system that were deficient in grade and section. It was determined that there were 69.2 miles of deficient levee within the Mississippi Levee District.
The Corps of Engineers hosted similar Scoping Meetings in 1997 for the Supplemental Environmental Impact Statement (SEIS) for the Mainline Mississippi River Levee Enlargement and Berms Project. This 1998 SEIS supplemented the original 1976 Environmental Impact Statement. The riverside batture land includes very important habitat for waterfowl, fisheries and wildlife. As part of this original 1998 SEIS the Corps adopted “avoid & minimize” criteria within their design parameters in an effort to eliminate and lessen impacts to the environment.

Since 1998 the Corps and the Mississippi Levee Board have completed enlarging 44.0 miles of the 69.2 miles of deficient levee and currently have another 8.8 miles of levee under contract. The Corps has completed the design for an item containing another 2.7 miles of deficient levee and the Mississippi Levee Board is currently obtaining right-of-way to construct this item in 2019. The Mississippi Levee Board has obtained right-of-entry for the Corps to survey and perform soil borings at 2 more items totaling 6.2 miles. Once all these items are constructed this leaves only 7.5 miles of deficient levee left to raise on our Mainline Mississippi River Levee within the Mississippi Levee District.

During the past 20 years the Corps of Engineers has done a wonderful job of avoiding and minimizing damage to the environment when they design and construct these levee enlargement and berm projects. When you raise a levee you must first widen out the base and since the riverside slope is steeper than the landside slope of the levee the Corps has utilized a riverside enlargement for the majority of our levee enlargement projects. The practice of using riverside enlargements lessens the footprint and greatly reduces the amount of borrow material needed to raise the levee.

When the Corps starts the design of a levee enlargement project it first looks at batture land in which the Levee Board holds a perpetual easement. If not enough borrow material exists within our easement, the Corps starts looking just outside our right-of-way at adjacent riverside property. Every attempt to minimize damage to the environment is made and post-project borrow area use for the landowner is considered.

These 44 miles of completed levee construction have included utilizing existing landside seepage berm material to raise the levee; utilizing a hydraulic dredge to build back berms using sand from the Mississippi River; using an unused set-back levee as borrow material; building numerous aquatic riverside borrow areas that are irregular shaped, varying depths and islands left in the middle which is perfect for fish habitat; building numerous riverside duck holes that are precision graded and installing water control structures so that water levels can be held, regulated and drained so that millet can be planted for ducks; building numerous riverside reforested borrow areas in which the pit is graded to drain and reforested with trees which provides terrestrial habitat; and finally the Corps is installing Relief Wells in certain areas instead of construction of an earthen landside seepage berm which greatly reduces the need for more borrow material from the borrow areas.

The Levee Enlargement & Berms Project needs to move towards completion because at this point our Mainline Mississippi River Levee will overtop during a Project Design Flood (PDF). If our levee overtops and fails, over a million acres are subject to flooding, hundreds of thousands of people will be displaced, homes, roads and farms will be damaged causing billions of dollars of damage in the Mississippi Delta alone.
The Backwater Levees within the MR&T Project are designed to be 2' below the Project Design Flood (PDF). Therefore in the future when we experience a PDF these Backwater Levees are designed to overtop and take pressure off the Mainline Mississippi River Levees. However, the Yazoo Backwater Levee located within the Mississippi Levee District is currently 7.8' below the PDF and it needs to be raised 5.8'. We request that the Corps of Engineers immediately begin designing the enlargement of the Yazoo Backwater Levee.

The Mississippi Levee Board has been pleased to partner with the U.S. Army Corps of Engineers over the past 20 years on the Mainline Mississippi River Levee Enlargement Project and we are proud of the Corps of Engineers designing and building projects that not only provide critical flood protection for the Mississippi Delta, but also provide environmental gains in all environmental categories.

The Mississippi Levee Board requests that the U.S. Army Corps of Engineers continue to expeditiously design and enlarge the remaining deficient Mainline Mississippi River Levee and the entire deficient Yazoo Backwater Levee using the same design criteria and the same avoid and minimize environmental considerations that they have utilized over the past 20 years. It is also important that the landowners giving up lands for the construction of these projects continue to have input into the design process and the location of borrow areas.

On behalf of the Mississippi Levee Board, we continue to value our partnership and association with the U.S. Army Corps of Engineers and we appreciate the opportunity to make this statement in support of the SEIS II and the completion of the remaining authorized work for the Mississippi River Levees of the Mississippi River & Tributaries Project.

BOARD OF MISSISSIPPI LEVEE COMMISSIONERS

[Signature]

Peter Nimrod, P.E., P.L.S.
Chief Engineer
ATTN: CEMVN-PDC-UDC

Regarding: Kentucky Transportation comment on the Mississippi River Mainline Levee (MRL) Supplemental Environmental Impact Statement (SEIS II)

KYTC Liaison to the USACE contact information:

Deanna Mills, P.E.
Kentucky Transportation Cabinet – Division of Planning
200 Mero Street
Frankfort, KY 40622
(502) 782-5085
Deanna.Mills@ky.gov

To whom it may concern,

As the Kentucky Transportation Cabinet (KYTC) liaison to the Army Corps of Engineers, I am sending information to you regarding a large KYTC bridge project currently in planning and environmental stages. This project may be pertinent your MRL SEIS II. The original USACE notice of public hearing email was sent on August 23, 2018, and the comment period continues through October 15, 2018.

KYTC is in the planning stage of replacing the US 51 bridge over the Ohio River in Ballard County, Kentucky, between Cairo, Illinois and Wickliffe, Kentucky; commonly referred to as the Cairo Bridge. This bridge is located just north of the Mississippi River and Ohio River confluence. The KYTC 2018 Highway Plan currently lists three projects for preliminary engineering and environmental documentation beginning in 2020, with some construction funding scheduled as early as 2024. A US 51 Ohio River Bridge Alternative Selection Report was completed in 2014 to look at rehabilitation or replacement recommendations.

Please feel free to contact me if additional information on the Cairo Bridge project is needed.

Thank you,

Deanna P. Mills, P.E.
Transportation Engineer Specialist
Division of Planning – Strategic Corridor
200 Mero Street, 5th Floor West
Frankfort, KY 40622
Phone: (502) 782-5085
Mr. Mike Thron  
U.S. Army Corps of Engineers  
Vicksburg District  
4155 Clay Street  
Vicksburg, Mississippi  39183

Re: Scoping Comments for the Mississippi River and Tributaries Project; Mississippi River Mainline Levees and Channel Improvement Supplemental Environmental Impact Statement No. II (SEIS)

Dear Mr. Thron:

The U.S. Environmental Protection Agency has reviewed the available information provided by the U.S. Army Corps of Engineers (USACE) Vicksburg Office in accordance with our authority provided by Section 309 of the Clean Air Act and Section 102(2)(C) of the National Environmental Policy Act (NEPA). The EPA Region 4 Office will function as the cooperating agency point of contact in providing comments and technical recommendations from EPA Regions 5, 6, and 7 for the Mississippi River and Tributaries (MRL) SEIS No. II.

The purpose of the SEIS scoping comments is to help summarize some of the impacts associated with the USACE’s Mississippi River flood control efforts. The Mississippi River and its tributaries represents the world’s third largest watershed. The EPA appreciates the challenges associated with this expansive project. The EPA’s comments and technical recommendation are provided in the enclosure to provide the USACE with early information to illustrate some solutions and to potentially enhance the NEPA collaborative process associated with this project. (See enclosure).

We appreciate your ongoing coordination with the EPA and we appreciate the opportunity to provide comments on the proposed SEIS. We look forward to working with your project delivery team. Should you have questions, feel free to coordinate with Mr. Larry Long, of my staff, at 404-562-9460 or at long.larry@epa.gov.

Sincerely,

Christopher A. Militscher  
Chief, NEPA Program Office  
Resource Conservation and Restoration Division

Enclosure
ENCLOSURE
Scoping Comments for the Mississippi River and Tributaries Project; Mississippi River Mainline Levees and Channel Improvement Supplemental Environmental Impact Statement No. II (SEIS)

The EPA appreciates the opportunity to serve as a cooperating agency with the U.S. Army Corps of Engineers (USACE) in developing a SEIS that addresses the complexity and scale of the proposed project. We also appreciate the multitude of state and federal regulatory agencies and programs that are encompassed in the Mississippi River Levee (MRL) project. The EPA looks forward to working with the USACE to provide technical expertise in the resolution for past and future mitigation issues. Our goal for this collaborative process is to help provide a higher level of sustainable flood control and environmental protection within the project study area.

Issue: Active vs Passive Flood Control
The Federal Emergency Management Agency (FEMA) recommends passive flood control devices for the protection of buildings and other structures. The issues of passive versus active flood control can become complicated and confusing when evaluating project alternatives.

Recommendation:
The USACE may wish to include as part of the alternatives section of the SEIS, a discussion on active and passive flood control measures. A resource-based economic feasibility analysis may provide a greater level of flood protection in areas where the cost of building levees would be cost prohibitive as determined by the USACE. The USACE may also wish to consider passive, non-structural and restoration-based alternatives for flood risk reduction, including new floodways, levee removal/notches or setbacks, especially in areas that require frequent maintenance.

Issue: Multi-agency Assessment Approach
For projects of this scale and complexity, it may be advantageous to provide a multi-agency assessment approach for the economic and engineering considerations, and include an in-depth discussion on the compatibility of environmental methods, models, data analyses used for decision-making of the alternatives. Part of this assessment approach would be define and consider the risk and uncertainty of performing certain analyses that could be associated with this project.

Recommendation: The EPA recommends that the USACE consider forming Independent External Peer Review (IEPR) panels to: 1) Create a decision matrix capable of determining the compatibility of the different models. 2) Assess differences in geology and hydrology between impact sites and proposed mitigation sites when determining the adequacy of proposed mitigation. 3) Determine how appropriate duck use days' (DUD) models are when applied outside the growing season. It may be important to address separately if a project’s impacts reduce DUD. The EPA recommends that they should not be used strictly for wetland mitigation for the rest of that year, and are not a decision endpoint. 4) Establish a decisional process that addresses multi-state mitigation methods for wetlands and other waters of the U.S., 5) Evaluate differences in growing season variations due to the large geographic project scale, and, 6) Evaluate past mitigation projects from previous project phases and future mitigation needs for the current project alternatives with consideration of the regulatory requirements of several States in order to potentially maximize the mitigation for wetland losses due to temporal, functional and direct impacts.
RE: C20180095, Coastal Zone Consistency
U.S. Army Corps of Engineers
Direct Federal Action
Notice of Intent to Prepare Supplement II to the Final Environmental Impact Statement, Mississippi River and Tributaries (MR&T) Project, Mississippi River Mainline Levees and Channel Improvement (MRL)
St. James, St. John the Baptist, St. Charles, Orleans, Jefferson, St. Bernard, and Plaquemines Parishes, Louisiana

Dear Ms. Hansen:

The Louisiana Department of Natural Resources, Office of Coastal Management (OCM) has reviewed the referenced Notice of Intent, and attended the September 12, 2018, Public Scoping Meeting in Baton Rouge, LA. The following comments are submitted for your consideration for the Supplemental Environmental Impact Statement (SEIS).

Flood control and protection are critical to Louisiana, as is the commerce that utilize the Mississippi River and its tributaries. Well-maintained navigation and flood control systems greatly benefit this state and are fully supported by OCM. Nevertheless, the control imposed upon the Mississippi River does result in direct, secondary and cumulative impacts to Louisiana’s coastal resources, and the National Environmental Policy Act (NEPA) requires their full evaluation so that the Corps may be guided in their avoidance, minimization, and compensation.

Direct impacts can be expected from proposed MRL project features such as levee enlargements, stability berm construction, seepage control, and pumping station construction or expansion. For such impacts in the Louisiana coastal zone, mitigation will be necessary to compensate for the unavoidable loss of coastal wetlands.

The Corps must also consider secondary and cumulative impacts resultant from these activities. Louisiana’s fragile coastal wetlands experience significant and rapid degradation rates. This land
loss has several causes, but one of the most significant is the confinement of the Mississippi River to its channel. By preventing overbank flooding, the MRL project cuts Louisiana’s coastal wetlands off from the sediment replenishment necessary to keep up with erosion and subsidence. The MRL project, along with navigation maintenance practices, has resulted in the central Gulf of Mexico coast becoming a sediment-starved system despite being the recipient of drainage from nearly half of the nation. Over many decades this has compromised the State’s fragile coastal wetlands.

The loss of coastal wetlands affects not only the regional wildlife, waterfowl, and inshore and Gulf fisheries, but also reduces the buffer that protects onshore infrastructure such as roads, pipelines, utility lines, and communities and businesses, from relative sea level rise and hurricane-related storm surge.

OCM urges the Corps to fully evaluate the secondary and indirect environmental impacts resulting from confining the river to its channel and, as required by NEPA, to develop additional project measures to help offset and reverse the unavoidable adverse effects this necessary project has had on Louisiana’s coastal wetlands.

Finally, please be reminded that, pursuant to the Coastal Zone Management Act of 1972, as amended, the construction of all MRL project features that may have reasonably foreseeable effects on Louisiana’s coastal land use, water use, or natural resources, will require the submission of consistency determinations for review by OCM wherever that work occurs along the Mississippi River system.

The Office of Coastal Management appreciates the opportunity to comment at this stage of the environmental review process, and looks forward to reviewing the Draft SEIS when completed. If you have any questions concerning these comments please contact Jeff Harris of the Consistency Section at (225) 342-7949 or jeff.harris@la.gov.

Sincerely,

/S/ Charles Reulet
Administrator
Interagency Affairs/Field Services Division

CR/SK/jdh

Cc: Daniel Sumerall, COE-VD
    Mike Thron, COE-MD
    Nick Sims, COE-NOD
    Mark Lahare, COE-NOD
October 15, 2018

U.S. Army Corps of Engineers
Attn: CEMVN-PDC-UDC
c/o Mike Thron, NEPA Coordinator
167 North Main Street, Room B-202
Memphis, TN 38103-1894

Via e-mail: MRL-SEIS-2@usace.army.mil
John.M.Thron@usace.army.mil
Daniel.C.Sumerall@usace.army.mil

Re: Mississippi River & Tributaries Project, Mississippi River Levees
Supplemental Environmental Impact Statement II

Dear Mr. Thron:

This written statement is presented as part of the U.S. Army Corps of Engineers preparation of Supplement II to the Final Environmental Impact Statement (SEIS II) for the Mississippi River Mainline Levees of the MR&T Project. Following the devastating 1927 Flood, Congress passed the 1928 Flood Control Act which established the Mississippi River & Tributaries (MR&T) Project and set up the U.S. Army Corps of Engineers to design and construct levee enlargement projects. The local Levee Boards are the local sponsors and we provide right-of-way for Corps projects and we maintain the completed levee projects.

Following the 1973 Flood, the Corps of Engineers evaluated the performance of the Mainline Mississippi River Levee system and they discovered that there were areas along the levee system that were deficient in grade and section. The Corps of Engineers performed an Environmental Impact Statement (EIS) in 1976. In 1998 the Corps performed a Supplemental Environmental Impact Statement (SEIS) for the Mainline Mississippi River Levee Enlargement and Berms Project. The riverside batture land includes very important habitat for waterfowl, fisheries and wildlife. As part of this 1998 SEIS the Corps adopted “avoid & minimize” criteria within their design parameters in an effort to eliminate and lessen impacts to the environment.

Since 1998 the Corps of Engineers and the Levee Boards have partnered together and have been actively enlarging the deficient levees using various “avoid and minimize” design techniques. These levee enlargement projects not only provide critical flood protection, but also provide environmental gains in all environmental categories.
The Levee Enlargement & Berms Project needs to move towards completion because at this point our Mainline Mississippi River Levee will overtop during a Project Design Flood (PDF). If the levee overtops and fails, millions of acres are subject to flooding, millions of people will be displaced, homes, roads, farms, infrastructure and wildlife will be impacted causing billions of dollars of damage.

We request that the U.S. Army Corps of Engineers continue to expeditiously design and enlarge the remaining deficient Mainline Mississippi River Levee using the same design criteria and the same avoid and minimize environmental considerations that they have utilized over the past 20 years. It is also important that the landowners giving up lands for the construction of these projects continue to have input into the design process and the location of borrow areas.

We continue to value our partnership and association with the U.S. Army Corps of Engineers and we appreciate the opportunity to make this statement in support of the SEIS II and the completion of the remaining authorized work for the Mississippi River Levees of the Mississippi River & Tributaries Project.

If you have any questions, please contact me at 318-574-2206.

Yours truly,

Reynold S. Minsky
President
Fifth Louisiana Levee Board

RM/jt
October 15, 2018

U. S. Army Corps of Engineers
Attn: CEMVN-PDC-UDC
c/o Mike Thron, NEPA Coordinator
167 North Main Street, Room B-202
Memphis, TN 38103-1894

Via e-mail   MRL-SEIS-2@usace.army.mil
            John.M.Thron@usace.army.mil
            Daniel.C.Sumerall@usace.army.mil

Re: Mississippi River & Tributaries Project, Mississippi River Levees
    Supplemental Environmental Impact Statement II

Dear Mr. Thron:

This written statement is presented as part of the U.S. Army Corps of Engineers
preparation of Supplement to the Final Environmental Impact Statement (SEIS II) for the
Mississippi river Mainline Levees of the MR&T Project. Following the devastating 1927
Flood, Congress passed the 1928 Flood Control Act which established the Mississippi
River and Tributaries (MR&T) Project and set up the U. S. Army Corps of Engineers to
design and construct levee enlargement projects. The local Levee Boards are the local
sponsors and we provide right of way for Corps projects and we maintain the completed
projects.

Following the 1973 Flood, the Corps of Engineers evaluated the performance of the
Mainline Mississippi River Levee system and they discovered that there were areas
along the levee system that were deficient in grade and section. The Corps of Engineers

performed an Environmental Impact Statement (EIS) in 1976. In 1998 the Corps performed a Supplemental Environment Impact Statement (SEIS) for the Mainline Mississippi River Levee Enlargement and Berms Project. The riverside batture land includes very important habitat for waterfowl, fisheries and wildlife. As part of this 1998 SEIS the Corps adopted “avoid & minimize” criteria within their design parameters in an effort to eliminate and lessen impacts to the environment.

Since 1998 the Corps of Engineers and the Levee Boards have partnered together and have been actively enlarging the deficient levees using various “avoid and minimize” design techniques. These levee enlargement projects not only provide critical flood protection, but also provide environmental gains in all environmental categories.

The Levee Enlargement & Berms Project needs to move towards completion because at this point our Mainline Mississippi River Levee will overtop during a Project Design Flood (PDF). If the levee overtops and fails, millions of acres are subject to flooding, millions of people will be displaced, homes, roads, farms, infrastructure and wildlife will be impacted causing billions of dollars of damage.

We request that the U.S. Army Corps of Engineers continue to expeditiously design and enlarge the remaining deficient Mainline Mississippi River Levee using the same design criteria and the same avoid and minimize environmental considerations that they have utilized over the past 20 years. It is also important that the landowners giving up lands for the construction of these projects continue to have input into the design process and the location of borrow areas.

We continue to value our partnership and association with the U. S. Army Corps of Engineers and we appreciate the opportunity to make this statement in support of the SEIS II and the completion of the remaining work for the Mississippi river Levees of the Mississippi River & Tributaries.

SOUTHEAST

ARKANSAS LEVEE DISTRICT

By ________________________________ ________________________________

Gillison, Jr.

Attorney

cc: Mr. Johnny Johnson, President

David F.
October 15, 2018

U.S. Army Corps of Engineers
Memphis District
Attn: CEMVN-PDC-UDC
c/o Mike Thron, NEPA Coordinator
167 North Main Street, Room B-202
Memphis, TN 38103-1894

Reference: Mississippi River & Tributaries Project, Mississippi River Levees Supplemental Environmental Impact Statement II

Mr. Thron and Corps Team:

This statement is presented as part of the U.S. Army Corps of Engineers (Corps) preparation of Supplement II to the Final Environmental Impact Statement (SEIS II) for the Mississippi River Mainline Levees of the MR&T Project.

Considering the information below and intent of the Congress and the Administration we request that the Corps complete the subject SEIS II within 18 months.

Following the devastating 1927 Flood, Congress passed the 1928 Flood Control Act which established the Mississippi River & Tributaries (MR&T) Project and set the Corps up to design and construct levee enlargement projects. The local Levee Boards are the local sponsors and provide right-of-way and maintenance for completed levee projects based on legally binding signed Levee Assurances.

Following the 1973 Flood, the Corps evaluated the performance of the Mainline Mississippi River Levee system and discovered that there were areas along the levee system that were deficient in grade and section. The Corps performed an Environmental Impact Statement (EIS) in 1976. In 1998 the Corps performed a Supplemental Environmental Impact Statement (SEIS) for the Mainline Mississippi River Levee Enlargement and Berms Project. The riverside batture land includes significant and important habitats for waterfowl, fisheries and wildlife. As part of the 1998 SEIS the Corps adopted “avoid & minimize” criteria within the design parameters in an effort to help eliminate and lessen impacts to the environment.

Since 1998 the Corps and the local Levee Boards have partnered together and have been actively enlarging the deficient levees using “avoid and minimize” design techniques. These levee enlargement projects provide critical flood control, flood protection and environmental gains in all environmental categories.
The Levee Enlargement & Berms Projects need to move to completion because our Mainline Mississippi River Levee is not currently built to the federally authorized project design and will be overpowered and/or overtopped during a Project Design Flood (PDF). If the levee overtops and/or fails because it is incomplete, millions of acres are subject to flooding, millions of people will be displaced, homes, Interstates and roads, airports, petroleum refineries, power generation facilities, farms, regionally and other nationally significant infrastructure and wildlife will be impacted resulting in tens of billions of dollars of damages.

We request that the Corps expeditiously design and enlarge the remaining deficient Mainline Mississippi River Levee using an engineering practitioners approach considering the relevant conditions of the local area to design criteria and avoid and minimize environmental considerations that have been used for 20 years. The local landowners that provide their land and property for the construction of these projects for the benefit of the federal flood control system along with the local sponsors must continue to have input into the design process and the location of borrow areas.

We value our 90-year partnership and association with the Corps and we appreciate the opportunity to make this statement in support of the SEIS II and the completion of the remaining federally authorized work for the Mississippi River Levees of the Mississippi River & Tributaries Project. The longer it takes to build the project to its authorized federal design ... the longer our inner-coast of the US is exposed to extreme economic and life safety risks.

Thank you for what you do every day to help assure the protection and productivity of the local people along this great Alluvial Valley. Our nation’s interest and future are at stake.

If you have questions or comments, please contact our office.

Sincerely,

Rob Rash, PE, PLS
CEO/Chief Engineer, St. Francis Levee District of AR

CC:

MG Kaiser (MVD), Col Clancy (MVN), Col Derosier (MVK), Col Ellicott (MVM), Col Sizemore (MVS)

Via e-mail:  
MRL-SEIS-2@usace.army.mil  
John.M.Thron@usace.army.mil  
Daniel.C.Sumerall@usace.army.mil
October 15, 2018

U.S. Army Corps of Engineers, Memphis District
ATTN: Mr. Mike Thron, NEPA Coordinator
167 North Main Street, Room B-202
Memphis, TN 38103-1894

Reference: Mississippi River & Tributaries Project, Mississippi River Levees Supplemental Environmental Impact Statement II

Dear Mr. Thron and Corps Team:

This statement is presented as part of the U.S. Army Corps of Engineers (Corps) preparation of Supplement II to the Final Environmental Impact Statement (SEIS II) for the Mississippi River Mainline Levees of the MR&T Project.

Considering the information following and attached and the current direction and intent of the Congress and the Administration we request that the Corps complete the subject SEIS II within 18 months.

Since 1998 the Corps and the local Levee Boards have partnered to enlarge the deficient levees using “avoid and minimize” design techniques. These levee enlargement projects provide critical flood control, flood protection and environmental gains in all categories.

We request that the Corps expeditiously complete the design and enlargement of the remaining deficient Mainline Mississippi River Levee. We ask that the Corps use an engineering practitioners approach considering the relevant conditions of the local area and conditions for the design criteria and the avoid and minimize environmental considerations that have been used for 20 years. Expediency is imperative for the local landowners who provide their land for the construction of the projects that benefit the federal flood control system. The local land owners and local sponsors must continue to have input into the design process and the location of borrow areas. We cannot over emphasize that the local people are giving up their land for the comprehensive federal project.

The Levee Enlargement & Berms Projects need to move to completion because our Mainline Mississippi River Levee is not currently built to the federally authorized project design and will be overpowered and/or overtopped during a Project Design Flood (PDF). If the levee overtops and/or fails because it is not completed, millions of acres are subject to flooding, millions of people will be displaced, homes, interstates and roads, airports, petroleum refineries, power generation facilities, farms, regionally and other significant regional and national infrastructure along with wildlife and their essential habitat will be impacted, resulting in hundreds of billions of dollars of damages and an environmental catastrophe.

Protect – Produce – Provide

The MVFCA is the strong, consistent voice from eleven states of connected local people who own homes, land and businesses that deliver world envied productivity with unmatched efficiency along a super water highway with strategically located on-ramps. This economic engine that feeds the world depends on a flood control system that enables reliable business, land, and water commerce.
We value our 90-years of work and partnership with the Corps and we appreciate the opportunity to make this statement in support of the SEIS II and the completion of the remaining federally authorized work for the Mississippi River Levees of the Mississippi River & Tributaries Project. The longer it takes to build the project to its authorized federal design ... the longer the inner-coast of the United States is exposed to extreme economic, life safety risks, and adverse environmental impacts.

Thank you for what you do every day to help provide the protection and productivity of the local people along the God-given Alluvial Valley known as the Mississippi River Watershed. Our nation’s interests’ and future productivity are at stake.

If you have questions or comments, please contact our office.

Sincerely,

Sam M. Hunter, DVM
Chairman, MVFCA

Enclosures:
Information Paper
Protect – Produce – Provide information

CC: MG Kaiser (MVD), Col Clancy (MVN), Col Derosier (MVK), Col Ellicott (MVM), Col Sizemore (MVS)

Via e-mail: MRL-SEIS-2@usace.army.mil; John.M.Thron@usace.army.mil; Daniel.C.Sumerall@usace.army.mil
The Nation can realize the extreme benefits of building the MR&T project to design by 2028, within 10 years, the 100th anniversary of the 1928 Flood Control Act that authorized the project known as the greatest “public works” undertaking in America. In order for this to happen the SEIS II would have to be completed in 18 months and we would need to secure the funding (~$7B) within 3 years to build to design.

When the SEIS II is completed in 18 months then the design of the deficient parts of the system and the concurrent building of the system would require 5 to 7 years at best while local sponsors secure right-of-way, borrow material and other land agreements. This requires focused energy to have the funding in place to efficiently and effectively pursue the work.

When Congress directs a date certain -- as they did for the Red River Waterway Navigation project currently known as the J. Bennett Johnston Waterway ($2B, Dec 1994) – it happens.

When the Corps directs a date certain – as it did for assuring a flood protection date for Greater New Orleans ($14B, Sep 2011) – it happens.

Targeted water infrastructure investments like the MR&T and the ones described don’t just happen, leaders set the conditions for them and focused responsive professionals are able to proudly deliver them for the public good, national security, and global economic gain. We must assure that our Nation realizes the impressive benefits of more than 70 to 1 return on investment in the MR&T by building it to design by May 15, 2028. Let’s do this before an overpowering of the system occurs.

A brief synopsis of the MR&T EIS/SEIS: Following the devastating 1927 Flood, Congress passed the 1928 Flood Control Act which established the Mississippi River & Tributaries (MR&T) Project and set the Corps up to design and construct levee enlargement projects. The local Levee Boards are the local sponsors and provide right-of-way and maintenance for completed levee projects based on legally binding signed Levee Assurances.

Following the 1973 Flood, the Corps evaluated the performance of the Mainline Mississippi River Levee system and discovered that there were areas along the levee system that were deficient in grade and section. The Corps performed an Environmental Impact Statement (EIS) in 1976. In 1998 the Corps performed a Supplemental Environmental Impact Statement (SEIS) for the Mainline Mississippi River Levee Enlargement and Berms Project. The riverside batture land includes significant and important habitat for waterfowl, fisheries and wildlife. As part of the 1998 SEIS the Corps adopted “avoid & minimize” criteria within the design parameters in an effort to help eliminate and lessen impacts to the environment.
U.S. Army Corps of Engineers
Attn: CEMVN-PDC-UDC
c/o Mike Thron, NEPA Coordinator
167 North Main Street, Room B-202
Memphis, TN 38103-1894

Via e-mail: MRL-SEIS-2@usace.army.mil
John.M.Thron@usace.army.mil
Daniel.C.Sumerall@usace.army.mil

Re: Mississippi River & Tributaries Project, Mississippi River Levees
Supplemental Environmental Impact Statement II

Dear Mr. Thron:

This written statement is presented as part of the U.S. Army Corps of Engineers preparation of Supplement II to the Final Environmental Impact Statement (SEIS II) for the Mississippi River Mainline Levees of the MR&T Project. Following the devastating 1927 Flood, Congress passed the 1928 Flood Control Act which established the Mississippi River & Tributaries (MR&T) Project and set up the U.S. Army Corps of Engineers to design and construct levee enlargement projects. The local Levee Boards are the local sponsors and we provide right-of-way for Corps projects and we maintain the completed levee projects.

Following the 1973 Flood, the Corps of Engineers evaluated the performance of the Mainline Mississippi River Levee system and they discovered that there were areas along the levee system that were deficient in grade and section. The Corps of Engineers performed an Environmental Impact Statement (EIS) in 1976. In 1998 the Corps performed a Supplemental Environmental Impact Statement (SEIS) for the Mainline Mississippi River Levee Enlargement and Berms
Project. The riverside batture land includes very important habitat for waterfowl, fisheries and wildlife. As part of this 1998 SEIS the Corps adopted “avoid & minimize” criteria within their design parameters in an effort to eliminate and lessen impacts to the environment.

Since 1998 the Corps of Engineers and the Levee Boards have partnered together and have been actively enlarging the deficient levees using various “avoid and minimize” design techniques. These levee enlargement projects not only provide critical flood protection, but also provide environmental gains in all environmental categories.

The Levee Enlargement & Berms Project needs to move towards completion because at this point our Mainline Mississippi River Levee will overtop during a Project Design Flood (PDF). If the levee overtops and fails, millions of acres are subject to flooding, millions of people will be displaced, homes, roads, farms, infrastructure and wildlife will be impacted causing billions of dollars of damage.

We request that the U.S. Army Corps of Engineers continue to expeditiously design and enlarge the remaining deficient Mainline Mississippi River Levee using the same design criteria and the same avoid and minimize environmental considerations that they have utilized over the past 20 years. It is also important that the landowners giving up lands for the construction of these projects continue to have input into the design process and the location of borrow areas.

We continue to value our partnership and association with the U.S. Army Corps of Engineers and we appreciate the opportunity to make this statement in support of the SEIS II and the completion of the remaining authorized work for the Mississippi River Levees of the Mississippi River & Tributaries Project.

BOARD OF LEVEE COMMISSIONERS FOR THE YAZOO-MISSISSIPPI DELTA LEVEE DISTRICT

Bruce Cook, P.E., P.S.
Chief Engineer
National Park Service Comments for the Mississippi River Project – Mississippi River Mainline Levees and Channel Improvement (NPS Environmental Review Tracking Solution Item: ER-18/0330).

Submitted by Jill Jensen (801-741-1012, ext 115; jill_jensen@nps.gov), Archeologist, Intermountain Region, National Park Service:

The project area shares a footprint with a major water route of the Trail of Tears National Historic Trail. As federal administrators of this National Historic Trail the National Park Service (NPS) requests that USACE consults with NPS regarding the potential for affects under the National Trails System Act, NEPA and under NHPA.
October 15, 2018

Via email:  MRL-EIS-2@usace.army.mil
Colonel Michael C. Derosier
Commander and District Engineer
Memphis District
U.S. Army Corps of Engineers
167 North Main Street, Room B-202
Memphis, TN  38103-1894

Re: Scoping Comments on Supplement II to the Final Environmental Impact Statement, Mississippi River and Tributaries Project, Mississippi River Mainline Leveses and Channel Improvement

Dear Col. Derosier:

The National Wildlife Federation appreciates the opportunity to submit comments on the scope of Supplement II to the Final Environmental Impact Statement, Mississippi River and Tributaries Project, Mississippi River Mainline Levees and Channel Improvement of 1976, as amended and updated by the 1998 Supplement I.

The National Wildlife Federation (NWF) is the nation’s largest conservation education and advocacy organization.  NWF has almost six million members and supporters and conservation affiliate organizations in 51 states and territories.  NWF has a long history of advocating for the protection, restoration, and ecologically sound management of the Mississippi River.  NWF also has a long history of working to modernize federal water resources planning to protect the nation’s rivers, wetlands, floodplains, and coasts and the fish and wildlife that depend on those vital resources.

General Comments

The National Wildlife Federation appreciates the decision to prepare Supplement II to the environmental impact statement for the above-referenced MR&T project.  Supplement II is both necessary and required given the dramatic changes in the human and natural environment affected by the Mississippi River Mainline Levee system, the significant new scientific information related to the hydrological conditions in the Mississippi River, and the changes in law and policy since the last supplement was completed 20 years ago.
The National Wildlife Federation recognizes the importance of the Mainline Levee system and the need to address deficiencies in that system. However, we also recognize that meaningful, long-term flood damage reduction will also require addressing the underlying causes of increased flood risks and protecting and restoring the river’s hydrologic processes and floodplain and delta wetlands to minimize future flood risks. Recommendations for ensuring that Supplement II can help achieve these goals are set forth below.

Given the significance of Supplement II to public safety and the environment, the National Wildlife Federation urges the U.S. Army Corps of Engineers (Corps) to have the National Academy of Sciences conduct the independent external peer review for Supplement II that is required by 33 U.S.C. § 2343. The panel should be charged with evaluating the long-term effectiveness of the alternative recommended by the Corps; whether the selected alternative will protect and restore the functions of the Mississippi River and its floodplain and coastal wetlands; and whether the selected alternative includes a detailed mitigation plan that is likely to produce ecologically successful mitigation.

To comply with longstanding environmental laws and the National Water Resources Planning Policy, the Corps should select an alternative that utilizes integrated river management to reduce flood risks while also protecting and restoring the ecologically vital Mississippi River.

Detailed Comments

The human and natural environment affected by the Mississippi River Mainline Levee system has seen dramatic changes since completion of the 1998 Supplement I. Since that time the scientific understanding of the river’s hydrological conditions and the implications of those conditions has also increased dramatically, and important changes have been made to applicable laws and policies.

Supplement II must fully address these changes and new information in developing alternatives and in analyzing the direct, indirect, and cumulative impacts of those alternatives. The Corps should then select an alternative that utilizes integrated river management to reduce flood risks while also protecting and restoring the ecologically vital Mississippi River.

To help achieve these goals and comply with the National Environmental Policy Act (NEPA), the National Water Resources Planning Policy, and the civil works mitigation requirements, the National Wildlife Federation urges the Corps to follow the recommendations set forth below.

A. Utilize an Appropriate Project Purpose

It is critical that Supplement II utilize a substantively and legally appropriate project purpose, which determines the universe of alternatives that must be evaluated.1

All reasonable alternatives that accomplish the project purpose must be examined in an environmental impact statement (EIS), while alternatives that are not reasonably related to the project purpose do not

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1 Citizens Against Burlington v. Busey, 938 F.2d 190, 195 (D.C. Cir. 1991) (the project purpose and need “delimit[s] the universe of the action’s reasonable alternatives.”) See also Wyoming v. U.S. Dep’t of Agric., 661 F.3d 1209, 1244 (10th Cir. 2011) (“how the agency defines the purpose of the proposed action sets the contours for its exploration of available alternatives.”).
have to be examined.\(^2\) An overly narrow project purpose can defeat the very purpose of an EIS by eliminating consideration of highly reasonable, less environmentally damaging alternatives:

“One obvious way for an agency to slip past the strictures of NEPA is to contrive a purpose so slender as to define competing “reasonable alternatives” out of consideration (and even out of existence). . . . If the agency constricts the definition of the project’s purpose and thereby excludes what truly are reasonable alternatives, the EIS cannot fulfill its role. Nor can the agency satisfy the Act. 42 U.S.C. § 4332(2)(E).”\(^3\)

A court “will reject an ‘unreasonably narrow’ definition of objectives that compels the selection of a particular alternative.”\(^4\) Agencies are also prohibited from so narrowly defining a project purpose that it “forecloses a reasonable consideration of alternatives”\(^5\) or makes the final EIS “a foreordained formality.”\(^6\)

The project purpose used in the 1998 Supplement I provides a clear example of an unreasonably narrow project purpose: “to raise and stabilize portions of the levee system to protect against the PDF.”\(^7\) This project purpose is overly narrow because it both forecloses a reasonable consideration of alternatives that do not focus solely on raising the levee system and compels selection of an alternative that does raise the levee system. Indeed, the 1998 Supplement I rejected the use of flowage easements precisely because it could not satisfy this project purpose.\(^8\)

Supplement II should utilize a fundamentally different project purpose that, as required by law, considers “the views of Congress, expressed, to the extent that an agency can determine them, in the

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\(^2\) Methow Valley Citizens Council v. Regional Forester, 833 F.2d 810, 815-16 (9th Cir. 1987).

\(^3\) Simmons v. United States Army Corps of Eng’rs, 120 F.3d 664, 666 (7th Cir. 1997); City of Carmel-by-the-Sea v. United States Dep’t of Transp., 123 F.3d 1142, 1155 (9th Cir. 1997) (“an agency cannot define its objectives in unreasonably narrow terms”); Citizens Against Burlington, Inc. v. Busey, 938 F.2d 190, 195-96 (D.C. Cir. 1991), cert. denied, 502 U.S. 994 (1991) (“an agency may not define the objectives of its action in terms so unreasonably narrow that only one alternative from among the environmentally benign ones in the agency’s power would accomplish the goals of the agency’s action”); City of New York v. United States Dep’t of Transp., 715 F.2d 732, 743 (2d Cir. 1983), cert. denied, 456 U.S. 1005 (1984) (“an agency will not be permitted to narrow the objective of its action artificially and thereby circumvent the requirement that relevant alternatives be considered”).


\(^6\) City of Bridgeton v. FAA, 212 F.3d 448, 458 (8th Cir. 2000) (quoting Citizens Against Burlington, Inc. v. Busey, 938 F.2d 190, 196 (D.C. Cir. 1991), cert. denied 502 U.S. 994 (1991); citing Simmons v. U.S. Army Corps of Eng’rs, 120 F.3d 664, 666 (7th Cir. 1997)).

\(^7\) 1998 Supplement I at 1-6.

\(^8\) 1998 Supplement I at 34 and SEIS-v (“Nonstructural alternatives such as acquisition of flowage easements can be utilized only if they further a project purpose or there is some legal obligation for them. Flowage easements were considered as a substitute for provision of PDF protection through levee raising. Such an alternative would not accomplish the congressionally mandated project purpose to provide a prescribed level of flood protection.”).
agency’s statutory authorization to act, as well as in other Congressional directives.”

Notably, Congress has established a multitude of directives that explicitly require and/or promote: (1) the protection and restoration of the nation’s waters and fish and wildlife resources; and (2) the use of natural infrastructure and nonstructural measures as a tool for achieving those goals. For example:

(1) In 2018, Congress required the Corps to “consider the use of both traditional and natural infrastructure alternatives, alone or in conjunction with each other, if those alternatives are practicable” in flood and storm damage risk reduction studies. America’s Water Infrastructure Act of 2018 § 1149(c). Natural infrastructure alternatives include, but are by no means limited to, actions to protect and restore floodplain wetlands.

(2) In 2016, Congress directed the Corps to “consider, as appropriate” natural and nature-based measures in flood and storm risk reduction and ecosystem restoration studies. 33 USC 2289a.

(3) In 2007, Congress directed that all water resources projects protect and restore the environment, including by protecting and restoring the functions of natural systems. 42 USC 1962–3.

(4) In 1974, Congress directed the Corps to consider nonstructural alternatives when planning flood damage reduction projects. 33 USC 701b-11. Nonstructural alternatives avoid damage to natural systems, including floodplain wetlands.

(5) In 1973, Congress passed the Endangered Species Act to conserve endangered and threatened species and “the ecosystems upon which endangered species and threatened species depend.” The Endangered Species Act also declares a Congressional policy “that Federal agencies shall cooperate with State and local agencies to resolve water resource issues in concert with conservation of endangered species.” Endangered Species Act, 16 USC 1531.

(6) In 1972, Congress passed the Clean Water Act “to restore and maintain the chemical, physical, and biological integrity of the Nation’s waters.” Clean Water Act § 101, 33 USC § 1251. The Clean Water Act also directed the development of the 404(b)(1) Guidelines which establish clear policies and procedures for protecting wetlands and other special aquatic sites.

(7) In 1970, Congress directed the “Federal Government to use all practicable means” to “fulfill the responsibilities of each generation as trustee of the environment for succeeding generations.” National Environmental Policy Act, 42 U.S.C. § 4331(b).

(8) In 1958 Congress directed that “wildlife conservation shall receive equal consideration and be coordinated with other features of water-resource development” and that water resources development is to prevent loss and damage to fish and wildlife and improve the health of fish and wildlife resources. Fish and Wildlife Coordination Act, 16 U.S.C. §§ 661, 662.

To account for these many directives focused on protecting and restoring natural systems, including floodplain wetlands, and to ensure that the alternatives analysis does not inappropriately limit the analysis of alternatives, the National Wildlife Federation urges adoption of the following statement of project purpose:

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11 This bill, which was passed with overwhelming support in both the House and Senate, was awaiting the President’s signature as of the date of these comments.
The purpose of the proposed action is to reduce flood risks to Mississippi River communities while protecting and restoring the ecological health of the Mississippi River and its floodplain and delta wetlands.

B. Rigorously Evaluate All Reasonable Alternatives, Including Integrated River Management

To satisfy the requirements of NEPA, Supplement II must “[r]igorously explore and objectively evaluate all reasonable alternatives.”12 “[T]he existence of reasonable but unexamined alternatives renders an EIS inadequate.”13 “Reasonable alternatives include those that are practical or feasible from a technical and economic standpoint and using common sense, rather than simply desirable from the standpoint of the applicant.”14 Merely evaluating alternative approaches to levee and seepage control construction cannot satisfy the requirement to evaluate all reasonable alternatives because each alternative would have the same end result – raising the levees.15

Notably, Supplement II must evaluate alternatives that would protect and restore the natural functions of the Mississippi River, and must ultimately select an alternative that achieves these objectives. This is required by the National Water Resources Planning Policy established by Congress in 2007, which requires that “all water resources projects” are to protect the environment by “protecting and restoring the functions of natural systems and mitigating any unavoidable damage to natural systems.”16

The National Wildlife Federation urges the Corps to develop and adopt an alternative that utilizes a combination of low impact flood damage reduction measures, ecosystem restoration actions, and improved navigation management to reduce flood risks and restore the environment. Key activities that should be examined in depth for inclusion in this integrated river management alternative include at least the following:

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13 Ctr. for Biological Diversity v. United States Dep’t of the Interior, 623 F.3d 633, 642 (9th Cir. 2010); Westlands Water Dist. v. U.S. Dep’t of Interior, 376 F.3d 853, 868 (9th Cir. 2004); Morongo Band of Mission Indians v. Fed. Aviation Admin., 161 F.3d 569, 575 (9th Cir. 1998); Oregon Natural Desert Ass’n v. Bureau of Land Management, 531 F.3d 1114, 1121 (9th Cir. 2008).
15 State of California v. Block, 690 F.2d 753, 767 (9th Cir. 1982) (holding that an inadequate range of alternatives was considered where the end result of all eight alternatives evaluated was development of a substantial portion of wilderness).
16 42 U.S.C. 1962-3 (established by § 2031(a) of the Water Resources Development Act of 2007, and immediately applicable to all water resources projects). Enhancement of the environment has been an important federal objective for water resources programs for decades. Corps regulations in place since 1980 state that: “Laws, executive orders, and national policies promulgated in the past decade require that the quality of the environment be protected and, where possible, enhanced as the nation grows. . . . Enhancement of the environment is an objective of Federal water resource programs to be considered in the planning, design, construction, and operation and maintenance of projects. Opportunities for enhancement of the environment are sought through each of the above phases of project development. Specific considerations may include, but are not limited to, actions to preserve or enhance critical habitat for fish and wildlife; maintain or enhance water quality; improve streamflow; preservation and restoration of certain cultural resources, and the preservation or creation of wetlands.” 33 C.F.R. § 236.4. (emphasis added).
(1) Obtaining all levee construction material from non-wetland locations. This should be a fundamental component of every alternative evaluated in Supplement II and should be included in the final alternative recommended in Supplement II.

As the Corps is aware, Supplement I approved the utilization of wetlands as construction material for levee enlargements and seepage control structures (through the placement of borrow pits in wetlands). Use of wetlands for construction material was strongly opposed by the conservation community, the public, and other federal agencies during the 1998 Supplement I process.

The value of the nation’s wetlands—and the unacceptability of destroying wetlands so that wetland soils can be used for construction—is even more evident today. The nation’s wetlands are far too valuable for flood damage reduction, fish and wildlife habitat, clean water, ecosystem services, recreation, and the economy to be used in this manner.

For example, wetlands account for more than 90% of the $330 billion to $1.3 trillion estimated present value of the ecosystem goods and services provided by Mississippi Delta. Coastal wetlands reduced storm surge in some New Orleans neighborhoods by two to three feet during Hurricane Katrina, and levees with wetland buffers had a much greater chance of surviving Katrina’s fury than levees without wetland buffers. Wetlands prevented $625 million in flood damages in the 12 coastal states affected by Hurricane Sandy and reduced damages by 20% to 30% in the four states with the greatest wetland coverage. During Tropical Storm Irene, a network of wetlands and protected floodplain saved Middlebury Vermont $1.8 million in flood damages. Wetlands in California provide nearly $10 billion each year in flood damage reduction, groundwater recharge, and water purification benefits.

Wetlands are some of the most biologically productive natural ecosystems in the world, and support an incredibly diverse and extensive array of fish and wildlife. America’s wetlands support millions of migratory birds and waterfowl. Up to one-half of all North American bird species rely on wetlands. Although wetlands account for just about five percent of land area in the lower 48 states, those wetlands are the only habitat for more than one third of the nation’s threatened and endangered species and support an additional 20 percent of the nation’s threatened and endangered at some time in their life. These same wetlands are home to 31 percent of the nation’s plant species.

Wetlands are also a critical economic driver. For example, 90 percent of fish caught by America’s recreational anglers are wetland dependent, as are hundreds of species of birds, waterfowl, and wildlife. The U.S Fish and Wildlife Service estimates that in 2011, anglers spent “$41.8 billion on trips, equipment, licenses, and other items to support their fishing activities.” That same year, nearly 71.8 million people “fed, photographed, and observed wildlife,” spending $55 billion on those activities. In all, nearly 90.1 million Americans participated in

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17 Earth Economics, Gaining Ground, Wetlands, Hurricanes and the Economy: The Value of Restoring the Mississippi River Delta, at 11.
some form of fishing, hunting or wildlife-associated recreation in 2011, contributing $145 billion to the national economy. “This equates to 1% of gross domestic product; meaning one out of every one hundred dollars of all goods and services produced in the U.S.”

There is no legitimate justification for digging up wetlands to use the soil for construction purposes, and Supplement II should ensure that no wetlands are destroyed for this purpose by explicitly prohibiting the use of wetlands (including the location of borrow pits in wetlands) as a source of construction material. Adverse impacts to wetlands from other activities must be avoided to the maximum extent possible, as required by law.

(2) **Realigning segments of the levee system farther away from the river.** Levee setbacks give the river more room to spread out during flood events. Such setbacks have been used extensively along the Mississippi River. Indeed, at the Corps acknowledged in the 1998 Supplement I:

> “Numerous levee setbacks have been required through the years because of the evermoving Mississippi River. Since 1915, levee setbacks have continually increased acreages to lands between the Mississippi River mainline levees. To date, the approximate cumulative total is 50,000 acres of land added between the levees. A 1996 study of levees in the Vicksburg District indicated that 17 major levee setbacks since 1915 have resulted in 43,000 acres being added to the riverside flood plain.”

(3) **Modifying management of the MR&T floodways to reduce flood risks.** Supplement II should examine whether the Corps should recommend to Congress a different ratio than the current 70/30 split between the Mississippi and Atchafalaya rivers or whether other modifications to managing the Atchafalaya floodway system can be made to reduce flood risks. Supplement II should also evaluate whether other floodways could be used more regularly to reduce flood risk and create fish and wildlife habitat. NEPA requires review of alternatives that are currently outside the authority of the Corps to implement.

(4) **Utilizing sediment diversions to both reduce flood risks and advance coastal wetland restoration.** Supplement II should examine whether new sediment and freshwater diversions could be implemented in the future, and whether existing and planned structures could be better utilized to reduce flood risks and advance coastal wetland restoration. Supplement II should also examine other methods to transport sediment from the stretch below the Old River Control Structure to use in rebuilding coastal wetlands.

Sediment and freshwater diversions have long been identified as keystone restoration project types for building new land and maintaining existing wetlands in Louisiana. Integrated into the levee system, these gated structures can be opened and closed to allow water, sediment and nutrients from the river to flow into open water and degraded wetlands, mimicking the natural system that existed before levees were built. As much as possible, management of sediment diversions should mimic the natural flood cycles of the Mississippi River, so that the ecosystem, vegetation and species can self-organize around pulses of freshwater, sediment, and nutrients.

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(5) Modifying and/or removing targeted river training structures to reduce flood risks.

Supplement II should carefully examine modification and/or removal of targeted river training structures to reduce flood risks (see Section C of these comments for a discussion of these flood risks). The Corps has acknowledged that modification and/or removal of at least some structures will be required for mitigation purposes for the Regulating Works Project, and that such actions will not create problems for navigation.

C. Fully Analyze the Causes of Increased Flood Risks and Levee Deficiencies to Assist in Developing Meaningful, Long-Term Solutions

The National Wildlife Federation recognizes the importance of the Mainline Levee system and the need to address deficiencies in that system. However, we also recognize that meaningful, long-term flood damage reduction will also require addressing the underlying causes of increased flood risks and ensuring that any recommended alternative will protect and restore the river’s floodplain and delta wetlands and hydrologic processes to minimize future flood risks.

The short-term nature of relying solely on levee enlargement and seepage control measures is exemplified by the extensive deficiencies that have arisen since finalization of the 1998 Supplement I. The 1998 Supplement I identified 128 needed construction items that included 263 miles of levee enlargements and 132 miles of seepage control features. Construction was estimated to cost $911 million fully funded, and with appropriate funding could have been completed in 2020. However, in February 2017, the Mississippi River Commission reported that the Mississippi River Mainline Leveses now require 370 miles of levee enlargements (at 138 levees and floodwalls) and 395 miles of seepage control features (at 97 levees). Construction is estimated to cost $3.1 billion, with $2.0 billion of that work deemed to be critical.

According to the map of the proposed work items provided by the Memphis District, most of the proposed new construction is in areas not identified in the 1998 Supplement I. For example, an extensive amount of the proposed new construction would take place in the New Orleans District, which the 1998 Supplement I identified as requiring just over 14 miles of upgrades.

<table>
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<th>Corps District</th>
<th>1998 Supplement I Work Items</th>
<th>Levee Enlargements</th>
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Additional materials provided to NWF by the Corps state that approximately 150 miles of Mainline Mississippi River Levee in the New Orleans District are currently deficient, with deficiencies ranging from a few inches to 6.5 feet. These 150 miles are currently broken out into 77 Work Items. Each work item will also include a seepage analysis to determine whether seepage control measures are required.

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Clearly, then, the situation on the river has changed significantly in the past 20 years (or the 1998 Supplement II did not adequately evaluate the conditions on the ground). These changes include increased flood levels, channel aggradation, channel narrowing, subsidence, and sea level rise. Unless these problems are addressed, the Mainline Levee system will continue to degrade and the risk to the public will continue to increase.

To develop meaningful, long-term solutions that address these problems, Supplement II should fully evaluate the key factors that have affected the integrity and sufficiency of the Mainline Levee system, including those outlined below.

1) Supplement II should fully evaluate the role of channelization, channel aggradation, and river operations on flood levels and the integrity of the Mainline Levee system.

For example, a 2018 study concludes that “artificial channelization of the lower Mississippi River, and its effects on the river’s gradient, channel area and flow velocity” have “significantly increased the discharge of a given flood event relative to pre-engineering conditions.”25 This study shows that flooding on the lower Mississippi has increased by 20 percent over that past 500 years, with “75 per cent of this increase attributed to river engineering” and concludes that “the interaction of human alterations to the Mississippi River system with dynamical modes of climate variability has elevated the current flood hazard to levels that are unprecedented within the past five centuries.”26 This study further concludes:

“Our main finding—that river engineering has elevated flood hazard on the lower Mississippi to levels that are unprecedented within the past five centuries—adds to a growing list of externalized costs associated with conventional flood mitigation and navigation projects, including a reduction in a river’s ability to convey flood flows, the acceleration of coastal land loss and hypoxia. Despite the societal benefits that these major infrastructure projects convey, the costs associated with maintaining current levels of flood protection and navigability will continue to grow at the expense of communities and industries situated in the river’s floodplain and its delta. For those interested in improving seasonal and longer-term forecasts of flood hazard or management strategies that reconnect the river with its floodplain, the Mississippi River’s discharge of freshwater—and by extension the flux of sediment, nutrients and pollutants—to its outlet should be viewed as highly sensitive both to anthropogenic modifications to the basin and to variability of the global climate system.”27

Another 2018 study, that utilizes Corps data, demonstrates “significant changes in cross-sectional area, river stage, and river surface slope in specific discharge regimes along the first 140 km downstream of the LMR’s diversion to the Atchafalaya River at the Old River Control Structure (ORCS)” since 1992.28

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26 Id. at 95.
27 Id. at 98 (internal footnotes omitted).
“This study used the hydrographic survey measurements conducted in 1992, 2004, and 2013 as well as daily river discharge and stage records over the past three decades to assess long-term channel morphological changes at seven locations along a 327-km reach of the Lower Mississippi River (LMR), one of the most regulated alluvial rivers in the world. We found significant changes in cross-sectional area, river stage, and river surface slope in specific discharge regimes along the first 140 km downstream of the LMR’s diversion to the Atchafalaya River at the Old River Control Structure (ORCS), covering Tarbert Landing, Red River Landing, Bayou Sara, and Baton Rouge. Specifically, the first 20–25 km reach (reach 1) and the reach further downstream from 80 to 140 km (reach 3) showed continuous decreases in cross-sectional area and increases in river stage and river slope under all flow conditions. However, the 55–60 km reach in between (from 20–25 km to 80 km below ORCS) (reach 2) experienced exactly opposite trends, i.e. increase in cross-sectional area and decrease in river stages. Furthermore, the remaining 187 km reach (from 140 to 327 km; reach 4) had insignificant changes in its cross-sectional area, river stage, and river surface slope. We link these changes to channel bed adjustment pertaining to sediment deposition and erosion partially and propose that reaches 1 and 3 have probably experienced sediment deposition, reach 2 has probably experienced bed erosion, and reach 4 is probably approaching dynamic equilibrium over the past three to four decades. Therefore, substantial amount of sediment, potentially useful for land-building purposes, appears to be trapped along the first 140 km LMR reach below ORCS, while sediment flow seems higher along the next 187-km reach. These findings suggest that large alluvial rivers with intensive human interventions go through noticeable spatial and temporal changes in their corresponding bed adjustment processes. Such information can have relevant implications for riverine sediment management, channel engineering, and coastal land restoration in the world’s sinking deltas fed by regulated alluvial rivers.”

Copies of both of these 2018 studies are provided at Attachment A to these comments.

(2) Supplement II should fully evaluate the extensive body of peer reviewed science which shows that river training structures have significantly increased flood levels in the Middle Mississippi River, including in locations targeted for construction as identified in the project map.

As the Corps is aware, extensive peer-reviewed science demonstrates that river training structures have increased flood levels by up to 15 feet in some locations and 6 to 10 feet in broad stretches of the Middle Mississippi River where these structures are prevalent. The

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29 Id.
30 The National Wildlife Federation recognizes that the Corps disagrees with these findings. However, the Corps’ conclusion that river training structures do not affect flood heights has been conclusively disproved by research led by Nicholas Pinter, Ph.D., currently the Shlemon Chair in Applied Geology at the University of California Davis. Dr. Pinter has specifically rebutted the arguments used by the Corps to reject these findings in a series of exchanges published in the Journal of Hydraulic Engineering and in sworn affidavits submitted to the District Court for the Southern District of Illinois. These materials are provided at Attachment B to these comments.
impacts of river training structures are cumulative; the more structures placed in the river, the higher the flood stages. Flood stages increase more than 4 inches for each 3,281 feet of wing dike built within 20 river miles downstream:

“[O]ur analyses demonstrate that wing dikes constructed downstream of a location were associated with increases in flood height (“stage”), consistent with backwater effects upstream of these structures. Backwater effects are the rise in surface elevation of flowing water upstream from, and as a result of, an obstruction to water flow. These backwater effects were clearly distinguishable from the effects of upstream dikes, which triggered simultaneous incision and conveyance loss at sites downstream. On the Upper Mississippi River, for example, stages increased more than four inches for each 3,281 feet of wing dike built within 20 RM (river miles) downstream. These values represent parameter estimates and associated uncertainties for relationships significant at the 95 percent confidence level in each reach-scale model. The 95-percent level indicates at least a 95% level of certainty in correlation or other statistical benchmark presented, and is considered by scientists to represent a statistically verified standard. Our study demonstrated that the presence of river training structures can cause large increases in flood stage. For example, at Dubuque, Iowa, roughly 8.7 linear miles of downstream wing dikes were constructed between 1892 and 1928, and were associated with a nearly five-foot increase in stage. In the area affected by the 2008 Upper Mississippi flood, more than six feet of the flood crest is linked to navigational and flood-control engineering.”

Additional science shows that the Middle Mississippi River has been so constricted by river training structures and levees that it is now exhibiting “the flashy response” to flooding “typical of a much smaller river,” with extremely troubling implications for public safety. In recent comments submitted on the Corps’ Regulating Works Project Grand Tower Amended Environmental Assessment, Robert E. Criss, Ph.D., a professor in the Department of Earth and Planetary Sciences at Washington University in St. Louis, concludes:

“The consequences of current management strategy on floodwater levels are clearly shown by data from multiple gauging stations on the Middle Mississippi River (Figures). The Chester and Thebes stations were selected as they are the closest stations to the project area that have long, readily available historical records (USGS, 2016). These figures conclusively document that floodwater levels have been greatly magnified along the Middle Mississippi River, in the timeframe when most of the in-channel navigational structures were constructed. If these structures are not the cause, then we are left with no explanation for this profound, predictable effect. That USACE proposes more in-channel construction activities only two months after another “200-
year” flood (as defined by USACE, 2004, 2016) occurred in this area proves that their structures and opinions are not beneficial, but harmful."34

Dr. Criss adds that measurements at the Mississippi River at St. Louis and the Missouri River at Herman “document similar damaging and incontestable trends for other river reaches managed in the same manner.”35

A 2016 Journal of Earth Science study co-authored by Dr. Criss (“Criss and Luo 2016”) highlights the cumulative impact of the Corps’ excessive channelization of the Middle Mississippi River.36 As noted above, that study concludes that the Middle Mississippi River has been so constricted by river training structures and levees that it is now exhibiting “the flashy response” to flooding “typical of a much smaller river”:37

“Ehlmann and Criss (2006) proved that the lower Missouri and middle Mississippi Rivers are becoming more chaotic and unpredictable in their time of flooding, height of flooding, and magnitude of their daily changes in stage. This chaotic behavior is primarily the result of extreme channelization of the river, and its isolation from its floodplain by levees (e.g., Criss and Shock, 2001; GAO, 1995; Belt, 1975). The channels of the lower Missouri and middle Mississippi Rivers are only half as wide as they were historically, along a combined reach exceeding 1 500 km, as clearly shown by comparison of modern and historical maps (e.g., Funk and Robinson, 1974).”

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34 Comments on Draft Environmental Assessment by Robert E Criss, Washington University, March 3, 2016 (emphasis added).
35 Id.
36 The National Wildlife Federation recognizes that the Corps has disputed the findings of this study. However, the Corps’ critique of this study as provided in Appendix A to the May 2017 Regulating Works Project Final Environmental Impact Statement is fundamentally flawed. That critique does not address the content of the study, and instead focuses on a single locality (Chester) that was scarcely mentioned in the study. The discussion of this single locality (Chester) inappropriately compares the recent winter flood with prior, warm weather floods, and rising limb data with falling limb data. In addition, the critique, does not—and cannot—explain away critical findings in Criss and Luo 2016, including the findings related to: (1) The record high stages set during this recent flood just downstream at Cape Girardeau and Thebes, which as Criss and Luo point out would have been far higher but for the catastrophic failure of the Len Small levee; (2) Why the recent peak stage at Chester was nearly 3 feet higher than it was on April 30, 1973, which at that time was the highest water level ever recorded at that site; (3) The unusual winter timing of this recent flood and its short duration, both of which would not have caused a flood of this magnitude without constriction of the river; and (4) Why the site showing the greatest increase in stage over previous floods occurred adjacent to the Valley Park levee, built by the Corps in 2005. Moreover, contrary to the assertions in the critique, the Criss and Luo 2016 synopsis of weather conditions clearly acknowledges antecedent ground saturation, and all data used by Criss and Luo are identical to values reported by the cited federal agencies at the time of writing. Each of those values remains identical to the values reported today with the single exception that the 1982 stage at Pacific was revised subsequently by the National Weather Service. However, this change has no effect on the Criss and Luo 2016 conclusions.
“The aftermath of storm Goliath [which led to the December 2015 floods] provides another example in an accelerating succession of record floods, whose tragic effects have been greatly magnified by man. The heavy rainfall was probably related to El Nino, and possibly intensified by global warming. . . . The Mississippi River flood at St. Louis was the third highest ever, yet it occurred at the wrong time of year, and its brief, 11-day duration was truly anomalous. Basically, this great but highly channelized and leveed river exhibited the flashy response of a small river, and indeed resembled the response of Meramec River, whose watershed is smaller by 160×. Yet, only a few percent of the watershed above St. Louis received truly heavy rainfall during this event; the river rose sharply because the water simply had nowhere else to go.”

“Further downstream, new record stages on the middle Mississippi River were set. Those record stages would have been even higher, probably by as much as 0.25 m, had levees not failed and been overtopped. The sudden drop of the water level near the flood crest at Thebes clearly demonstrates how levees magnify floodwater levels. In this vein, it is very significant that the water levels on the lower Meramec River were highest, relative to prior floods, proximal to a new levee and other recent developments.”

“Forthcoming calls for more river management, including higher levees and other structures, must be rejected. Additional “remediations” to this overbuilt system will only aggravate flooding in the middle Mississippi Valley (see Walker, 2016).”

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“In contrast, Goliath’s extraordinary rainfall impacted only a tiny fraction of the huge, 1.8 million km² Mississippi River Basin above St. Louis, yet flooding occurred which was truly remarkable for the high water level, time of year, and brief duration.”

“This continental-scale river exhibited the flashy response typical of a much smaller river such as the Meramec. This unnatural response is clearly consistent with the dramatic channelization of the middle Mississippi River and its isolation from its floodplain by levees, as clearly pointed out by Charles Belt more than 40 years ago. It is time for this effect to be accepted and for flood risk and river management to be reassessed.”

(3) Supplement II should fully evaluate the role of levee construction and levee enlargements on increased flood levels, along with the potential of the proposed work items to also increase flood levels.

It is of course well recognized that new and/or higher levees increase flood heights. Indeed, the Corps recognized this in the 1998 Supplement I, when it concluded that two private levees were key factors in higher water surface elevations during the Mississippi River flood of 1995:

“The 1993 and 1995 floods on the upper Mississippi River revealed significant upward changes in stage-discharge relationships on the upper Mississippi River. The higher than expected water surface elevations experienced during the flood of 1995 on the reach of
the Mississippi River above Cairo, Illinois, indicated that significant changes in the flood plain have occurred from the conditions used to develop the 1956 PDF flowline. Therefore, the MR&T Project design flowline from Cairo to Cape Girardeau was revised in 1996. The revision was based on available data and analyses of river hydraulic and hydrologic parameters. Two private levees (Powers Island levee and the Miller City levee) located in the Upper Mississippi River Commerce to Birds Pt. reach are factors in the changed flood plain conditions. Earlier, these private levees have tended to fail during floods, permitting partial conveyance of flow through the flood plain. In recent years, these levees have demonstrated greater resistance to failure, resulting in higher than expected flowlines against the project levee.”39

(4) Supplement II should fully evaluate the role of sea level rise and subsidence on the deficiencies in the Mainline Levee system.

As the Corps is aware, subsidence is a critical problem exacerbated by a lack of land building sediments reaching the river’s lower reaches combined with sea level rise. A recent study concludes that the Mississippi River downstream of New Orleans—where most of the New Orleans District work items would occur—is subsiding at a higher rate than the already high average rate of subsidence across coastal Louisiana:

“While spatial variability between our discrete monitoring sites is high, the map shows that the expected average subsidence rate is relatively uniform across coastal Louisiana, with a mean rate of 9 mm yr−1 and a standard error of the mean of 1 mm yr−1. . . . The map predicts slightly higher than average subsidence rates in the eastern Chenier Plain, the Atchafalaya and Wax Lake Deltas, and along the Mississippi River downstream of New Orleans.”40

(5) Supplement II should fully evaluate the implications of climate change, and climate change-induced sea level rise and more extreme weather events.

An extensive body of science demonstrates that the earth’s climate is changing and that this change is causing significant increases in sea level rise and more frequent and extreme weather events. Supplement II should fully analyze and account for this information and changed conditions that have significant implications for the long-term effectiveness of flood damage reduction measures and the long term health and viability of coastal and riverine wetlands and the fish and wildlife that rely on those resources.

For example, climate change is implicated in significant changes in precipitation in the Mississippi River basin. In March 2005, the U.S. Geological Survey reported upward trends in rainfall and stream flow for the Mississippi River.41 In 2009, the U.S. Global Change Research Program issued a report showing that the Midwest experienced a 31% increase in very heavy

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precipitation events (defined as the heaviest 1% of all daily events) between 1958 and 2007.42 That study also reports that during the past 50 years, “the greatest increases in heavy precipitation occurred in the Northeast and the Midwest.”43 Models predict that heavy downfalls will continue to increase:

Climate models project continued increases in the heaviest downpours during this century, while the lightest precipitation is projected to decrease. Heavy downpours that are now 1-in-20-year occurrences are projected to occur about every 4 to 15 years by the end of this century, depending on location, and the intensity of heavy downpours is also expected to increase. The 1-in-20-year heavy downpour is expected to be between 10 and 25 percent heavier by the end of the century than it is now. . . . Changes in these kinds of extreme weather and climate events are among the most serious challenges to our nation in coping with a changing climate.44

In March 2012, Midwest regional assessments were issued that provide important technical input into the National Climate Assessment.45 In 2013, Regional Climate Trends and Scenarios were issued for the Midwest U.S. showing that for the Midwest region, annual and summer trends for precipitation in the 20th century are upward and statistically significant; the frequency and intensity of extreme precipitation in the region has increased, as indicated by multiple metrics; and models predict increases in the number of wet days (defined as precipitation exceeding 1 inch) for the entire Midwest region, with increases of up to 60%.46

(6) Supplement II should fully evaluate whether the current flowline is appropriate.

Supplement II should utilize the findings from the analyses identified above and the numerous sources of new data and extensive new modeling capacity developed over the last 20 years to establish a more accurate and nuanced assessment of the dynamic baseline conditions and flowlines affecting the river reaches covered by the MR&T.

Relevant studies that are currently ongoing include the Mississippi River Hydrodynamic and Delta Management Study, which will address the Mississippi River from Vicksburg, Mississippi to the Gulf of Mexico. This study is highly relevant to Supplement II, as the Corps’ website makes clear:

“This study will identify and evaluate a combination of large-scale management and restoration features to address the long-term sustainability of the lower Mississippi

43 Id.
44 Id.
River Deltaic Plain, and will balance the interests of ecosystem restoration, flood risk reduction and navigation."47

Assessment of the new flowline should also utilize the recently released new Guidelines for determining flood flow frequency—Bulletin 17C.48 This long-awaited Bulletin, which was released by the U.S. Geological Survey on March 29, 2018, updates guidelines that were last updated in 1982. “Federal agencies are requested to use these Guidelines in all planning activities involving water and related land resources.”49

The National Wildlife Federation notes that the PDF flowline was updated for the 1998 Supplement I,50 but is not clear from the materials provided by the Memphis District whether an update has been carried out in advance of this scoping process.51 Updating the flowline would appear to be an essential component for developing an adequate Supplement II.

(7) Supplement II should fully evaluate the role that sediment and freshwater diversions could play in minimizing future deficiencies in the Mainline Levee system.

Important efforts are underway to build and re-operate Mississippi River diversion projects to move more sediment into the Mississippi River delta to rebuild the delta’s wetlands. For example, the Mid-Barataria Sediment Diversion, which is one of the most studied and modeled projects in Louisiana’s history, will bring sediments and nutrients into the Barataria Basin building land and spurring growth of wetland plants. Supplement II should carefully evaluate the role of sediment diversions in increasing the resiliency of the MR&T and in reducing flood risks for the region.

Diversions have been recognized as critical projects for the future of Louisiana’s coastal in every Louisiana Coastal plan issued over the past 40 years precisely because the Mississippi River is the region’s greatest force for building land.52 Most of the areas of Louisiana’s coast that have

50 1998 Supplement I, Project Report at 10 (“The 1993 and 1995 floods on the upper Mississippi River revealed significant upward changes in stage-discharge relationships on the upper Mississippi River. The higher than expected water surface elevations experienced during the flood of 1995 on the reach of the Mississippi River above Cairo, Illinois; indicated that significant changes in the flood plain have occurred from the conditions used to develop the 1956 PDF flowline. Therefore, the MR&T Project design flowline from Cairo to Cape Girardeau was revised in 1996. The revision was based on available data and analyses of river hydraulic and hydrologic parameters. Two private levees (Powers Island levee and the Miller City levee) located in the Upper Mississippi River Commerce to Birds Pt. reach are factors in the changed flood plain conditions. Earlier, these private levees have tended to fail during floods, permitting partial conveyance of flow through the flood plain. In recent years, these levees have demonstrated greater resistance to failure, resulting in higher than expected flowlines against the project levee.”)
52 http://mississippiriverdelta.org/coastal-restoration-and-louisiana-more-than-40-years-of-planning/
been maintaining or even gaining land instead of losing it are doing so because of regular sediment input from the Mississippi River.\textsuperscript{53} For example, the Wax Lake Delta, located in Atchafalaya Bay, has been impacted by storm surge over the years, but this delta quickly recovers and continues to grow and push out into the Atchafalaya Bay because of the steady supply of sediment. As a result, it is one of the few areas of the Louisiana coast that is gaining land.\textsuperscript{54}

(8) Supplement II should fully evaluate whether the proposed deepening of the lower Mississippi River navigation channel could create additional stressors on the Mainline Levee system.

The Corps is currently considering a proposal to deepen the navigation channel in portions of the lower Mississippi River. Among other impacts, this proposed deepening could increase hurricane-induced storm surge height and distance of storm surge propagation upstream. This would significantly intensify pressure on river levees, particularly those in Louisiana’s Plaquemines Parish. During Hurricanes Katrina and Isaac, storm surge increased river stage at the Corps’ Carrollton gage in New Orleans by at least 10-ft and 6-ft, respectively.

These analysis should be used to properly assess current and potential future conditions; analyze direct, indirect, and cumulative impacts; and critically, to develop meaningful and long-term solutions to reducing flood damages while improving the health of the environment.

D. Comprehensively Evaluate the Full Suite of Direct, Indirect, and Cumulative Impacts

In addition to the investigations outlined in Section C of these comments, Supplement II also must examine the direct, indirect, and cumulative environmental impacts of all reasonable alternatives, the conservation potential of those alternatives, and the means to mitigate adverse environmental impacts that cannot be avoided.\textsuperscript{55} These assessments are critical for determining whether less environmentally damaging alternatives are available.

Supplement II should ensure a full assessment of the direct, indirect, and cumulative impacts on at least the resources outlined below.

(1) Impacts on hydrology, including the impacts on flood heights, channel morphology, and sedimentation. Depending on the alternatives considered, the project could have significant adverse impacts to these process or could help return these processes to more natural conditions with significant positive benefits. In light of the vital importance of sediment transport for coastal Louisiana restoration, Supplement II should carefully evaluate and quantify the impacts on sediment transport downstream, including any resulting impacts on


\textsuperscript{55} 40 C.F.R. § 1502.16.
coastal wetland losses and/or coastal wetland restoration.

(2) Impacts on special aquatic habitats – including riverine, floodplain, and coastal wetlands. The Mississippi River and its floodplain have suffered astounding wetland losses. The loss of these vital habitats has cascading negative impacts on fish and wildlife, public safety, recreation, and economies that rely on healthy river and floodplain systems. Supplement II must carefully evaluate and quantify the potential for additional losses – or gains – of wetlands and other special aquatic sites. The cumulative impacts of historical losses to these key habitats must also be fully evaluated and accounted for in any final recommended alternative.

Notably, "[t]he single most important factor affecting wetlands has been the construction of levees to reduce the frequency and duration of flooding throughout much of the lower Mississippi River Valley."56 This includes significant losses to bottomland hardwood wetlands, which are recognized as being "among the Nation’s most important wetlands."57 When the U.S. Fish and Wildlife Service was providing input for the 1998 Supplement I, it concluded that “any further loss of forested wetlands within the project area should be considered significant considering the cumulative losses.”58 Recognizing the true importance and value of wetlands, and the role of projects such as this one in causing the losses of these wetlands, is critical for making an informed decision that avoids additional wetland impacts.

As noted above, the National Wildlife Federation urges the Corps to prohibit the use of wetlands (including through placement of borrow pits in wetland areas) for construction material. Such use is anathema to sound water resources management and is contrary to the clear directives in law and policy to protect the nation’s wetland resources and avoid and minimize damage to the nation’s wetlands.

(3) Impacts on fish and wildlife. Supplement II must examine the impacts of the alternatives on the species that utilize the Mississippi River, including the impacts to fish, waterfowl, birds, mammals, reptiles, amphibians, and mussels. The Mississippi River is used by an astounding array of wildlife, including 360 species of birds, 260 species of fish, 145 species of amphibians and reptiles, 98 species of mussels, and 50 species of mammals.

Forty percent of North America’s waterfowl migrate through the Mississippi River flyway. The impacts on the critical array of migratory species that utilize the Mississippi River and Mississippi River flyway must also be analyzed, including the cumulative impacts of climate change on these species. As discussed below, migratory wildlife are particularly vulnerable to the impacts of climate change.

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57 Report to Congress by the Secretary of the Interior, Impact of Federal Programs on Wetlands, Volume I, at 39 (1988). Indeed, bottomland hardwood wetlands are so important that they Congress has determined that in any Corps project proposed to Congress, losses of bottomland hardwoods must be mitigated in kind whenever possible. 33 U.S.C. § 2283(d)(2).
58 November 30, 1995 letter from Allan J. Mueller to Colonel Gary W. Wright. A copy of this letter is found at Appendix 11 of the DSEIS for Supplement I.
An accurate assessment of fish and wildlife impacts will require an accurate assessment of impacts to the full range of habitats that these species rely on. A meaningful assessment would also include an evaluation of the impacts of each alternative on the ability of the fish and wildlife that utilize the river and flyway to withstand the adverse impacts of climate change (i.e., the species’ resiliency to climate change).

(9) **Impacts on endangered species.** Supplement II should pay particular attention to the impacts on threatened and endangered species and any critical habitat.

(10) **Impacts on water quality, including nutrient composition.** The Mississippi River remains plagued by water quality problems, including excess nutrients that have both local and ecosystem wide impacts (including, for example, yearly development of the Gulf of Mexico dead zone). Supplement II must carefully evaluate and quantify the impacts of each alternative on water quality in the river, including the potential water quality impacts caused by loss of wetlands and increased sedimentation.

(11) **Impacts on vegetation, including wetland vegetation and threatened, endangered and at risk plant species.** Impacts to plant species, which of course are a critical component of the environment, must be evaluated in Supplement II. Moreover, without this analysis it is not possible to accurately assess impact to fish and wildlife or water quality.

(12) **Cumulative impacts of climate change.** Supplement II must assess the cumulative impacts of climate change, including climate-change induced increases in precipitation, extreme weather events, and sea level rise. Of critical concern are the additive and magnifying effect of climate change on increased flood risks, wetland losses, and fish and wildlife.

Climate change may significantly exacerbate the impacts on the many migratory species that utilize the Mississippi River, Mississippi River Flyway, and the project area. As recognized by the United Nations Environment Program and the Convention on the Conservation of Migratory Species of Wild Animals, migratory wildlife is particularly vulnerable to the impacts of climate change:

“As a group, migratory wildlife appears to be particularly vulnerable to the impacts of Climate Change because it uses multiple habitats and sites and use a wide range of resources at different points of their migratory cycle. They are also subject to a wide range of physical conditions and often rely on predictable weather patterns, such as winds and ocean currents, which might change under the influence of Climate Change. Finally, they face a wide range of biological influences, such as predators, competitors and diseases that could be affected by Climate Change. While some of this is also true for more sedentary species, migrants have the potential to be affected by Climate Change not only on their breeding and non-breeding grounds but also while on migration.”

“Apart from such direct impacts, factors that affect the migratory journey itself may affect other parts of a species’ life cycle. Changes in the timing of migration may affect breeding or hibernation, for example if a species has to take longer than normal on migration, due to changes in conditions en route, then it may arrive late, obtain poorer quality breeding resources (such as
territory) and be less productive as a result. If migration consumes more resources than normal, then individuals may have fewer resources to put into breeding . . . .”

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“Key factors that are likely to affect all species, regardless of migratory tendency, are changes in prey distributions and changes or loss of habitat. Changes in prey may occur in terms of their distributions or in timing. The latter may occur though differential changes in developmental rates and can lead to a mismatch in timing between predators and prey (“phenological disjunction”). Changes in habitat quality (leading ultimately to habitat loss) may be important for migratory species that need a coherent network of sites to facilitate their migratory journeys. Habitat quality is especially important on staging or stop-over sites, as individuals need to consume large amounts of resource rapidly to continue their onward journey. Such high quality sites may [be] crucial to allow migrants to cross large ecological barriers, such as oceans or deserts.”

Migratory birds are at particular risk from climate change. Migratory birds are affected by changes in water regime, mismatches with food supply, sea level rise, and habitat shifts, changes in prey range, and increased storm frequency.

(13) **Impacts on restoration efforts.** The Corps, other federal agencies, states, non-governmental organizations, and members of the public are engaged in significant efforts to restore the Mississippi River, Mississippi River floodplain, and Mississippi River delta. Supplement II should carefully assess the impacts of each alternative on these other vital efforts, including any implications for timely issuance of Section 408 permits for sediment diversion projects. Supplement II should also evaluate the ability of each alternative to comply with the National Water Policy which requires that all water resources projects protect and restore the functions of natural systems and mitigate any unavoidable damage to natural systems.

(14) **Impacts on ecosystem services provided by a healthy Mississippi River and floodplain.** “Ecosystem services” are the goods and services produced by ecosystems that benefit humankind. These services include (but are by no means limited to) such things as carbon sequestration, wildlife habitat, nutrient retention, and erosion reduction. While these services have traditionally been undervalued because they often fall outside of conventional markets and pricing, society is increasingly recognizing the essential link between healthy ecosystems and human welfare and significant progress has been made in the science of ecosystem services evaluation. Supplement II should carefully assess the impacts of each alternative on ecosystem services.

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60 *Id.* at 42-43.

61 42 U.S.C 1962-3.

(15) Impacts on recreational fishing and tourism industries that rely on a healthy Mississippi River and floodplain. Mississippi River tourism generates approximately $2 billion annually. Recreational opportunities, including recreational fishing, are vitally important to the public. The SEIS should fully evaluate the impacts of each alternative on these important activities.

(16) Disproportionate impacts on low income and minority communities (i.e., environmental justice). Supplement II must examine whether the proposed project would cause disproportionate impacts to low income and minority communities. Particular concerns include: exposing such communities to increased flood risks (including by raising levees in locations upstream); releasing or re-suspending contaminated sediments including in or near borrow pits; adversely affecting subsidence fishing including through increases toxic contamination of fish; the potential for re-exposure to toxic materials resulting from disturbance of borrow pits and disposal sites during floods and storms; significant noise, air pollution or other construction impacts; and the cumulative impacts of any such activities.

As noted above, Supplement II must assess the direct, indirect, and cumulative impacts on these resources and natural and human communities. Direct impacts are caused by the action and occur at the same time and place as the action. Indirect impacts are also caused by the action, but are later in time or farther removed from the location of the action. Cumulative impacts are:

“the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.”

The cumulative impacts analysis ensures that the agency will not “treat the identified environmental concern in a vacuum.” The cumulative impacts analysis must examine the cumulative effects of federal, state, and private projects and actions. The cumulative impacts analysis must also evaluate the cumulative impacts of climate change.

These direct, indirect, and cumulative impacts must be assessed at the site specific level. If the Corps intends Supplement II to be a programmatic EIS, the Corps must commit to preparing tiered site-specific

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63 40 C.F.R. § 1508.8.
64 40 C.F.R. § 1508.7.
65 Grand Canyon Trust v. FAA, 290 F.3d 339, 346 (D.C. Cir. 2002).
66 The requirement to assess non-Federal actions is not “impossible to implement, unreasonable or oppressive: one does not need control over private land to be able to assess the impact that activities on private land may have” on the project area. Resources Ltd., Inc. v. Robertson, 35 F.3d 1300, 1306 (9th Cir. 1993).
67 See Center for Biological Diversity v. Nat’l Hwy Traffic Safety Administration, 538 F.3d 1172, 1217 (9th Cir. 2008) (holding that analyzing the impacts of climate change is “precisely the kind of cumulative impacts analysis that NEPA requires agencies to conduct” and that NEPA requires analysis of the cumulative impact of greenhouse gas emissions when deciding not to set certain CAFE standards); Center for Biological Diversity v. Kempthorne, 588 F.3d 701, 711 (9th Cir. 2009) (NEPA analysis properly included analysis of the effects of climate change on polar bears, including “increased use of coastal environments, increased bear/human encounters, changes in polar bear body condition, decline in cub survival, and increased potential for stress and mortality, and energetic needs in hunting for seals, as well as traveling and swimming to denning sites and feeding areas.”).
NEPA analyses for each work item. 68 “The critical inquiry in considering the adequacy of an EIS prepared for a large scale, multi-step project is not whether the project’s site-specific impact should be evaluated in detail, but when such evaluation should occur.” 69

Supplement II must also conduct site-specific Clean Water Act Section 404 reviews, including to establish that the Corps is not locating a non-water dependent activity (for example, obtaining construction material) in wetlands without making the requisite showings. The Corps is prohibited from discharging dredged and fill materials unless it demonstrates compliance with Section 404.

Supplement II must provide “quantified or detailed information” on the impacts, including the cumulative impacts, so that the courts and the public can be assured that the Corps has taken the mandated hard look at the environmental consequences of the Project. 70 If information that is essential for making a reasoned choice among alternatives is not available, the Corps must obtain that information unless the costs of doing so would be “exorbitant.” 71

Importantly, as the Council on Environmental Quality has made clear, in situations like those in the Mississippi River where the environment has already been greatly modified by human activities, it is not sufficient to compare the impacts of the proposed alternative against the current conditions. Instead, the baseline must include a clear description of how the health of the resource has changed over time to determine whether additional stresses will push it over the edge. 72

E. Fully Analyze Mitigation and Include a Detailed Mitigation Plan

To comply with NEPA, Supplement II must analyze mitigation measures with “sufficient detail to ensure that environmental consequences have been fairly evaluated.” 73 To comply with the Water Resources Development Acts, Supplement II must meet the mitigation requirements established by 33 U.S.C. § 2283(d), including the requirement to develop a detailed mitigation plan.

Supplement II must discuss mitigation measures “in sufficient detail to ensure that environmental consequences have been fairly evaluated.” 74 A “perfunctory description” of the mitigating measures is not sufficient. 75 As the Supreme Court has noted, this is because:

omission of a reasonably complete discussion of possible mitigation measures would undermine the ‘action-forcing’ function of NEPA. Without such a discussion, neither the agency nor other interested groups and individuals can properly evaluate the severity of

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68 If the Corps opts to conduct tiered site-specific NEPA analyses, it must prepare a full scale site-specific Environmental Impact Statement, an Environmental Assessment and FONSI, or an Environmental Assessment and Mitigated FONSI for each Work Item before the Corps may proceed with construction. The Corps will also be required to conduct a Clean Water Act Section 404 review for each item of construction.

69 State of California v. Block, 690 F.2d 753, 761 (9th Cir. 1982)
70 Neighbors of Cuddy Mountain v. U. S. Forest Service, 137 F.3d 1372, 1379 (9th Cir. 1998); Natural Resources Defense Council v. Calloway, 524 F.2d 79, 87 (2d Cir. 1975).
71 40 C.F.R. § 1502.22 (emphasis added).
74 Id.
75 Neighbors of Cuddy Mountain v. U.S. Forest Service, 137 F.3d 1372, 1380 (9th Cir.1998).
the adverse effects. An adverse effect than can be fully remedied by, for example, an inconsequential public expenditure is certainly not as serious as a similar effect that can only be modestly ameliorated through the commitment of vast public and private resources.\textsuperscript{76}

Supplement II also must discuss the effectiveness of the proposed mitigation:

“An essential component of a reasonably complete mitigation discussion is an assessment of whether the proposed mitigation measures can be effective. The Supreme Court has required a mitigation discussion precisely for the purpose of evaluating whether anticipated environmental impacts can be avoided. A mitigation discussion without at least some evaluation of effectiveness is useless in making that determination.”\textsuperscript{77}

This should include a discussion of how the mitigation will effectively address temporal losses (i.e., it takes many years to restore a fully functioning, mature wetland and many decades to restore a fully functioning mature bottomland hardwood wetland forest). A bald assertion that mitigation will be successful is not sufficient. The effectiveness must instead be supported by “substantial evidence in the record.”\textsuperscript{78}

A discussion of the effectiveness is particularly critical because, despite progress in this area, wetland and stream mitigation often fails or does not fully replace lost ecological values. For example, the National Research Council has concluded:

“Attempts to restore forested wetlands of the Southeast (e.g., bottomland hardwoods and cypress swamps) have encountered difficulties related to the time required to replace mature trees, the lack of material to transplant, the lack of knowledge of how and when to carry out seeding or transplantation, (Clewell and Lea, 1989) and altered hydrology (drainage for conversion to agriculture) of the wetland area. Natural forested wetlands may support hundreds of plant species, many of which thrive in the understory (91 percent of 409 species in one riverine forest were understory species). Old-growth forests are dominated by trees that gradually achieve a dominant role in the canopy and that are self-sustaining through their ability to reproduce in their own shade. It is not clear that such climax species can be successfully established in open sites, or whether their introduction must await development of seral (intermediate successional stage) plant communities. Clewell and Lea (1989) noted the need for intensive site preparation to reduce competition between weeds and transplanted tree seedlings. Their review was the first to mention insect herbivory and fire as potential problems. In many cases, restoration of suitable hydrologic conditions will be necessary. The short time period within which forest restoration attempts have been monitored precludes an evaluation of their functional equivalency with natural reference systems.”\textsuperscript{79}

\textsuperscript{76} Id.
\textsuperscript{77} \textit{South Fork Band Council v. Dept. of Interior}, 588 F.3d 718, 727 (9th Cir. 2009) (internal citations omitted).
\textsuperscript{79} National Research Council, Restoration of Aquatic Ecosystems: Science, Technology, and Public Policy (1992) at 311-12.
Absent a meaningful discussion of the effectiveness of the proposed mitigation, Supplement II will not have taken the mandated “hard look” at the environmental impacts of the proposed action and alternatives to the action, and will fail to provide “a clear basis for choice among options by the decisionmaker.”

The Water Resources Development Acts require the Corps to mitigate the adverse impacts of the Project. The Corps is required to mitigate all losses to fish and wildlife created by a project unless the Secretary determines that the adverse impacts to fish and wildlife would be “negligible.” 33 U.S.C. § 2283(d)(1). To ensure that this happens, the Corps is prohibited from selecting a “project alternative in any report” unless that report includes a “specific plan to mitigate fish and wildlife losses.” Id. Accordingly, the DSEIS must include a specific mitigation plan.

Corps mitigation plans must ensure that “impacts to bottomland hardwood forests are mitigated in-kind and harm to other habitat types are mitigated to not less than in-kind conditions, to the extent possible.” 33 U.S.C. § 2283(d)(1). Mitigation plans “shall include, at a minimum:”

1. The type, amount, and characteristics of the habitat being restored, a description of the physical actions to be taken to carry out the restoration, and the functions and values that will be achieved;
2. The ecological success criteria, based on replacement of lost functions and values, that will be evaluated and used to determine mitigation success;
3. A description of the lands and interest in lands to be acquired for mitigation, and the basis for determining that those lands will be available;
4. A mitigation monitoring plan that includes the cost and duration of monitoring, and identifies the entities responsible for monitoring if it is practicable to do so (if the responsible entity is not identified in the monitoring plan it must be identified in the project partnership agreement that is required for all Corps projects). Corps mitigation must be monitored until the monitoring demonstrates that the ecological success criteria established in the mitigation plan have been met; and
5. A contingency plan for taking corrective action in cases where monitoring shows that mitigation is not achieving ecological success as defined in the plan. 33 U.S.C. § 2283(d).

Corps mitigation plans must also comply with “the mitigation standards and policies established pursuant to the regulatory programs” administered by the Corps. 33 U.S.C. § 2283(d).

Corps mitigation must be monitored until the monitoring demonstrates that the ecological success criteria established in the mitigation plan have been met. The Corps is also required to consult yearly on each project with the appropriate Federal agencies and the states on the status of the mitigation efforts. The consultation must address the status of ecological success on the date of the consultation, the likelihood that the ecological success criteria will be met, the projected timeline for achieving that success, and any recommendations for improving the likelihood of success. 33 U.S.C. § 2283(d).

81 The Water Resources Development Act of 2007 requires the Corps to implement mitigation, and comply with mitigation planning requirements, for any project for which the Corps “select[s] a project alternative in any report.” 33 U.S.C. § 2283(d). Thus, mitigation will be required for the Project as a matter of law upon issuance of the final SEIS, and mitigation is required as a matter of law for components of the Regulating Works Project that are proceeding under environmental assessments.
In addition, mitigation lands for Corps civil works projects must be purchased before any construction begins. 33 U.S.C. § 2283(a). Any physical construction required for purposes of mitigation should also be undertaken prior to project construction but must, at the latest, be undertaken “concurrently with the physical construction of such project.” *Id.*

**Conclusion**

The National Wildlife Federation appreciates the opportunity to provide these comments and looks forward to working with the Corps to ensure that Supplement II fully evaluates environmental impacts and complies with NEPA and the nation’s other vitally important environmental laws. We urge the Corps to assess and address the underlying causes of increased flood risks and to develop and adopt an alternative that utilizes a combination of low impact flood damage reduction measures, ecosystem restoration actions, and improved navigation management to reduce flood risks and protect and restore the ecologically vital Mississippi River.

Sincerely,

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National Wildlife Federation Comments

Scoping Comments on Supplement II to the Final Environmental Impact Statement, Mississippi River and Tributaries Project, Mississippi River Mainline Levees and Channel Improvement

Submitted October 15, 2018
Climatic control of Mississippi River flood hazard amplified by river engineering

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Over the past century, many of the world’s major rivers have been modified for the purposes of flood mitigation, power generation and commercial navigation1. Engineering modifications to the Mississippi River system have altered the river’s sediment levels and channel morphology2, but the influence of these modifications on flood hazard is debated3–5. Detecting and attributing changes in river discharge is challenging because instrumental streamflow records are often too short to evaluate the range of natural hydrological variability before the establishment of flood mitigation infrastructure. Here we show that multi-decadal trends of flood hazard on the lower Mississippi River are strongly modulated by dynamical modes of climate variability, particularly the El Niño–Southern Oscillation and the Atlantic Multidecadal Oscillation, but that the artificial channelization (confinement to a straightened channel) has greatly amplified flood magnitudes over the past century. Our results, based on a multi-proxy reconstruction of flood frequency and magnitude spanning the past 500 years, reveal that the magnitude of the 100-year flood (a flood with a 1 per cent chance of being exceeded in any year) has increased by 20 per cent over those five centuries, with about 75 per cent of this increase attributed to river engineering. We conclude that the interaction of human alterations to the Mississippi River system with dynamical modes of climate variability has elevated the current flood hazard to levels that are unprecedented within the past five centuries.

Flooding of the lower Mississippi River in the spring of 2011 was among the largest discharge events since systematic measurements began in the late nineteenth century, and it caused US$3.2 billion in agricultural losses and damages to infrastructure6. This and other recent flood events on the Mississippi River—including those in 2016 and 2017—have repeatedly, although controversially, been attributed to an aggressive campaign of river engineering designed and implemented over the past 150 years3–5. Federally mandated efforts to reduce the impacts of flooding began in the late nineteenth century and initially relied almost exclusively on the use of artificial levees, but this strategy was revised in the wake of a particularly devastating flood in 1927 that overwhelmed the levee system7. The current flood management system—the Mississippi River & Tributaries Project (MR&T)—includes a series of spillways that can be opened to relieve pressure on an enlarged levee system, as well as an artificially shortened and straightened main channel that is held in place by concrete retaining walls (revetments) and isolated from most of its natural floodplain7,8. Although these modifications are credited with protecting infrastructure, climate variability can also shape the dynamics of continental drainage networks, particularly over decadal to centennial timescales that are difficult to detect using short observational records10,11. Precipitation and soil water storage over the Mississippi River basin are influenced by climate variability driven by sea-surface-temperature anomalies in both the Pacific and Atlantic Oceans12,13. Yet establishing the natural controls on discharge extremes of the lower Mississippi has proved challenging because gauging-station measurements record a limited range of variability, particularly before major investments were made in river engineering. As a result, analyses of historical streamflow records disagree over the role that dynamical modes of climate variability play in modulating the discharge12,14,15. To plan flood mitigation and other infrastructure projects, it is critical to understand the climate controls on the discharge of the lower Mississippi River, but the short length of the instrumental record limits our ability to evaluate the range of natural hydrological variability from observational data alone.

Recent advances in paleoflood hydrology could extend the instrumental record back in time to diagnose the controls on the discharge of large alluvial rivers such as the lower Mississippi. Traditional approaches in paleoflood hydrology, which include the use of slackwater deposits as flood event indices16, are of limited use on the low-relief landscapes that characterize the Mississippi River alluvial plain. One new approach uses the sedimentary archives held in floodplain lakes, which act as sediment traps during overbank floods, to develop continuous, quantitative and event-scale records of past flood frequency and magnitude17,18. Parallel work in dendrochronology demonstrates that when trees are inundated by floodwaters they exhibit anatomical anomalies in that year’s growth ring such that they provide a precise chronology of flood events that occurred during the growing season19. Together, these methodological advances provide an opportunity to evaluate interannual to multi-decadal scale trends in flood frequency and magnitude on a large alluvial river such as the lower Mississippi, before and during the era of river engineering.

Here we analyse records of individual overbank flood events derived from sedimentary and tree-ring archives from the lower Mississippi River’s floodplain (Fig. 1). We collected sediment cores from the infilling thalwegs of three oxbow lakes, Lake Mary (MRY), False River Lake (FLR) and Lake Saint John (STJ), that formed by neck cut-offs of the lower Mississippi River in AD 1776, AD 1722 and roughly AD 1500, respectively20 (Extended Data Figs 1–3). In these sedimentary archives, we identified individual flood events by using grain-size analysis, bulk geochemistry (from X-ray fluorescence scanning, XRF) and radiography; developed age–depth models constrained by multiple independent chronological controls (Extended Data Figs 4–6); and estimated flood magnitudes from a linear model that relates the coarse
grain-size component to the discharge of historical flood events \cite{18} (Extended Data Fig. 7; see Methods for details). We also include tree-ring records from the floodplain of the lower Mississippi, collected and described by ref. 21; each tree-ring series was examined for anatomical evidence of flood injury to produce a record of overbank flood events that extends back to the late seventeenth century \cite{21}. A composite time series for flood frequency describing the number of flood events in a moving 31-year window derived from sedimentary and tree-ring archives (Fig. 2b) is highly correlated with instrumental flood frequency ($r = 0.90, t = 19.12$, effective degrees of freedom $\nu_{\text{eff}} = 3.77$, $p < 0.001$) for the interval of overlap, while reconstructed flood magnitudes (Fig. 2c) track trends observed in gauging-station measurements (see Supplementary Information for additional validation), indicating that the palaeoflood archives provide robust reconstructions of hydrological extremes on the lower Mississippi River beyond the period of instrumental record.

Our multi-proxy palaeoflood dataset extends the record of extremes in the discharge of the lower Mississippi River back to the early sixteenth century and demonstrates that both the frequency and magnitude of flooding have increased over the past 150 years as land use and river engineering efforts have intensified (Fig. 2). Flood frequencies and magnitudes exhibit multi-decadal oscillations that increase in amplitude around the beginning of the twentieth century such that these oscillations and magnitudes exhibit multi-decadal oscillations that increase in amplitude around the beginning of the twentieth century such that the continuous record of floods in the palaeoflood archives provide robust reconstructions of hydrological extremes on the lower Mississippi River beyond the period of instrumental record.

Human impacts to the lower Mississippi River (MR&T refers to a major river engineering initiative): timing and intensity of agricultural land use \cite{26} and river engineering. b. Flood frequencies (number of flood events in a 31-year moving window) derived from palaeoflood records, including mean and bootstrapped $2\sigma$ confidence intervals of all palaeoflood archives, and the instrumental frequency of all floods attaining major flood stage ($>1.5 \text{ m above flood stage}$) at the Mississippi River gauging station at Baton Rouge (station number 07374000). c. Flood magnitudes derived from the sedimentary palaeoflood records, with $1\sigma$ uncertainties, and instrumental flood magnitudes for the Mississippi River gauging station at Vicksburg (station number 07289000).

To evaluate the role of climate variability on flood hazard, we examined the relationships between flood frequency, the El Niño–Southern Oscillation (ENSO) and the Atlantic Multidecadal Oscillation (AMO), to find that sea-surface temperature anomalies in both the Pacific and Atlantic Oceans exert a strong influence on the occurrence of lower Mississippi River floods (Fig. 3). Over the past five centuries, correlations between composite flood frequency and the frequency of El Niño events ($r = 0.73$) and the AMO index ($r = -0.39$) derived from instrumental and palaeoclimate data sets are significant ($p < 0.001$; see Methods for details). The strength and direction of these relationships support the hypothesis that discharge extremes on the lower Mississippi River arise through the interaction of ENSO, which influences antecedent soil moisture, with the AMO, which controls the flux of moisture from the Gulf of Mexico inland \cite{12,15}. Extreme precipitation events over the Mississippi River basin are associated with a stronger and more westerly position of the North Atlantic Subtropical High that is characteristic of the negative phase of the AMO \cite{12,15}, and these heavy precipitation events are more likely to generate discharge extremes if they fall on the saturated soils that tend to be left in the wake of El Niño events \cite{15}.

Despite the strong influence of climatic variability on lower Mississippi River flood occurrence, the amplification of flood magnitudes that we observe over the past 150 years is primarily the result of human modifications to the river and its basin (Fig. 4). The magnitude the artificial channelization of the river with levees and cut-offs in the late nineteenth and early twentieth centuries \cite{27}. Yet the continued presence of multi-decadal oscillations in flood frequency and magnitude throughout the entire period of record indicates that anthropogenic modifications to the Mississippi River system are acting in concert with other factors to alter flood hazard through time.
of the 100-year flood ($Q_{100}$; a flood with a 1% chance of exceedance in any year) estimated from gauging-station measurements (AD 1897–2015) is $(20 \pm 7)$% larger than $Q_{100}$ for the period before major human impacts to the river and its basin (AD 1500–1800), as estimated from the palaeoflood data (see Methods for details). To identify the influence of human activities on this observed increase in $Q_{100}$, we use a linear model that relates peak discharge to the AMO index over the period before major human impacts to the river, AD 1500–1800 ($R^2 = 0.35$, degrees of freedom $\nu = 18$, $p < 0.01$) and use this model to predict flood magnitudes over the entire period of record. This ‘climate-only’ regression predicts that, in the absence of human modifications to the land surface, $Q_{100}$ would have increased by only $(5 \pm 6)$% over the same period, accounting for only about 25% of the observed increase in $Q_{100}$ and implying that the remainder (about 75%) of this elevated flood hazard is the result of human modifications to the river and its basin.

The timing and nature of the amplification of flood magnitudes at the onset of the twentieth century strongly imply that it reflects the transformation of a freely meandering alluvial river to an artificially confined channel, because the confinement of flood flows to a levee-defined floodway can speed up the downstream propagation of a flood wave and increase peak discharge for a given flood $Q_{100}$. The establishment of widespread agricultural activity in the Mississippi River basin occurred in the nineteenth century, before the divergence of the observed and ‘climate-only’ flood magnitudes, indicating a secondary and possibly lagged influence of agricultural expansion on flood magnitudes relative to that of river engineering. In short, this analysis identifies artificial channelization of the lower Mississippi River, and its effects on the river’s gradient, channel area and flow velocity, as having significantly increased the discharge of a given flood event relative to pre-engineering conditions.

Figure 3 | Lower Mississippi River flood frequency and its relation to dominant modes of climate variability. a, AMO derived from instrumental and palaeoclimate datasets. b, Frequency of El Niño events (the warm phase of the ENSO) in a 31-year moving window derived from instrumental and palaeoclimate datasets (mean with 2σ bootstrapped confidence interval). SST, sea surface temperature. c, Frequency of lower Mississippi River floods derived from palaeoflood data (mean with bootstrapped 2σ confidence interval). d, Correlation field of monthly precipitation with the AMO (AD 1901–2014) smoothed with a common 121-month filter. e, Correlation field of monthly Palmer Drought Severity Index with the Niño 3.4 index (AD 1948–2011). Correlation fields are interpolated to a common $2^\circ \times 2^\circ$ grid, and individual points with significant correlations at the $P < 0.05$ level are marked with a hollow circle.

Figure 4 | Attribution of the observed increase in flood magnitudes over the past five centuries. a, Composite peak discharges from palaeoflood archives and the instrumental record from Vicksburg. The red line indicates observed trends in the largest flood of the century in a moving window; the blue line indicates trends under ‘climate-only’ conditions, estimated from a statistical model (see text for details). Both lines are shown with 1σ confidence intervals. Instrumental peak discharge estimates are reported without uncertainty and are therefore plotted without confidence intervals. b, Comparison of the 100-year flood observed during the baseline period (AD 1500–1800, before major human modifications to the Mississippi River and its basin; grey boxplot) with that estimated using a statistical model under ‘climate-only’ conditions (blue boxplot) and observed (red boxplot) during the modern period of instrumental record (AD 1897–2015). Boxplots show mean (centre line) and 1σ confidence intervals (box top and bottom) for $Q_{100}$ estimates.
Our main finding—that river engineering has elevated flood hazard on the lower Mississippi to levels that are unprecedented within the past five centuries—adds to a growing list of externalized costs associated with conventional flood mitigation and navigation projects, including a reduction in a river’s ability to convey flood flows, the acceleration of coastal land loss and hypoxia. Despite the societal benefits that these major infrastructure projects convey, the costs associated with maintaining current levels of flood protection and navigability will continue to grow at the expense of communities and industries situated in the river’s floodplain and its delta. For those interested in improving seasonal and longer-term forecasts of flood hazard or management strategies that reconnect the river with its floodplain, the Mississippi River’s discharge of freshwater—and by extension the flux of sediment, nutrients and pollutants—to its outlet should be viewed as highly sensitive both to anthropogenic modifications to the basin and to variability of the global climate system.

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9. Louisiana Coastal Protection and Restoration Authority. Louisiana’s Comprehensive Master Plan for a Sustainable Coast (Coastal Protection and Restoration Authority of Louisiana, 2017).

Supplementary Information is available in the online version of the paper.

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Author Contributions L.G. and J.P.D. initiated the project. S.E.M., L.G., M.D.T., J.W.F.R., Z.S. and J.P.D. conceived the ideas, designed the study and interpreted the results. M.D.T. provided dendrochronological data. J.W.F.R. provided historical discharge and geospatial data. Z.S. performed OSL dating. S.E.M., L.G., R.M.S., C.W. and M.G. collected sedimentary archives and/or performed laboratory analyses. S.E.M. wrote the manuscript with contributions from all authors.

Author Information Reprints and permissions information is available at www.nature.com/reprints. The authors declare no competing interests. Readers are welcome to comment on the online version of the paper. Publisher’s note: Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations. Correspondence and requests for materials should be addressed to S.E.M. (s.munoz@northeastern.edu).

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**METHODS**

**Instrumental streamflow data.** We obtained daily stage data for Mississippi River gauges at Vicksburg (station number 02789000) and Baton Rouge (07374000) from the United States Army Corps of Engineers (USACE) and the United States Geological Survey (USGS). Discharges for the Vicksburg, Memphis (07032000), Helena (07047970), Arkansas City (07146500) and Baton Rouge gauges were compiled from multiple sources. For the early instrumental record (pre-1927), peak discharges and measured discharges were compiled from historical documents43–45.

In the central Mississippi River basin, high-magnitude streamflow events have occurred during the growing season21. For events in which annual peak streamflow was not recorded during this period, we used the measured discharges to create rating curves from which to determine the peak discharge for the annual peak stage. Discharge data after AD 1927 were acquired either from the USACE or from the USGS. The discharge record at Vicksburg is the longest and most continuous of the available discharge records, and its peak annual discharge is highly correlated ($r > 0.86, p < 0.01$) with that of other lower Mississippi River gauging stations in the study area (see Supplementary Information) and was thus used to reconstruct flood magnitudes from the sedimentary archives.

**Sedimentary archives.** We collected sediment cores from the inflowing tributaries of MRV, FLR and STJ with a rod-driven vibracore system in July 2012 and March 2016 (Extended Data Figs 1–3). For each core, we collected a replicate drive using a 7.5-cm-diameter polycarbonate piston corer to ensure recovery of an intact sediment/water interface. The targeted lakes were selected because the lateral position of the active channel near the lake’s arm has remained relatively stable from the time of cut-off to the mid-twentieth century36. We cannot eliminate the possibility that minor lateral and/or vertical channel migration has occurred near these lakes since the time of cut-off, but we reduce the influence of this potential bias on our analysis by (i) using a low-pass filter on the grain-size data (see below) and (ii) validating the resulting flood frequency and magnitude data sets against the instrumental record (see Supplementary Information). At FLR and STJ, mainline levees of the MRV and MR&T have inhibited the deposition of fluvial sediment in the lake during overbank floods after about AD 1950 and 1937, respectively; MRV is not protected by artificial levees and it continues to be inundated during overbank floods. Oxbow lakes can continue to exchange water and sediment with the main channel when the river is below flood stage90 to create high rates of fine-grained ‘background sedimentation’ that differs in texture and composition from the coarser material that is mobilized during high-magnitude flood events. Cores were collected along an arm of the oxbow lakes at locations proximal to the ‘plug’ that separates the active channel from the lake to maximize the contrast between background and flood event sediments. Core locations at each site were targeted based on bathymetric surveys before core collection.

Cores were transported back to the Woods Hole Oceanographic Institution (WHOI) where they were split, described and photographed. Archived core halves were subjected to high-resolution XRF (4,000 μm resolution) and radiography (200 μm resolution) in an ITRAX core scanner housed at WHOI. For grain-size analysis, sediment sub-samples at continuous 1-cm intervals were dispersed in water using a vortex mixer before 5 s sonication and analysis in a Beckman Coulter LS 13 320 laser diffraction particle-size analyser; randomly selected replicate samples showed < 1% volume difference in any detector. Complex, multi-modal grain-size distributions were modelled as mixtures of discrete, simple distributions and decomposed using end-member calculations into four representative populations, or end-members (EMs), that were considered geologically meaningful, using the EMMAgeo package run in RStudio. The score of each sample on the coarsest end-members (EM1), representing deposition of bedload during overbank floods18, was normalized with a low-pass (41-cm) moving minimum filter to remove long-term trends in sediment composition caused by local geomorphic processes. We then identified potential flood deposits as normalized EM1 scores that exceeded a high-pass (11-cm) moving mean with a 0.1 EM1 score threshold, and we verified identified flood deposits using XRF and radiocarbon dating.

To estimate flood magnitudes from the sediment records, we used the method of ref. 18 and developed linear models that describe the normalized EM1 scores as a function of historical flood event discharge at the Mississippi River gauging station at Vicksburg. Using this, we assigned each flood deposit to a historical flood event approximating ‘major flood stage’ as defined by the USGS at a nearby gauging station, in stratigraphic order, and within the 2σ age estimate for the deposit (Extended Data Fig. 7). The requirement for flood deposits to be assigned to historical floods in stratigraphic order eliminated ambiguity in cases in which more than one historical flood fell within a deposit’s 2σ age estimate. There were no cases for which a flood deposit could not be assigned to a historical flood based on the period of instrumental observations (AD 1897–2015), but there were three cases at FLR (AD 1944, 1929 and 1920) and two cases at STJ (AD 1920 and 1913) for which a major historic flood did not leave an identifiable flood deposit. These ‘missing’ flood deposits are rare and occurred during periods of high flood frequency, and they may reflect reduced sediment availability97 during these events. The sedimentary record reconstructs peak annual discharge at the Vicksburg gauge, not at individual site locations.

We developed age–depth models using Bacon v.2.2.38, a Bayesian age–depth modelling program, informed by multiple independent dating techniques (see Supplementary Information), including: (i) 137Cs and 210Pb activity in desiccated and powdered bulk sediment samples in a Canberra GL2020RS well detector for low-energy germanium gamma radiation, for which we used the constant rate of supply model39 to estimate the age of a sampled depth; (ii) radiocarbon (14C) dating via accelerator mass spectrometry of a terrestrial plant macrofossil at the National Ocean Sciences Accelerator Mass Spectrometers facility at WHOI, calibrated using the IntCal13 curve embedded in Bacon; (iii) optically stimulated luminescence (OSL) dating with the fast component of silt-sized quartz40 using a Riso DA-15 B/C luminescence reader at the University of Liverpool, UK; (iv) core tops as the date of collection and, when appropriate, the age of lake formation26 as the core bottom. Sedimentation rate priors were increased to near-instantaneous rates through thick (>20 cm) flood deposits7.

**Tree-ring records.** Tree-ring samples from 33 living and 2 dead oak (Quercus lyrata and Q. macrocarpa) trees were collected from Big Oak Tree State Park (BOT) in southeast Missouri13. One to four core samples were extracted from each tree at or below breast height (about 1.4 m) using a 5-mm-diameter Swedish increment borer. Cross-sections from dead trees were collected as close to the base of the tree as possible. All samples were absolutely cross-dated using the skeleton-plot method of dendrochronology. Tree-ring widths were measured on a stage micrometer to a nominal resolution of 0.001 mm. We crosschecked the accuracy of our visual dating using the computer program COFECHA. We visually determined flood-ring years by examining each tree-ring series for any evidence of flood injury consistent with the anomalous anatomical features caused by flooding by previous flood-ring studies46. Additional characteristics used in our identification included ‘jumbled ranks’ or ‘additional ranks’ of early wood vessels or zones of ‘extended earlywood’ and disorganized flame parenchyma as well as ‘offset’ early wood ranks19. We used the same criteria as ref. 21 to identify flood events (that is, a year in which more than 10% of sampled trees exhibited signs of flood injury) as this threshold encompasses all historic floods that attained major flood stage and occurred during the growing season21.

**Historical climate and paleoclimate data.** Historical (late nineteenth century to present) indices of ENSO and AMO52 were extended back to the sixteenth century with annual paleoclimate reconstructions of ENSO15–18 and AMO53. To compare the ENSO series, we identified El Niño events in the historical Niño 3.4 index as periods of five consecutive overlapping 3-month windows at or above +0.5°C, and with years as anomalies of more than +0.5°C in the paleoclimatic series. We then derived El Niño event frequencies using a 31-year moving window on each record, and we computed the mean of the historical and all paleoclimatic El Niño frequencies and bootstrapped 2σ confidence intervals using the boot function in RStudio. For the composite AMO series, we used the detrended historical AMO index27 back to AD 1871, and then transitioned to a paleo-climate AMO reconstruction16 to AD 1572. We sampled this composite AMO index at the median age probability of the 20 paleoevents that occurred between AD 1500–1800, and used these data to develop a linear model (using the lm function in Rsstudio) that relates peak discharge from the AMO index, the El Niño frequency timeseries was not a significant predictor of flood magnitudes, presumably because Pacific sea-surface temperatures do not control the inland flux of Gulf of Mexico moisture that triggers high-magnitude discharge events45; so only the AMO index was used to statistically estimate flood magnitudes under ‘climate-only’ conditions. The AMO is detrended to remove recent warming of North Atlantic sea surface temperatures, so the ‘climate-only’ estimates of $Q_{050}$ do not consider the potential effects of recent greenhouse warming on flood magnitudes—although we note that the inverse relationship between AMO and Mississippi River flood magnitudes implies that warming of North Atlantic sea-surface temperatures would act to suppress flood magnitudes. When evaluating the significance of Pearson correlations between climate and hydrological time-series that exhibited high degrees of serial autocorrelation, we estimated the effective degrees of freedom with the following relation42:

$$n_{\text{eff}} = \frac{N(1-\phi_1^2)(1+\phi_2^2)}{1-\phi_1^2\phi_2^2} \left(1 + \frac{\phi_2^2}{\phi_1^2} \right)$$

where $N$ is the number of independent samples, and $\phi_1$ and $\phi_2$ are the lag-1 autocorrelation coefficients of time-series $x$ and $y$ respectively.

**Flood hazard attribution.** The magnitude of $Q_{050}$ was estimated both empirically through statistical modelling and through statistical modelling of the sedimentary paleoflood archives record major flood events over periods greater than 100 years, and are suitable for estimating recurrence intervals empirically through the relation:

$$t_n = (n + 1)/m$$

where $t_n$ is the age of a sampled depth; (ii) radiocarbon (14C) dating via accelerator mass spectrometry of a terrestrial plant macrofossil at the National Ocean Sciences Accelerator Mass Spectrometers facility at WHOI, calibrated using the IntCal13 curve embedded in Bacon; (iii) optically stimulated luminescence (OSL) dating with the fast component of silt-sized quartz40 using a Riso DA-15 B/C luminescence reader at the University of Liverpool, UK; (iv) core tops as the date of collection and, when appropriate, the age of lake formation26 as the core bottom. Sedimentation rate priors were increased to near-instantaneous rates through thick (>20 cm) flood deposits7.

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where $t_r$ is the recurrence interval (the inverse of $t_r$ is the probability that the event magnitude will be exceeded in any one year), $n$ is the number of years in the window being considered, and $m$ is the number of recorded occurrences of the event being considered. The same approach was used to estimate $Q_{100}$ in the statistically modelled ‘climate-only’ peak annual discharges derived from palaeoclimate and historical climate records. The instrumental record at the Vicksburg gauge provides a measurement for peak annual discharge in every year, but is relatively short, so the modern $Q_{100}$ was estimated statistically by fitting a log Pearson type III distribution to the data set following standard protocols outlined by the United States Interagency Advisory Committee of Water Data for instrumental hydrological data sets. We compared the observed $Q_{100}$ baseline (AD 1500–1800) with the observed and ‘climate-only’ $Q_{100}$ estimates for the modern period (AD 1897–2015) and attributed the proportion of the observed change that was not explained by the ‘climate-only’ estimates to human alterations to the river channel and basin. The modern $Q_{100}$ estimated empirically from sedimentary records and the modern $Q_{100}$ estimated by fitting a generalized extreme value distribution to the instrumental data both fall within the 1σ confidence intervals of the modern $Q_{100}$ estimated by fitting a log Pearson type III to the instrumental record (see Supplementary Information), indicating that our findings are robust to different estimations of flood hazard.

Data availability statement. The datasets generated by this study are available as Supplementary Data. Code availability. The R code used to produce the figures in this paper is available from the corresponding author on reasonable request.
Extended Data Figure 1 | Location of Lake Mary, Mississippi (MRY) and sediment core (MRY2) used in this study. Lake Mary is an oxbow lake that formed via neck cut-off of the lower Mississippi River in AD 1776\(^2\) and is situated inside the modern floodway such that it continues to be inundated during overbank floods. Bathymetric contours (white) given in metres. Shaded relief shows relative topographic lows (dark shades) and highs (light shades) according to the National Elevation Dataset\(^2\)\(^5\).
Extended Data Figure 2 | Location of False River Lake, Louisiana, and sediment core (FLR1) used in this study. False River Lake is an oxbow lake that formed via neck cut-off of the lower Mississippi River in AD 1722 and is situated outside the modern floodway. Bathymetric contours (white) given in metres. Shaded relief shows relative topographic lows (dark shades) and highs (light shades) according to the National Elevation Dataset. © 2018 Macmillan Publishers Limited, part of Springer Nature. All rights reserved.
Extended Data Figure 3 | Location of Lake Saint John, Louisiana, and sediment core (STJ1) used in this study. Lake Saint John is an oxbow lake that formed via neck cut-off of the lower Mississippi River in about AD 1500\(^{20}\) and is situated outside the modern floodway. Bathymetric contours (white) given in metres. Shaded relief shows relative topographic lows (dark shades) and highs (light shades) according to the National Elevation Dataset\(^{25}\).
Extended Data Figure 4 | Radiography, bulk geochemistry, grain size and chronology of core MRY2. The age–depth model at right shows the median age probability (black line) and 1σ confidence intervals (grey shading), with 2σ confidence intervals on individual chronological controls.
Extended Data Figure 5 | Radiography, bulk geochemistry, grain size and chronology of core FLR1. The age–depth model at right shows the median age probability (black line) and 1σ confidence intervals (grey shading), with 2σ confidence intervals on individual chronological controls.
Extended Data Figure 6 | Radiography, bulk geochemistry, grain size and chronology of core STJ1. The age–depth model at right shows the median age probability (black line) and 1σ confidence intervals (grey shading), with 2σ confidence intervals on individual chronological controls.
Extended Data Figure 7 | Relationships between peak annual discharge and normalized EM score for historical floods in sedimentary archives. Scatterplots and linear regressions with 1σ prediction intervals relating normalized EM score (a measure of grain size) to peak annual discharge of historical flood events for (a) MRY, (b) FLR and (c) STJ. Peak annual discharge estimates are from the Mississippi River gauging station at Vicksburg. Calibration periods vary owing to site-specific factors discussed in the Methods and Supplementary Information. adj., adjusted.
Recent changes in channel morphology of a highly engineered alluvial river – the Lower Mississippi River

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Recent changes in channel morphology of a highly engineered alluvial river – the Lower Mississippi River

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ABSTRACT
Changes in channel morphology provide relevant insights into sediment transport and deposition in alluvial river systems. This study assessed three to four decades of morphological changes at seven locations along a 327-km reach of the Lower Mississippi River (LMR) to better understand channel adjustment processes of this large alluvial river. The assessment included analysis of three cross-sectional areas at each location during the period 1992–2013, as well as analysis of the changes in river stage and maximum surface slopes under four flow conditions over the last three to four decades. We found that the first 20–25 km LMR reach below its diversion to the Atchafalaya River and the reach from 80 to 140 km experienced significant riverbed aggradation, while the reach in between (i.e. from 20 to 80 km) experienced riverbed degradation. The lower 187-km reach (i.e. from 140 to 327 km) showed negligible sediment trapping. These findings may have relevant implications for management of river sediment diversions along the LMR and other large alluvial rivers in the world.

INTRODUCTION
Alluvial rivers are well defined by constant interaction of flow, sediment transport, and channel morphology dynamics. Bathymetry of alluvial rivers can affect hydrodynamics, hence sediment transport and deposition, which, in turn, can change geomorphological properties of the river (Bridge, 1993; Merwade, 2009). Similarly, river stage, river surface slope, and discharge are three other important factors affecting riverbed dynamics over time. Therefore, changes in river stage and river surface slope over time within the same discharge regime can indicate riverbed adjustment, i.e. channel bed aggradation or channel erosion (Leopold & Wolman, 1957, 1970; Van Rijn, 1993). Previous studies have explored river bathymetry (Biedenharn, Thorne, & Watson, 2000; Harmar & Clifford, 2006; Harmar, Clifford, Thorne, & Biedenharn, 2005) and river stage and slope in specific discharge regimes separately (Biedenharn & Watson, 1997; Pinter, Ickes, Wlosinski, & Van der Ploeg, 2006; Wasklewicz, Grubaugh, Franklin, & Gruelich, 2004); however, there is still ambiguity over how these components interact to affect long term sediment transport and deposition in river systems. Such information can be especially useful for management of regulated rivers.
that are of great relevance to transportation, flood control, and sediment delivery to their deltaic plains.

The Lower Mississippi River (LMR), the lowermost 500-km reach of the Mississippi River, which starts from the Old River Control Structure (ORCS) and drains to the northern Gulf of Mexico, is one prominent example of rivers facing significant morphological changes pertaining to artificial interference along their channels. River engineering since the early 1900s, such as control and diversion structures, training dikes, spillways, levees, meander cutoffs, bank stabilization, and dredging, has led the LMR channel to be straightened and confined, with reductions to sediment supply and floodplain connectivity (Hudson, Middelkoop, & Stouthamer, 2008; Kesel, 2003; Meade & Moody, 2010; Mossa, 1996). These channel adjustments have played a significant role in the substantial land loss along the delta associated with the LMR, i.e. the Mississippi River Delta Plain (MRDP), from the last several decades (Couvillion et al., 2011; Craig, Turner, & Day, 1979; Gagliano, Meyer-Arendt, & Wicker, 1981; Meade & Moody, 2010). Several MRDP restoration projects focus on diverting LMR water carrying maximum amounts of sediment to coastal marshes for building lands (Coastal Protection and Restoration Authority of Louisiana [CPRA], 2012; Dean, Wells, Fernando, & Goodwin, 2013; Peyronnin et al., 2013). The United States Army Corps of Engineers (USACE) has constructed the West Bay sediment diversion and proposed two other sediment diversions in the lowermost river reach (~8–165 km upstream of Head of the Passes near the Gulf of Mexico) (CPRA, 2012). Sediment loads along the lowermost LMR reach have been destabilized by frequent channel dredging for navigation and large cargo transportation, and have maximum probable chances of disappearing into the deeper waters of the Gulf of Mexico. Therefore, there is an urgent need to determine potential sediment diversion sites along the upper and middle LMR reach (~65–450 km upstream of Head of the Passes). In-depth knowledge of the morphological changes pertaining to sediment transport and deposition mechanics along upper and middle LMR reaches can aid in identifying such sites.

In spite of their significance, the LMR morphological changes have only been well documented for the uppermost LMR reach (~365–500 km above Head of the Passes) (Harmar et al., 2005; Hudson & Kesel, 2000; Knox & Latrubesse, 2016) and remain poorly examined for the middle (165–365 km above Head of the Passes) and lower LMR (0–165 km above Head of the Passes) reaches. Harmar and Clifford (2006) investigated the whole length of the LMR channel (~1600-km long from Cairo, Illinois to Head of the Passes); however, their study focused only on channel shape. Also, these studies analyzed the LMR morphological changes using the river’s bathymetry measurements over time and ignoring the spatiotemporal trends in river stages and their slopes in specific discharge regimes. Mossa (2013) used both bathymetric and river stage data to analyze hydrological changes in the Lower Old River, the river which connects the Mississippi, Atchafalaya, and Red Rivers. However, the bathymetric investigation in her study was not carried out at any site of the LMR and the river stage analysis only matched for two proximate sites in the uppermost LMR reach (Tarbert Landing and Red River Landing). Combined analysis of cross-sectional change and river stage and slope change at specific discharges can strengthen our understanding of morphological changes with respect to sediment transport and deposition along the LMR reach.

Previous studies have recognized several behavioral aspects of sediments and their grain-size fractions in the LMR, but less attention has been given to investigating sediment transport and deposition mechanics along the reach. Pereire, McCorquodale, Meselhe,
Georgiou, and Allison (2009) and Nittrouer, Shaw, Lamb, and Mohrig (2012) estimated sediment transport rates at several sites in the upper and middle LMR, but without clear information about temporal sediment deposition and erosion mechanics along the reach. Allison et al. (2012) carried out a sediment budget investigation at four sites in the upper and middle LMR, but with a short-term data series (2008–2010). Rosen and Xu (2014) and Joshi and Xu (2015) analyzed long-term sediment and sand availability and flow-sediment and flow-sand relationships, respectively, but only for the uppermost location at Tarbert Landing (near ORCS). Furthermore, to the best of our knowledge, no peer-reviewed literature is available on how long-term changes in river bathymetry and in river stages and maximum river surface slopes pertaining to specific flow conditions can synchronously relate to morphological changes along the LMR reach downstream.

This study analyzes multi-decadal changes in river channel morphology and in river stages and maximum river surface slopes under equal flow conditions at seven locations in the upper and middle LMR reaches, from Tarbert Landing to Carrollton. Such an assessment can aid in understanding sediment routing downstream, differentiating between sediment erosion and deposition mechanics along the reach, and further distinguishing potential sediment diversion sites based on maximum sediment availability. The specific objectives of this study include: (1) assessing decadal changes in cross-sectional areas of river bed profiles at six locations covering the upper and middle LMR reaches, (2) analyzing long-term trends in average annual river stages pertaining to specific flow conditions ranging from low to high at the selected locations, and (3) investigating long-term river surface slope trends (for consecutive sites) pertaining to maximum annual river stages in each of the aforementioned flow conditions. The primary goal of the study is to determine the long-term riverbed adjustment (i.e. erosion and deposition) at each selected location to elucidate sediment transport and transformation patterns in this large, highly engineered alluvial river. Therefore, the information gained from this study may have implications for riverine sediment management, channel engineering, and coastal land restoration in the world’s other sinking deltas fed by alluvial rivers.

Methods

Study site selection

The area of focus for this study is the LMR, which stretches from its diversion structure, the ORCS, over 500 km downstream to its outlet of the Gulf of Mexico (Figure 1). Over the last four decades (1973–2013), daily discharge ($Q_d$) below the ORCS at Tarbert Landing averaged 15,027 cubic meters per second (cms), varying from 3143 to 45,844 cms (Joshi & Xu, 2015). Average $Q_d$ during high water months in the LMR is approximately three times more than average $Q_d$ during low water months (Meade, 1995; Rosen & Xu, 2013). In terms of sediment transport, the LMR at Tarbert Landing discharged an average annual load of 127 megatonnes (MT) of total suspended solids during 1980–2010 (Rosen & Xu, 2014), while an average annual load of 27 MT of sand particles at this site has been reported for 1973–2013 (Joshi & Xu, 2015).

In this study, we selected seven locations along the LMR over a distance of 327 km for comprehensive assessment of bathymetric and river stage changes. These locations included: Tarbert Landing (TBL) at river kilometer (rk) 492.8, Red River Landing (RRL) at rk 486.5,
Bayou Sara (BS) at rk 427, Baton Rouge (BTR) at rk 367.5, College Point (CP) at rk 253.3, Bonnet Carre (BC) at rk 204.2, and Carrollton (CAR) at rk 165.4 (Figure 1). USACE has daily river stage measurements for at least 20 years at these locations from Red River Landing to Carrollton; however, only a few years of river stage measurements are available for locations below Carrollton. The 160-km reach below Carrollton is the lowermost end of the LMR, which has experienced frequent channel dredging and revetments for large cargo transportation, complicating sediment transport assessment. Hence, that reach was excluded in this study.

Data collection

For bathymetric analysis, we selected three cross-sectional (CS) measurements conducted by USACE in 1992, 2004, and 2013, each at six of the seven locations (except Red River Landing) described above. USACE used single-beam fathometer and multibeam sidescan sonar to measure cross sections while developing hydrographic survey maps for the Mississippi River (during these years) from Black Hawk, Louisiana (rk 521.4, just above the ORCS) to the river’s Gulf Outlet at Head of Passes (rk 0). Each cross-section consisted of tagline riverbed elevation measurements in a distance of 30 m across the river. All elevations in the LMR during 2004 and 2013 were recorded with reference to the North American Vertical Datum of 1988 (NAVD 88), while elevations in 1992 were recorded with reference
to the National Geodetic Vertical Datum of 1929 (NGVD 29). Therefore, we converted the 1992 survey data to NAVD 88 using corresponding reference conversion factors at each location provided by USACE. We excluded Red River Landing because of its close proximity to Tarbert Landing (~5 km) and used CSs at Tarbert Landing to represent bathymetric and areal changes near ORCS.

For river stage analysis in specific discharge conditions, we collected daily discharge records ($Q_d$) at Tarbert Landing and daily river stage records ($RS_d$) at Red River Landing, Bayou Sara, Baton Rouge, College Point, Bonnet Carre, and Carrollton for corresponding available periods (Red River Landing and Baton Rouge: 1987–2015; Tarbert Landing, Bayou Sara, and College Point: 1973–2015; Bonnet Carre: 1989–2015, and Carrollton: 1986–2015) from USACE. It is noted that during these four decades of $Q_d$ and $RS_d$ records (1973–2015), the LMR experienced high magnitude spring floods in 1973 and 2011, and a summer flood in 1993.

No long-term discharge measurements are available for the sites downstream of Tarbert Landing. Based on USACE's velocity observations across several river-stage ranges (from low to high) at Tarbert Landing (average surface velocity of 2.88 km/hr at a stage of 1.52 m, to 8.32 km/hr at a stage of 18.29 m) and Baton Rouge (average surface velocity of 1.92 km/hr at a stage of 0.61 m to 8.8 km/hr at a stage of 12.12 m), we deduced that the LMR flows from Tarbert Landing to Carrollton between 24 and 36 hrs. Therefore, we used discharge measurements at Tarbert Landing to analyze corresponding river stages for same days at all other locations downstream of Tarbert Landing.

*Bathymetric and specific river stage analyzes*

The cross-sectional area of a given transverse river bed profile was calculated as the sum of areas of all sub cross sections between two opposite top bank elevations of the profile (Figure 2). River bed elevations in the profile (depth) multiplied with the distance between their measurement points (breadth = 30 m, see Section “Data collection”) gave the areas of all sub cross sections (Figure 2). Also, the two opposite top-bank elevations in each profile were defined by water surface lines marked by USACE (Figure 2). In each profile, a few points had variable elevations above mean sea level. Therefore, we subtracted all elevations from a single benchmark elevation higher than and nearest to the highest elevation of the profile during 1992, 2004, and 2013 to get a unified reference point for calculating all areas in the profile. Changes in areas of all corresponding cross-sections from 1992 to 2004 and 2004 to 2013 were determined to discern decadal trends of the river channel and bed sediment dynamics. Cross sections with decreased areas from 1992 to 2013 indicate bed sediment accumulation, while those with increased areas suggest bed erosion. For this analysis, we kept a prerequisite of ± 5% change in area as noticeable change. Thus, sites with a cross-sectional area decrease >5% were identified to have noticeable sediment accumulation, and the sites with an area increase >5% were identified as having noticeable bed erosion. Sites with changes in between 5% areal decrease and increase were identified as having no change. During the period 1992–2013, the LMR’s stage at Red River Landing was lower than the flood stage provided by National Weather Service (14.6 m) for 1992, 1999, 2005, 2006, and 2012. The river stage was above 14.6 m for fewer than 50 days each year for 8 years during this period. Furthermore, the river stage was above 14.6 m for more than 50 but fewer than 75 days each year for 8 of the remaining 9 years. In 2011 only, the river stage stayed above
14.6 m for as much as 87 days. Based on these trends, we hypothesize that the annual flood cycle in LMR did not significantly affect the changes in cross sections.

We examined long-term trends in daily river stages of all locations below Tarbert Landing based on the following four selected flows at Tarbert Landing: 10,000 $Q_d$ representing for $9000 \leq Q \leq 11,000$ cms (29th to 40th percentile of total flow in the LMR during 1973–2015), 15,000 $Q_d$ for $14,000 \leq Q \leq 16,000$ cms (53rd to 60th percentile of the total flow), 20,000 for $19,000 \leq Q \leq 21,000$ cms (70th to 77th percentile of the total flow), and 25,000 cms for $24,000 \leq Q \leq 26,000$ cms (85th to 90th percentile of the total flow). These flows covered low-to-high percentages of the LMR discharge during 1973 to 2015 and 1986/1987/1989 to 2015, and their ranges were selected according to ±5–10% bin width criteria given by Turnipseed and Sauer (2010). The percentage occurrence of these flows were calculated for the two periods, 1973–2015 and 1986–2015, because river stage data for specific discharge analysis were available from 1973 at Bayou Sara and College Point and from 1986/1987/1989 at the other sites. Trends in $RS_{d}$ over time in the four $Q_d$ types were analyzed by fitting a linear trendline between $RS_d(y)$ (dependent variable) and date ($x$) (independent variable). Temporal autocorrelation was checked by the Durbin–Watson test (Durbin & Watson, 1950, 1951, 1971). An autoregressive model with 1-day lag in each dependent variable was applied for $RS_d$ with significant temporal autocorrelation (Farebrother, 1980; Krämer, 2011). Finally, $RS_d$ trends were determined by following three ranges of $p$-values obtained from

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**Figure 2.** Screenshot from the LMR Hydrographic Survey Book of 2013 (USACE, 2013) showing schematics of three cross sections at Tarbert Landing.

Notes: “Water Lines” in red represent the black dashed water surface lines marked by USACE to denote the top bank elevations for both ends of the cross section. Elevations of the cross sections measured are shown next to the blue line. Elevations in the Hydrographic Survey Book are in feet and have been converted to meters for this study.
RSd trends were also analyzed by comparing the percentage difference between mean annual RSs of starting and ending years in each Qd type at all locations below Tarbert Landing. For all Qd types in all locations, mean annual RS had an increasing trend if the percentage difference was more than +5%, a decreasing trend if the difference was less than −5%, while an insignificant trend if the difference was between +5 and −5% (Error Range = ±5%). Finally, locations with sediment accumulation (increasing trend in RS) were distinguished from locations with sediment erosion (decreasing trend in RS).

Slopes of maximum annual river stages of all discharge types

River surface slope between two consecutive sites downstream of a river is the difference between maximum annual RSs in both sites divided by the length of the reach between the sites (Biedenharn et al., 2000). For this study, we analyzed the change in slopes of maximum annual RSs between the LMR sites, i.e. from Red River Landing to Bayou Sara, Bayou Sara to Baton Rouge, Baton Rouge to College Point, College Point to Bonnet Carre, and Bonnet Carre to Carrollton, for all Qd types. Trends in yearly slope in maximum annual RSs of the four Qd types were checked by fitting a trendline between annual slope (y) (dependent variable) and year (x) (independent variable). Criteria used for determining trends in slope were exactly same as those of specific river stage analysis, i.e. the three ranges of p values obtained from the annual slope-year model had exactly the same interpretation as those obtained from the daily river stage-date model. Finally, locations downstream from Tarbert Landing were checked with sediment accumulation (increasing trend in slope) or sediment erosion (increasing trend in slope).

Results

Channel morphological changes

The net and percentage changes in all cross sections (CS) from 1992 to 2004 and 2004 to 2013 at the six study locations along the LMR have been shown as cross-sectional plots in Figure 3 and documented in Table 1. Over these three decades, areas of the first and third cross sections (CS I and III) at Tarbert Landing observed a continuous decrease of 14 and 12%, respectively, from 1992 to 2013. However, CS II decreased by 10% during the first decade (1992–2004) and increased by a negligible 2% during the second decade (2004–2013), balancing up to a decrease of 8% during 1992–2013. At Bayou Sara, the next station downstream, areas of CSs I and II increased continuously by 8 and 7%, respectively, from 1992 to 2013. However, CS III at Bayou Sara had a negligible alternate change in area.
Table 1. Comparison of net and percentage changes in cross-sectional areas (CSA) at six locations along the LMR (in the order of distance from upstream to downstream): Tarbert Landing (TBL), Bayou Sara (BS), Baton Rouge (BTR), College Point (CP), Bonnet Carre (BC) and Carrollton (CAR).

<table>
<thead>
<tr>
<th>Station</th>
<th>CS [BE (m)]</th>
<th>CSA (m²)</th>
<th>Net-change in CSA (m²)</th>
<th>% change in CSA</th>
<th>Overall change from 1992–2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>TBL</td>
<td>I (4)</td>
<td>5051</td>
<td>4969.2</td>
<td>4402.3</td>
<td>−381.8</td>
</tr>
<tr>
<td></td>
<td>II (6)</td>
<td>6839.4</td>
<td>7190.6</td>
<td>7199.9</td>
<td>−748.7</td>
</tr>
<tr>
<td></td>
<td>III (4)</td>
<td>5076.7</td>
<td>5305.3</td>
<td>4896.6</td>
<td>−328.6</td>
</tr>
<tr>
<td>BS</td>
<td>I (6)</td>
<td>10,028.6</td>
<td>10,498.6</td>
<td>10,718.1</td>
<td>470</td>
</tr>
<tr>
<td></td>
<td>II (4)</td>
<td>7447.1</td>
<td>7861.4</td>
<td>7923.9</td>
<td>414.2</td>
</tr>
<tr>
<td></td>
<td>III (6)</td>
<td>9968.4</td>
<td>10,446.6</td>
<td>10,011.3</td>
<td>478.2</td>
</tr>
<tr>
<td>BTR</td>
<td>I (8)</td>
<td>16,296.2</td>
<td>14,516.6</td>
<td>14,138.6</td>
<td>−1779.6</td>
</tr>
<tr>
<td></td>
<td>II (10)</td>
<td>17,022.1</td>
<td>17,322.9</td>
<td>16,210.5</td>
<td>300.8</td>
</tr>
<tr>
<td></td>
<td>III (10)</td>
<td>15,660.3</td>
<td>15,466.8</td>
<td>15,763.6</td>
<td>−193.5</td>
</tr>
<tr>
<td>CP</td>
<td>I (10)</td>
<td>18,586.3</td>
<td>18,513.2</td>
<td>19,016.1</td>
<td>−73.2</td>
</tr>
<tr>
<td></td>
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<td>16,825.5</td>
<td>16,997.4</td>
<td>17,692.4</td>
<td>171.9</td>
</tr>
<tr>
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<td>III (10)</td>
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<td>18,102.5</td>
<td>18,852.4</td>
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</tr>
<tr>
<td>BC</td>
<td>I (6)</td>
<td>16,528.9</td>
<td>16,112</td>
<td>16,368.1</td>
<td>−417</td>
</tr>
<tr>
<td></td>
<td>II (8)</td>
<td>17,707.2</td>
<td>16,322.2</td>
<td>17,795.5</td>
<td>−1384.9</td>
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<tr>
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<td>III (4)</td>
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<td>CAR</td>
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<td>19,482</td>
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<td>−374.9</td>
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<tr>
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<td>II (4)</td>
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<td>17,289.8</td>
<td>−182.9</td>
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<tr>
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<td>III (8)</td>
<td>20,123</td>
<td>19,720.6</td>
<td>20,132.1</td>
<td>−402.3</td>
</tr>
</tbody>
</table>

Notes: BE represents bench elevation for each Cross-Section (CS). CSs with "−" sign within parenthesis of their corresponding % CSA change had a clear increase in area, those with "−" sign had a clear decrease in area, while, those with "0" sign had no conclusive change in area (since the areal changes fell within the aforementioned error range of ±5%).
during 1992–2013 (5% increase from 1992 to 2004 and 4% decrease from 2004 to 2013). At Baton Rouge, the next station downstream from Bayou Sara, areas of CS I and II decreased continuously by 14% and 8% respectively from 1992 to 2013. The change in area of CS III at Baton Rouge during 1992–2013 was also continuous, but negligible (1 and 2% increase during 1992–2004 and 2004–2013, respectively). The areal change (increase or decrease) in all but one CS at all stations further downstream from Baton Rouge was within the selected error range (±5%) both from 1992 to 2004 and from 2004 to 2013. The only CS with an areal change greater than the error range was CS II at Bonnet Carre from 1992 to 2004 (decrease of 8%) and from 2004 to 2013 (increase of 9%). However, these decadal changes balanced to a negligible areal change (1% decrease) at Bonnet Carre during 1992–2013. Of all study locations along the LMR, Tarbert Landing had the highest change (either increase or decrease) in total cross-sectional areas of selected cross sections during 1992–2013 (−34%), while the cross-sectional change at Carrollton was lowest (+1%).

### Distribution of river stages in specific discharge regimes

The four selected discharge regimes represent a substantial range (from low to high) of daily discharge in the LMR over the last three to four decades. The lowest selected LMR discharge regime, between 9000 and 11,000 cms, accounted for approximately 71 to 61% of all discharge events during 1986–2015 and 71–60% during 1973–2015 (Table 2). Similarly, the highest selected regime, from 24,000 to 26,000 cms, accounted for about 14 to 10% of all discharge events during 1986–2015 and 15–11% of all events during 1973–2015 (Table 2). Other discharge ranges in between these lowest and highest selected flows varied between 47% (14,000 cms) and 23% (21,000 cms) during 1986–2015 and 47–24% during 1973–2015.

All maximum $RS_s$ and all but one minimum $RS_s$ within the four selected discharge ranges increased gradually from lowest (29th percentile) to highest (90th percentile) selected discharge ranges at each location (Figure 4). For only a single instance at Red River Landing, the minimum river stage in the 14,000–16,000 cms discharge regime (6.19 m) was lower than the minimum river stage in the 9000–11,000 cms discharge regime (6.90 m) (Figure 4). Also, all minimum and maximum river stages in the same discharge regimes decreased gradually from upstream (at Red River Landing) to downstream (at Carrollton), except that the minimum discharge at Bayou Sara in 14,000–16,000 cms (6.80 m) was higher than the minimum river stage at Red River Landing upstream under the similar flow regime (6.19 m) (Figure 4). Furthermore, the highest variability observed between intra-discharge maximum and minimum river stage along the LMR was for 14,000–16,000 cms flow range
Figure 3. River channel cross sections (CS I, II, III) from six locations on the Lower Mississippi River in 1992, 2004, and 2013: (a) Tarbert Landing (TBL), (b) Bayou Sara (BS), (c) Baton Rouge (BTR), (d) College Point (CP), (e) Bonnet Carre (BC), and (f) Carrollton (CAR).
Figure 3. (Continued).
Figure 3. (Continued).
at Red River Landing (6.61 m), while the lowest variability was for 24,000–26,000 cms flow range at Carrollton (1.22 m). All other intra-discharge variabilities between maximum and minimum discharge had a low range from 1.26 m (for 9000–11,000 cms discharge at Carrollton during 1986–2015) to 3.83 m (for 9000–11,000 cms discharge at Bayou Sara during 1986–2015) (Figure 4). The intra-discharge variability in river stages generally decreased gradually from upstream to downstream locations (Figure 4).

**Specific river stage changes**

From 1987 to 2015, an increasing $R S_d$ and mean annual RS trend was found in all $Q_d$ types at Red River Landing ($p < 0.0001$ and % difference between mean annual RS of 1987 and 2015 = 11.5, 12.2, 12.8, and 10.9 for 10,000, 15,000, 20,000, and 25,000 cms $Q_d$ types, respectively) and Baton Rouge ($p < 0.0001$ and % difference between mean annual RS of 1987 and 2015 = 13.9, 11.2, 13.5, and 15.1 for 10,000, 15,000, 20,000, and 25,000 cms $Q_d$ types, respectively) (Figures 5(a), (c), 6; Table 3). However, Bayou Sara (the station between Red River Landing and Baton Rouge) showed a decreasing trend of $R S_d$ and mean annual RS in two of the four $Q_d$ types (15,000 and 20,000 cms $Q_d$ types: $p = 0.0047$ and < 0.0001 and % difference between mean annual RS of 1973 and 2015 = –13.4 and –8.6, respectively) (Figures 5(b), 6; Table 3). $R S_d$ and mean annual RS at Bayou Sara had no significant trend in 10,000 cms flow ($p = 0.19$ and % difference between mean annual RS of 1973 and 2015 = 2.9) (Figures 5(b), 8; Table 2), while trend could not be concluded...
for the 25,000 cms flow ($p = 0.0123$ and % difference between mean annual RS of 1973 and 2015 = 2.9) (Figures 5(b), 6; Table 3).

No clear trend in RS was found for all other sites further downstream from Baton Rouge (Figures 5(d)–(f), and 6, Table 3). $R_s$ and mean annual RSs further downstream from Baton Rouge had a decreasing trend only in one $Q_d$ type at College Point (1973–2015) (15,000 cms flow: $p < 0.0001$ and % difference between mean annual RSs of 1973 and 2015 = -13.4) (Figures 5(d), 6; Table 3), and two $Q_d$ types at Bonnet Carre (1989–2015) (10,000 and 15,000 cms flow: $p = 0.008$ and 0.014 and % difference between mean annual RSs of 1989 and 2015 = −6.8 and −7.3 respectively) (Figures 5(e), 6; Table 3). $R_s$ and
mean annual RSs of all other $Q_d$ types at all other locations had insignificant trends in six instances (25,000 cms flow at College Point, 20,000 cms flow at Bonnet Carre and all flows at Carrollton) and inconclusive trends in two instances (20,000 cms flow at College Point and 25,000 cms flow at Bonnet Carre) (Figures 5(d)–(f), 8; Table 3).

**River stage slope changes**

Significant long-term river surface slope trends between maximum annual RSs of all $Q_d$s were observed only at upper consecutive sites of LMR (Red River Landing-Bayou Sara and Bayou Sara-Baton Rouge), while, the lower consecutive sites (Baton Rouge-College Point, College Point-Bonnet Carre, Bonnet Carre-Carrollton) all had either insignificant
or inconclusive trends (Figure 7; Table 4). Annual slope from Red River Landing to Bayou Sara had a decreasing trend in 10,000 cms flow type \((p = 0.0004)\) (Figure 7(a); Table 4), increasing trend in 25,000 cms flow type \((p = 0.0072)\) (Figure 7(d); Table 4), while inconclusive and insignificant trends in the 15,000 and 20,000 cms flow types, respectively \((p = 0.02\) (inconclusive) and 0.12 (insignificant)) (Figure 7(b), (c); Table 4). Further downstream from Bayou Sara to Baton Rouge, slope had an increasing trend for 10,000, 15,000, and 20,000 cms flow types \((p = 0.0075, 0.0019,\) and 0.0037, respectively) (Figure 7(a)–(c); Table 4), while the trend could not be concluded for 25,000 cms flow type \((p = 0.022)\) (Figure 7(d); Table 4).
All but one of the LMR slope trends in maximum annual river stage of all flow types at all other consecutive reaches downstream from Baton Rouge (Baton Rouge-College Point, College Point-Bonnet Carre, and Bonnet Carre-Carrollton) were insignificant (Figure 7; Table 4). Only, the slope trend in maximum annual \( R_2 \) of 25,000 cms flow from College Point to Bonnet Carre could not be concluded (\( p = 0.07 \)) (Figure 7(d); Table 4).

**Discussion**

Our findings suggest that the first 135–140 km reach of the LMR below the ORCS, covering Tarbert Landing, Red River Landing, Bayou Sara, and Baton Rouge, experienced significant changes in cross-sectional area, river stage and river surface slope in specific discharge regimes. However, we did not observe any noticeable change in these components along the lower reach of the LMR from 140 to 327 km below the ORCS, which covers College Point, Bonnet Carre and Carrollton. Specifically, we noticed a significant decrease in cross-sectional area during 1992–2013 and a significant increase in river stages of all flows during 1987–2015 along the first 20–25 km LMR reach below ORCS, covering Tarbert Landing and Red River Landing (reach 1) and the 60 km reach further downstream (from ~80 to 140 km below ORCS) covering Baton Rouge (reach 3). In the 55–60 km river reach between these reaches (from ~20–25 to 80 km below ORCS) covering Bayou Sara (reach 2), we observed a significant increase in the cross-sectional area during 1992–2013, a significant
decrease in river stages of 15,000 and 20,000 cms flows at Bayou Sara during 1973–2015, and a significant increase in slopes of maximum annual river stages of 10,000, 15,000, and 20,000 cms flows from Bayou Sara to Baton Rouge during 1987–2015.

Conclusive areal changes along the upper 140 km LMR reach have not been found earlier although Little and Biedenharn (2014) also analyzed cross sections throughout the reach for 1963–2004. They reported noticeable increase in a few cross-sectional areas from ~10 km above to ~4 km below the ORCS and negligible changes in most cross-sectional areas from Tarbert Landing to the Head of Passes. Differences between their observations and those of our study could be because the cross sections in their study were at least 2 km away from the cross sections in our study. We selected our sites according to their exact location in river kilometers provided by USACE. With respect to river stage changes in specific discharge, however, their finding was opposite to ours only at Bayou Sara during 1993–2011 (increasing trend in $R_{St}$ of three specific flow conditions [low flow: 7500–9000 cms; medium flow: 15,500–18,000 cms; and high flow: 26,500–29,500 cms]). The contrasting observations at Bayou Sara between both studies could be because of the difference in comparison periods and flow ranges. However, Little and Biedenharn (2014) also found inconclusive or insignificant trends in annual $R_{St}$s of all flows for the lower LMR reach (with different study sites) further downstream from Baton Rouge to Carrollton (reach 4), which match our findings. Previously, Winkley (1977) also found increasing river stages across several discharge ranges from ~6000 to 14,500 cms at Red River Landing for the period 1962–1973.

### Table 3. Yearly trends in river stages of four flow types [(a) 10,000 cms (flow duration = 65.67%) (35th Percentile); (b) 15,000 cms (flow duration = 43.88%) (57th Percentile); (c) 20,000 cms (flow duration = 26.35%) (73rd Percentile); and (d) 25,000 cms (flow duration = 11.92%) (87th Percentile)] at the following six LMR sites downstream chronologically: Red River Landing (RRL), Bayou Sara (BS), Baton Rouge (BTR), College Point (CP), Bonnet Carre (BC), and Carrollton (CAR).

<table>
<thead>
<tr>
<th>Station</th>
<th>Flow type</th>
<th>Stage-time trend line equation</th>
<th>$p$-value</th>
<th>Stage trend</th>
</tr>
</thead>
<tbody>
<tr>
<td>RRL</td>
<td>10,000</td>
<td>$y = 7.06 + 0.00007x$</td>
<td>&lt;0.0001</td>
<td>SI</td>
</tr>
<tr>
<td></td>
<td>15,000</td>
<td>$y = 9.96 + 0.00006x$</td>
<td>&lt;0.0001</td>
<td>SI</td>
</tr>
<tr>
<td></td>
<td>20,000</td>
<td>$y = 11.71 + 0.00008x$</td>
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<td>SI</td>
</tr>
<tr>
<td></td>
<td>25,000</td>
<td>$y = 13.65 + 0.00006x$</td>
<td>&lt;0.0001</td>
<td>SI</td>
</tr>
<tr>
<td>BS</td>
<td>10,000</td>
<td>$y = 5.75 - 0.000004x$</td>
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<td>ND</td>
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<tr>
<td></td>
<td>15,000</td>
<td>$y = 8.32 + 0.00001x$</td>
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<tr>
<td></td>
<td>20,000</td>
<td>$y = 10.24 + 0.00002x$</td>
<td>&lt;0.0001</td>
<td>SD</td>
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<tr>
<td></td>
<td>25,000</td>
<td>$y = 11.91 - 0.00001x$</td>
<td>0.0123</td>
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</tr>
<tr>
<td>BTR</td>
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<td>SI</td>
</tr>
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<td>15,000</td>
<td>$y = 5.83 + 0.00004x$</td>
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<td>SI</td>
</tr>
<tr>
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<td>&lt;0.0001</td>
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</tr>
<tr>
<td></td>
<td>25,000</td>
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<td>&lt;0.0001</td>
<td>SI</td>
</tr>
<tr>
<td>CP</td>
<td>10,000</td>
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<td>IC</td>
</tr>
<tr>
<td></td>
<td>15,000</td>
<td>$y = 3.63 + 0.000006x$</td>
<td>&lt;0.0001</td>
<td>SD</td>
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<tr>
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<td>BC</td>
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<td>CAR</td>
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<tr>
<td></td>
<td>25,000</td>
<td>$y = 3.88 - 0.00005x$</td>
<td>0.12</td>
<td>ND</td>
</tr>
</tbody>
</table>

Notes: Information on the range of each flow types can be found in Section “Bathymetric and specific river stage analyzes”. River stage trends have been denoted as – SI: Significantly Increasing, SD: Significantly Decreasing, ND: No Difference (insignificant trend), and IC: Inconclusive (trend could not be concluded).
between the early 1940s and mid-1970s. Recently, Mossa (2013) reported an increase of ~2 m in river stages for specific discharges of 5000, 10,000 and 15,000 cms, respectively, at Tarbert Landing (~5 km upstream of Red River Landing) between the mid-1930s and the early 2010s. A few other studies also analyzed long-term river stage trends for the LMR, but used Natchez and Vicksburg, ~95 and 210 km upstream of Tarbert Landing, respectively, as locations for their analyzes (Biedenharn & Watson, 1997; Wasklewicz et al., 2004). Biedenharn and Watson (1997) found increasing river stage trends at both locations for 1972–1994, while Wasklewicz et al. (2004) found decreasing river stage trends at Vicksburg and non-significant trends at Natchez for 1887–1999. With respect to river surface slope trends, Biedenharn et al. (2000) compared pre-cutoff (1880s to 1930s) and post-cut off (1943–1992) slopes along the LMR ~930 to 95 km upstream of Tarbert Landing. One of their conclusions, that slopes during post-cutoff periods were more variable than pre-cutoff slopes, resembles the notable variability we observed in slopes along the upper three LMR reaches during 1987–2015.

Several factors could have caused these multi-decadal morphological and hydrological changes along the first three LMR reaches. The channel length of LMR from Memphis, TN (~690 km upstream of Red River Landing) to Tarbert Landing was artificially shortened by 30% (~274 km in length) following the construction and execution of 14 meander cutoffs at several locations along this reach during 1929 and 1942 (Smith & Winkley, 1996; Winkley, 1977, 1994). Several significant morphological and hydraulic alterations were
reported in the LMR channel during the post-cutoff periods, such as continuous widening of channel with increased pool depth (Biedenharn et al., 2000; Winkley, 1977), increase in minimum river stages (Elliott, Rentschler, & Brooks, 1991), subtle variation in channel roughness (Biedenharn et al., 2000; Stanley Consultants, 1990), and significant increase in channel slope at a few locations (Biedenharn et al., 2000). Although the cut-offs were executed specifically from ~50 to 600 km above Tarbert Landing, it is likely that the reported changes could also be occurring along the substantial portion of LMR reach downstream. A few studies noted that the effects of backwater flows on river stages and channel bed along the LMR reach, such as depositional backwater zones, and divergent offshore plumes cannot be neglected (Chatanantavet, Lamb, & Nittrouer, 2012; Lamb, Nittrouer, Mohrig, & Shaw, 2012; Nittrouer et al., 2012). Furthermore, local modifications in the LMR over small patches during 1973–2015, such as opening of Morganza Spillway during the 1973 and 2011 floods and Bonnet Carre Spillway during the 1973, 1993, and 2011 floods, construction of river training dikes in reach 3 (Pokrefke, Nickles, Raphelt, Trawle, & Boyd, 1995), and dredging to maintain navigational depths, could also have had subtle effects on LMR channel alternations.

Spatiotemporal changes in LMR cross sections, and river stages and slopes in the four discharge regimes along the first three reaches, and non-significant changes in these components along the fourth reach, can also be linked to bed adjustment pertaining to sediment deposition and erosion. In this regard, we propose a schematic model for channel adjustment along the LMR reach over the last three decades based on the aforementioned changes in cross sections, river stages, and river surface slopes (Figure 8). In the model, we deduce that over the last three decades

<table>
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<tr>
<th>Channel Reach (from – to)</th>
<th>Time period</th>
<th>Flow type (cms)</th>
<th>p-value</th>
<th>Slope trend</th>
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<tbody>
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<td>RRL-BS</td>
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<td>10,000</td>
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<td>SD</td>
</tr>
<tr>
<td></td>
<td></td>
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<td>0.02</td>
<td>IC</td>
</tr>
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<td>ND</td>
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<td>25,000</td>
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<td>SI</td>
</tr>
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<td>BS-BTR</td>
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<td>ND</td>
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</tr>
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<td></td>
<td></td>
<td>25,000</td>
<td>0.34</td>
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</table>

Notes: Information on the range of each flow types can be found in Section “Bathymetric and specific river stage analyzes”. Notations for slope trends are same as those of river stage trends as explained in Table 2.
decades LMR reaches 1 and 3 have probably been aggrading gradually over time, with more sediment deposition, while reach 2 has probably been degrading gradually, with more sediment erosion (Figure 8). We also deduce that no significant change has occurred along reach 4 of the LMR over the last three decades (Figure 8). The following two important phenomena seem to contribute significantly to sediment deposition along reach 1:

1. Reach 1 starts just below the ORCS, from where ~25% flows are diverted to the Atchafalaya River (Copeland & Thomas, 1992). The reduced flows along the Mississippi River have existed since the ORCS establishment in 1963 and have lower velocities, which can further aid in sediment deposition along the reach.

2. Reach 1 consists of a few sediment channel bars, three of which were recently investigated by Wang and Xu (2015, 2016). Wang and Xu (2015) reported that the total surface area of three channel bars located at 18, 24, and 26 km downstream from the ORCS, respectively, increased by 7.3% during the 2011 spring flood in the LMR. Similarly, Wang and Xu (2016) estimated that the three bars accumulated a total of ~36 MT sediment load during 1985–2013. These observations support our argument that river stages along reach 1 were probably increasing gradually over the last three to four decades because of sediment deposition, which possibly resulted in a decrease in cross-sectional area along the reach.

We further hypothesize the potential existence and significant growth of sediment channel bars along reach 3, based on our observations of identical morphological and hydrological
changes between reaches 1 and 3. However, channel bars either do not exist or did not experience noticeable sediment accumulation along reaches 2 and 4 because we observed contrasting morphological and hydrological changes along reach 2 and non-significant alternations along reach 4.

The possible alternative riverbed adjustment trend, which we deduced along reaches 1, 2, and 3, and negligible sediment deposition along reach 4, have been quantifiably supported by a short-term sediment budget study by Allison et al. (2012). They reported the highest sediment load at Tarbert Landing (470 MT) and significantly lower loads downstream at St. Francisville (416, ~11 km downstream from Bayou Sara) (271 MT) and Baton Rouge (277 MT), respectively during 2008–2010. These findings indicate that a substantial sediment load (199 MT) was trapped between Tarbert Landing and Bayou Sara (near St Francisville), while almost all load was eroded from Bayou Sara to Baton Rouge. They calculated a sediment load of 264 MT for only one location further downstream from Baton Rouge: Belle Chasse (rk 121.6, ~43 km downstream from Carrollton). Similarity between sediment loads at Baton Rouge and Belle Chasse (difference of 13 MT in 3 yr) in their study coincides with our observation that the lowermost 187 km reach is nearing dynamic equilibrium with negligible sediment deposition. A few recent studies found high long-term annual sediment and sand loads (30–40 yr) at Tarbert Landing (Rosen & Xu, 2014: 3180 MT sediment load during 1980–2010; Nittrouer & Viparelli, 2014: 936 MT sand load during 1973–2012; Joshi & Xu, 2015: 1115 MT sand load during 1973–2013). Also, Allison and Meselhe (2010) estimated that the annual sediment load at Tarbert Landing was higher than at St. Francisville by 20 MT/yr during 1981–2004. These studies provide some evidence of higher multi-decadal sediment deposition along reach 1. However, long-term sediment loads at other locations downstream from St. Francisville have not yet been quantified. Sediment and sand loads in all these studies were quantified from their corresponding rating curves; hence, all the loads are subjected to their corresponding error ranges.

Our proposed model of channel bed adjustment along the first 327 km of LMR from the ORCS to Carrollton, New Orleans, could have important implications for riverine management further downstream from Carrollton to Head of the Passes, too. Currently, sediment diversions have been planned only along the LMR reach below Carrollton, although a substantial portion of sediment load seems to be trapped along the first 140 km downstream of ORCS (~335–200 km above Carrollton). Therefore, sediment management along LMR could benefit if sediment load trapped along reaches 1 and 3 is systematically outsourced to reach 4. The sediment outflow from reach 4 to proposed diversion sites below Carrollton can be achieved without further engineering the LMR, as we deduced that reach 4 is probably approaching its dynamic equilibrium.

Conclusions

This study used the hydrographic survey measurements conducted in 1992, 2004, and 2013 as well as daily river discharge and stage records over the past three decades to assess long-term channel morphological changes at seven locations along a 327-km reach of the Lower Mississippi River (LMR), one of the most regulated alluvial rivers in the world. We found significant changes in cross-sectional area, river stage, and river surface slope in specific discharge regimes along the first 140 km downstream of the LMR’s diversion to the Atchafalaya River at the Old River Control Structure (ORCS), covering Tarbert Landing, Red River Landing, Bayou Sara, and Baton Rouge. Specifically, the first
20–25 km reach (reach 1) and the reach further downstream from 80 to 140 km (reach 3) showed continuous decreases in cross-sectional area and increases in river stage and river slope under all flow conditions. However, the 55–60 km reach in between (from 20–25 km to 80 km below ORCS) (reach 2) experienced exactly opposite trends, i.e. increase in cross-sectional area and decrease in river stages. Furthermore, the remaining 187 km reach (from 140 to 327 km; reach 4) had insignificant changes in its cross-sectional area, river stage, and river surface slope. We link these changes to channel bed adjustment pertaining to sediment deposition and erosion partially and propose that reaches 1 and 3 have probably experienced sediment deposition, reach 2 has probably experienced bed erosion, and reach 4 is probably approaching dynamic equilibrium over the past three to four decades. Therefore, substantial amount of sediment, potentially useful for land-building purposes, appears to be trapped along the first 140 km LMR reach below ORCS, while sediment flow seems higher along the next 187-km reach. These findings suggest that large alluvial rivers with intensive human interventions go through noticeable spatial and temporal changes in their corresponding bed adjustment processes. Such information can have relevant implications for riverine sediment management, channel engineering, and coastal land restoration in the world’s sinking deltas fed by regulated alluvial rivers.

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Disclosure statement

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References


Attachment B

National Wildlife Federation Comments

Scoping Comments on Supplement II to the Final Environmental Impact Statement, Mississippi River and Tributaries Project, Mississippi River Mainline Levees and Channel Improvement

Submitted October 15, 2018
DECLARATION OF NICHOLAS PINTER, Ph.D.
AND EXHIBITS 1-3 THERETO

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Attorneys for Plaintiffs NATIONAL WILDLIFE FEDERATION, et al.

IN THE UNITED STATES DISTRICT COURT
FOR THE SOUTHERN DISTRICT OF ILLINOIS

NATIONAL WILDLIFE FEDERATION, PRAIRIE RIVERS NETWORK, MISSOURI COALITION FOR THE ENVIRONMENT, RIVER ALLIANCE OF WISCONSIN, GREAT RIVERS HABITAT ALLIANCE, and MINNESOTA CONSERVATION FEDERATION,

Plaintiffs,

vs.

UNITED STATES ARMY CORPS OF ENGINEERS; LT. GENERAL THOMAS P. BOSTICK, Commanding General and Chief of Engineers, LT. GENERAL DUKE DELUCA, Commander of the Mississippi Valley Division of the Army Corps of Engineers,

Defendants.

CASE NO. 14-00590-DRH-DGW
DECLARATION OF NICHOLAS PINTER, Ph.D. IN SUPPORT OF PLAINTIFFS’ MOTION FOR PRELIMINARY INJUNCTION; EXHIBITS 1-3
HEARING: TBD
TIME: TBD
I, Nicholas Pinter, declare as follows:

**Professional Experience and Background**

1. I am a Professor in the Geology Department and Environmental Resources and Policy Program at the Southern Illinois University, and Director of the SIU’s Integrative Graduate Education, Research and Training (IGERT) program in “Watershed Science and Policy.” I have a Ph.D. (1992) from the University of California, Santa Barbara and an M.S. (1988) from Penn State University. I have authored, edited, or contributed to at least five books and authored over 39 peer-reviewed, published scholarly articles in rivers, flood hazard, and related fields.

2. My primary field of expertise is in earth-surface processes (geomorphology) applied to a broad range of theoretical questions and practical applications. Much of my recent work focuses on rivers, fluvial geomorphology, flood hydrology, and floodplains. This research includes field-based work, modeling, and significant public-policy involvement.

3. My lab uses hydrologic and statistical tools, 1D and 2D hydraulic modeling, and loss-estimation modeling to quantify the impacts of river and floodplain engineering, and to assess regional floodplain management strategies and mitigation solutions. My research group has also compiled a large NSF-funded GIS database of over 100 years of channel hydrography, floodplain topography, and engineering construction and infrastructure on over 2500 miles of the Mississippi and Missouri Rivers in order to empirically test the causal connections between channel and floodplain modifications and flood response. Another recent NSF-funded project assessed the impacts of progressive levee growth along the Mississippi River through hydraulic modeling of multiple calibrated time steps and multiple change conditions.

4. My research group also runs a series of FEMA-funded grants doing hazard modeling and mitigation planning across the central United States. To date, the group has completed more than 40 FEMA disaster mitigation studies, and we have a number of new plans and plan updates ongoing. One principal modeling tool is the Hazus-MH package that, along with various GIS-based and modeling tools, allows estimation of disaster damages and effects for a range of hazards and disaster scenarios. This modeling capability nicely bridges the gap between pure hydrologic and hydraulic analyses (as well as site-specific earthquake studies) and broad societal impacts.
5. My Curriculum Vitae is attached hereto as Exhibit 1.

**Documents Reviewed for this Declaration**

6. I am familiar with the literature regarding the morphology and dynamics of the Mississippi and other rivers and the interaction between river engineering structures and floods, including the studies cited in Appendix A, Summary of Research on the Effects of River Training Structures on Flood Levels, to the Final Environmental Assessments with Finding of No Significant Impact prepared by the U.S. Army Corps of Engineers ("Corps") for the Dogtooth Bend, Monsenthein/Ivory Landing, and Eliza Point/Greenfield Bend projects, and the Draft Environmental Assessment and Unsigned Finding of No Significant Impact for the Grand Tower project.

7. I have reviewed the Environmental Assessments with Finding of No Significant Impact for the Dogtooth Bend, Monsenthein/Ivory Landing, and Eliza Point/Greenfield Bend projects, and the Draft Environmental Assessment and Unsigned Finding of No Significant Impact for the Grand Tower project.

**Analysis**

8. I have been asked to form an independent professional opinion as to whether building new river training structures, including those planned by the Corps in the Dogtooth Bend, Monsenthein/Ivory Landing, Eliza Point/Greenfield Bend, and Grand Tower projects, may pose a significant risk of irreparable harm to the natural environment and to people and the property of people who live, work, attend school, or recreate in the floodplains, including by raising flood stage heights on the Mississippi River. As discussed in the following analysis, I conclude that the Corps’ proposed projects, and river training structures generally, do pose such a risk.

9. Damages from floods worldwide have risen dramatically over the past 100 years (Munich Re Group, 2007). While much of this increase is due to economic development in floodplains (Pinter, 2005; Pielke, 1999), it is also clear that flooding itself has physically increased in magnitude and frequency on many rivers, including the Mississippi River. (Pinter et al., 2006a; Pinter et al., 2006b; Helms et al., 2002). Historical time series of stage data, which are
unequivocally homogenous over time (Criss and Winston, 2008), show strong and statistically 
significant increases of flood heights on the Mississippi River over time.

10. A number of processes can lead to flood magnification or otherwise alter flood 
response in a river basin. These include climate change, agricultural practices, forestry practices, 
urbanization, road construction, construction of other impervious surfaces, loss of wetlands, 
decreases in floodplain storage areas, construction and operation of dams, and modifications and 
engineering of river channels. The range of these changes can alter the volume and timing of runoff 
(discharge or flow of water) entering and moving through river systems. In addition, other natural 
or human-induced changes to river channels and their floodplains can alter the conveyance of flow 
with the river channels, resulting in increases or decreases in water levels (including flood stages) 
for the same discharge.

11. The Mississippi River has been intensively engineered by the Corps over the past 50 
to 150-plus years (depending on the reach), and some of these modifications are associated with 
large decreases in the river’s capacity to convey flood flows. Numerous scientific investigations 
including Corps reports, some dating back to the 1950s, have noted large increases in flood levels in 
association with wing-dike construction. For example, investigators recognized as early as 1952 
that “the carrying capacity of the river has been decreased so materially by the [river training] work 
that floods have occurred at such points as Waverly, Boonville and Hermann, Mo., at lower gauge 
readings with smaller volumes of water than the 1929 flood stage.” (Schneiders, 1996 at 346).

These investigations have prompted some agencies to rethink their river management strategies. In 
the Netherlands, for example, the government has begun modifying river training structures on the 
Rhine River to reduce this recognized risk. General Accounting Office, “Mississippi River: 
Actions Are Needed to Help Resolve Environmental and Flooding Concerns about the Use of River 
Training Structures (December 2011)” (“GAO Report”) at 41. To date, however, the Corps has 
ever addressed in an EIS the vast body of peer-reviewed, independent research showing that river-
training structures increase flood heights. Id.

12. My research has looked extensively at the extent and causes of flood magnification, 
particularly on the Mississippi River. This research documents that climate, land-use changes, and
river engineering have contributed to statistically significant increases in flooding along portions of
the Mississippi River system. However, the most significant cause of flood height increases on the
Middle Mississippi River and Lower Missouri River can be traced to the construction of wing dikes
and other river training structures. Indeed, flood height increases on those river segments exceed
by a factor of ten the maximum credible increases that could be expected from climate-driven and
land-cover-driven flow increases (e.g., Pinter et al., 2008). The large multivariate study by Pinter et
al. (2010) identified the age, location, and extent of every large levee system added to the
Mississippi-Lower Missouri system during the past century, documenting that levees do contribute
some but not all of the observed flood-level increases on the Middle Mississippi and elsewhere
(confirming modeling by Remo et al., 2009; see Exhibit 2 to this declaration).

13. Recent theoretical analysis has shown that increased flood levels caused by wing-
dike construction are “consistent with basic principles of river hydro- and morphodynamics”
(Huthoff et al., 2013). This study concluded that even with extremely conservative parameters used
in modeling, “the net effect of wing dikes will be higher flood levels.” Id.

14. This theoretical analysis is supported by empirical studies that have utilized
hydrologic analyses; rigorous statistics; geospatial analyses; and 1D, 2D, and 3D hydraulic
modeling to confirm, empirically as well as theoretically, the potential for significant increases in
flood levels in response to the dense emplacement of wing-dike structures, such as employed on the
Middle Mississippi River. Among this body of research, my research group was funded by the
National Science Foundation to construct two large river-related databases to rigorously test for
trends in flood magnitudes over time on over 4000 kilometers (over 2400 miles) of the Mississippi
and Missouri Rivers, and to quantify the impacts on flood levels from each unit of channel and
floodplain infrastructure construction or other change.

15. Our hydrologic database consists of more than 8 million discharge and river stage
values, including new synthetic discharges generated for 41 stage-only stations. This hydrologic
database was used to test for significant trends in discharges, stages, and “specific stages.” We
also conducted an extensive review of the validity of using discharge data taken from different
types of measurement devices (float meters vs. other types of meters). Pinter (2010) tested whether
it was appropriate to utilize older discharge measurements by examining 2150 historical discharge measurements digitized from the three principal stations on the Middle Mississippi River (MMR), including 626 float-based discharges and 1516 meter-based discharges, and including 122 paired measurements. All statistical tests we performed demonstrated that it was appropriate to utilize both older historical discharge data and newer discharge data as those different types of measurement tools produced accurate discharge measurements.

16. Our geospatial database consists of the locations, emplacement dates, and physical characteristics of over 15,000 structural features constructed along the study rivers over the past 100 to 150 years. In developing this database we utilized: more than 4000 individual map and survey sheets; structure-history databases from six Corps Districts; databases from other agencies including the Coast Guard; and archival maps and surveys digitized and calibrated into a modern coordinate system and frame of reference. Within this database we parameterized 130 bridges, 54 dam structures, 25 artificial meander cut-offs, 1093 levees, and 13,231 wing-dam segments, among many other structures.

17. Together these two databases were used to generate reach-scale statistical models of hydrologic response. These models quantify changes in flood levels at each station in response to construction of wing dikes, bendway weirs, meander cutoffs, navigational dams, bridges, and other river modifications.

18. Our analyses show that while climate and other land-use changes did lead to increased flows, the largest and most pervasive contributors to increased flooding on the Mississippi River system were wing dikes and related navigational structures. In contrast, large reaches of the Mississippi and Missouri Rivers with little or no dike construction showed no significant increases in flood levels. System-wide, the hydrologic pattern was that large-scale increases in flood levels occurred when and where large numbers of dikes and dike-like structures have been built. Progressive levee construction was the second largest contributor.

19. Our analyses demonstrate that wing dikes constructed downstream of a location were associated with increases in flood height (“stage”), consistent with backwater effects upstream of these structures. Backwater effects are the rise in surface elevation of flowing water upstream
from, and as a result of, an obstruction to water flow. These backwater effects were clearly
distinguishable from the effects of upstream dikes, which triggered simultaneous incision and
conveyance loss at sites downstream. On the Upper Mississippi River, for example, stages
increased more than four inches for each 3,281 feet of wing dike built within 20 RM (river miles)
downstream. These values represent parameter estimates and associated uncertainties for
relationships significant at the 95 percent confidence level in each reach-scale model. The 95-
percent level indicates at least a 95% level of certainty in correlation or other statistical benchmark
presented, and is considered by scientists to represent a statistically verified standard. Our study
demonstrated that the presence of river training structures can cause large increases in flood stage.
For example, at Dubuque, Iowa, roughly 8.7 linear miles of downstream wing dikes were
constructed between 1892 and 1928, and were associated with a nearly five-foot increase in stage.
In the area affected by the 2008 Upper Mississippi flood, more than six feet of the flood crest is
linked to navigational and flood-control engineering.

20. More than 143 linear miles of wing dikes have been constructed on the Middle
Mississippi River over the past 100 years (Remo and Pinter 2007; Remo et al. 2008). This
represents about 3,960 feet of wing dikes per mile (or about 2,460 feet per kilometer) of channel.
Wing dikes have also been heavily utilized on the Lower Missouri River, with over 383 linear miles
constructed since 1890. This represents nearly 3,700 feet of wing dike per mile (or about 2,300 feet
per kilometer) of channel in the Lower Mississippi River. These and similar river training
structures are utilized to assist in river bank protection and stimulate channel scour which can
reduce the amount of dredging required to maintain adequate navigation depths (e.g. COPRI 2012).

21. The effects of wing dikes and other structures during flooding should not be
confused with effects during periods of low flow. There is general agreement that during low in-
channel flows, wing dikes lead to lowered water levels. This happens because the dikes cause
channel incision, which is a process of channel adjustment by which channel flow removes
sediment from the stream bed and ultimately establishes a lower bed elevation. Channel incision is
a process that has been well documented after dike construction in many (but not all) areas of the
alluvial Mississippi and Missouri Rivers (e.g., Pinter and Heine 2005; Maher 1964).
22. For example, water levels at St. Louis measured during periods of low to average flows have decreased over a period of about 60 years. This decrease reflects the well-documented effects of dike construction (also dredging) that has constricted the channel, eroded the channel bed, and thus lowered such non-flood water levels. Downstream at the Chester and Thebes measurement stations, water levels have also decreased during low flows, but they have risen for all conditions from average flows up to large floods. At Grand Tower, Illinois, water levels for just average flows have increased by almost three feet due to dike and weir construction. Near Grand Tower, bedrock underlies parts of the Middle Mississippi channel and limits incision (Jemberie et al. 2008). At all of these locations, at flood flows (flows equal to four or more times the average annual discharge level), water levels have increased by three to ten feet or more.

23. Many other studies confirm and corroborate these findings. Particularly after the record-breaking floods on the Middle Mississippi, researchers sought to answer why such large increases in flood levels had occurred for the same discharges (volumes of flow) that had been observed in the past. (e.g., Belt 1975; Stevens et al. 1975). Since then, multiple studies involving hydrologic time-series analyses, statistical analyses, geospatial analyses, and hydraulic modeling have correlated the timing and spatial distribution of dike construction with increases in flood stages (e.g., Criss and Shock 2001; Wasklewicz et al. 2004; Jemberie et al. 2008; Pinter et al. 2008; Remo et al. 2009; Pinter et al. 2010, and others).

24. Wing dikes and other river training structures increase flood heights during high water because of the way they interact with river flow and the way they change the shape and form of the river channel. Since the beginning of historical “training” (engineering of the river to facilitate navigation) of the Mississippi and Missouri rivers, construction of dikes has narrowed large portions of these river channels to one-half or less of their original width. In addition, construction of dikes, bendway weirs, and other in-channel navigational structures has increased the "roughness" of the channel, leading to decreased flow velocities during floods.

25. Channel roughness is a measure of objects and processes that cumulatively resist the flow of water through a given reach of a river, including drag effects of sedimentary grains, bedforms (e.g., ripples and dunes on the bed), vegetation, turbulence, eddy circulation, and many
others. A rough river bed exerts more resistance than a smooth river bed, resulting in slower flow of water. All other factors being equal, a flood that passes through a river reach with half the average flow velocity will result in average water depths that are double what they would otherwise be.

26. Recent modeling studies demonstrate the significant effects of flow turbulence and large-scale vertical and horizontal eddy circulation (Huthoff et al., 2013) of river training structures during flood events. Other recent studies have focused on flow dynamics around submerged wing dikes and their impact on channel flow resistance (e.g., Yossef 2005; Yossef and de Vriend 2011; Azinfar and Kells 2011). These studies show that submerged wing dikes create flow mixing in their wake zones (e.g., Yossef 2005; Yeo and Kang 2008; Jamieson et al. 2011). These recirculating flows consume energy from the bulk flow field, causing increases in effective resistance near wing dikes and through wing-dike fields. The impact of wing dikes on flow resistance was quantified by Yossef (2004, 2005), whose proposed relationship allows for an initial assessment of wing-dike impact on water levels (e.g., Azinfar 2010). According to Yossef’s laboratory experiments, the effective cumulative hydraulic roughness of the bank zone relates to the size and longitudinal distance between the wing dikes.

27. The role of river training structures in increasing flood heights is well recognized. For example, in the Netherlands, the impacts of wing dikes (navigational “groynes”) on flood levels have both been recognized and taken into account in flood protection strategies. The government of the Netherlands recently completed a €45 million program to lower 450 wing dikes (groynes) on the Rhine system as part of its strategy to reduce flood levels.

28. Changes in channel geometry and roughness related to river engineering tools employed for improved navigation and flood control are the principal drivers behind changes in flood stage on the Mississippi River. The increases in flood stage are caused by both the direct effects of wing dikes, meaning interaction with flow, and the indirect effects of wing dikes, meaning the effects of the wing dike in changing the shape or form of the river bed. Hydrodynamic simulations of indirect and direct effects of wing dikes show decreases in velocity, increases in roughness, and corresponding increases in flood stage.
29. River training structures constructed by the Corps to help maintain the nine-foot navigation channel have caused large-scale increases in flood levels, up to 15 feet in some locations and by some measures, and six to ten feet over broad stretches of the river where these structures are prevalent. Such large increases in flood heights in these rivers have occurred when and where – and only when and where – wing dikes, bendway weirs, and other river training structures have been built. These structures have led to significant increases in the frequency and magnitude of large floods.

30. The projects now proposed on the Middle Mississippi River are particularly problematic for several reasons. First, as mentioned above, bedrock underlies parts of the Middle Mississippi channel near the Grand Tower project, which limits incision (Jemberie et al. 2008). In such locations, the ameliorating effect of new wing dikes in causing bed incision is reduced or eliminated, leading in the past to the largest observed increases in flood levels.

31. The new dike construction projects now proposed on the Middle Mississippi are also problematic because they threaten nearby levees that already have identified deficiencies. The Dogtooth Bend Project is immediately downstream of one of the sites where the Len Small levee failed during floods in 2011 (Dogtooth Bend EA at E2). This 5,000-foot breach yielded to fast-moving water that “scored farmland, deposited sediment, and created gullies and a crater lake” (K.R. Olson and L.W. Morton, “Impacts of 2011 Len Small levee breach on private and public Illinois lands,” *Journal of Soil and Water Conservation*, Vol. 68:4, attached as Exhibit 3).

32. The proposed Grand Tower project spans approximately seven River Miles along the Big Five Levee Drainage and Levee Districts, including the Preston, Clear Creek, East Cape, and Miller Pond levees, together protecting over 49,000 acres of Illinois floodplain. The proposed Grand Tower wing dike project also lies just downstream of the Degognia/Fountain Bluff and Grand Tower Drainage and Levee Districts, protecting a further 56,000 acres. Currently, every segment of these levee systems have "Unacceptable" ratings following Corps inspections and assessment. The Dogtooth Bend Project likewise poses an unusually high potential for flood damage. The Cairo levee system ("Mississippi and Ohio Rivers Levee System at Cairo & Vicinity") is located a few miles downstream of the Dogtooth Bend Project. Although the greatest
effects of wing dikes occur upstream, statistically significant increases in flood levels have also
been identified downstream. Corps inspections have identified major deficiencies in the Cairo
levee system, leading to its current "Unacceptable" rating in the National Levee Database.

33. My work with local levee commissioners and other informed officials has revealed
depth concern and widespread discussion about levee safety and performance during future floods,
even without additional stresses. For at least the past decade, local stakeholders have repeatedly
called for the St. Louis District of the Corps of Engineers to rigorously and independently assess the
cumulative impacts of wing-dike construction in the Middle Mississippi River. Instead, a new
wave of dike construction has been undertaken, with each new project evaluated – perfunctorily –
on an individual basis and without regard to cumulative effects.

34. The new dike construction projects here – at Dogtooth Bend, Monsenthein/Ivory
Landing, Eliza Point/Greenfield Bend, and Grand Tower – pose significant threats of increased
flooding and flood risk. They are the latest manifestations of a flawed process that has allowed
construction of hundreds of new dikes and dike-like structures that are causing elevated flood stages
throughout the Middle Mississippi River. Unless these new dike construction projects are halted to
allow their reconsideration based on a comprehensive Supplemental Environmental Impact
Statement that takes the foregoing studies and analyses into consideration, needless and potentially
severe flooding will likely occur.

35. I declare under penalty of perjury that the foregoing facts are true of my personal
knowledge, that the foregoing expressions of professional judgment are honestly held in good faith,
that I am competent to and if called would so testify, and that I executed this declaration on June

Nicholas Pinter, Ph.D
Sources Cited


Wasklewicz, T.A., J. Grubaugh, and S. Franklin, 2004. 20th century stage trends along the


EXHIBIT

1
Nicholas Pinter

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EDUCATION
1988 - 1993 PhD., Geology, University of California, Santa Barbara
1986 - 1988 M.S., Geology, Penn State University, Univ. Park, PA
1982 - 1986 B.A., Geology and Archaeology, Cornell University, Ithaca, NY

RESEARCH AREAS
• Geomorphology: the geology of the earth-surface
• Human influences on landscapes and geomorphic processes
• Rivers, flooding, and floodplain management

PROFESSIONAL POSITIONS
1996 - Full Professor (since 7/05), Southern Illinois University
Author: Prentice Hall and John Wiley & Sons
1995 -1996 Postdoctoral Researcher, Yale University

RECENT HONORS/AWARDS
• 2013-2018: Fulbright Specialist, U.S. State Dept., Bureau of Educational and Cultural Affairs (roster)
• 2013: Nominee: W.K. Kellogg Foundation & APLU Engagement Award (to SIU Olive Branch team)
• 2012: Illinois Mitigation Award: Illinois Association of Floodplain and Stormwater Managers
• 2010: Marie Curie Fellowship (IIF), European Commission
• 2010: Fulbright Fellowship (declined; see above)
• 2009: Leo Kaplan Research Award, Sigma Xi, SIU Chapter
• 2008: SIU College of Science, Outstanding Researcher award
• 2007: Alexander von Humboldt Foundation, Germany Research Renewal Fellowship
• 2005, 2006: SIU nominee, Jefferson Fellows Program; National Academy of Sciences
• 2003 Friedrich Wilhelm Bessel Prize; Alexander von Humboldt Foundation
• 2002 John D. and Catherine T. MacArthur Foundation, Research and Writing Award
• 2000 Fulbright Foundation Fellowship
• 1999 Charles A. Lindbergh Foundation Prize

BOOKS, WORKSHOPS, EDITED VOLUMES, and OTHER PROF. ACTIVITIES
Associate Editor: Environmental & Engineering Geoscience, Association of Environmental & Engineering Geologists, Denver, CO.
Convener, American Association for the Advancement of Science Workshop: Managing rivers and floodplains for the new millennium. AAAS national meeting, 2006.

Member, Advisory Board: The Nature Conservancy Great Rivers Center (Upper Mississippi, Parana-Paraguay, and Upper Yangtze River systems).


Expert Witness: e.g., B&H Towing, Inc., Case No. 06-05-0233 (U.S. District Court, Southern District of W. Virginia); Great Rivers Habitat Alliance v. U.S. Army Corps of Engineers, No. 4:05-CV-01567-ERW (U.S. District Court, Eastern District of Missouri); Great Rivers Habitat Alliance v. City of St. Peters, No. 04-CV-326900 (Circuit Court of Cole County, Missouri); Henderson County Drainage District No. 3 et al. v. United States, No. 03-WL-179780 (Ct. Fed. Cls, Kansas City), etc.

Associate Editor: Geomorphology, Elsevier Science, 2004-2008

Instructor, European Union Advanced School on Tectonics: 3D Monitoring of Active Tectonic Structures, International Centre for Theoretical Physics, Trieste, April 18-22, 2005.


Author: Pinter, N, 1996. Exercises in Active Tectonics. Prentice Hall.


REFERENCES

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FUNDED PROJECTS

Active: NSF Infrastructure Management for Extreme Events: Community resilience through pro-active mitigation in the rural Midwest.

Active: NSF IGERT: Multidisciplinary, team-based training watershed science and policy. (Lead PI: Pinter; $3.2 million) + International Supplement

Active: FEMA: Illinois multi-hazard mitigation initiative (Lead PI: Pinter; with Indiana University-Purdue University at Indianapolis). ~40 awarded + ~12 pending.

NSF RAPID: A massive floodplain reconnects: physical and biotic responses of the Birds Point levee breach in the Mississippi River (J. Garvey, lead PI).

IEMA: Illinois statewide flood-hazard assessment (J. Remo, lead PI).

Walton Family Foundation: Olive Branch, IL Relocation Initiative: Community Disaster-Recovery Networking
NSF Sedimentology and Paleobiology program: Testing hypotheses of latest Pleistocene paleoenvironmental collapse, Northern Channel Islands, California (Lead PI: Pinter; collaborative project with Northern Arizona University; Univ. of Oregon)


U.S. Steel: Levee-breach modeling, Metro East Drainage and Levee District area.

European Commission, Marie Curie IIF Program: Early anthropogenic signatures on landscapes: geomorphic, paleobotanical, and other paleo-environmental fingerprints.

NSF, Geography and Regional Science: A multivariate geospatial model of levee impacts on flood heights, Lower Mississippi River + International Supplement awarded

National Geographic Society: Testing a hypothesis of latest Pleistocene paleo-environmental collapse, Northern Channel Islands, California.

USGS Upper Midwest Environmental Sciences Center: Development of a virtual hydrologic and geospatial data repository for the Mississippi River System

NSF, Office of International Science and Engineering: U.S.-Chile: Morphotectonic evolution of the U.S.-Chile: Mejillones Peninsula, northern Chile using precise GPS measurement of uplifted coastal terraces

NSF Hydrologic Sciences Program: Multivariate geospatial analysis of engineering and flood response, Mississippi River System, USA.

NSF, International Science and Engineering: US-Chile cooperative research on the Cenozoic paleoceanographic and paleoclimatic evolution of northern and central Chile. (Ishman and Pinter)

NATO Science Program: The Adria microplate: GPS geodesy, tectonics, and hazards.

John D. and Catherine T. MacArthur Foundation: Exporting Natural Disasters: Flooding and Flood Control on Transboundary Rivers

NATO: The Adria Microplate: Postdoctoral Fellowship for Dr. G. Grenenczy.

USGS National Cooperative Geologic Mapping Program (6/03-5/04). Plio-Pleistocene Deposits of the White/Inyo Mountains Range Front, Inyo and Mono Counties, CA

Alexander von Humboldt Foundation: Human forcing of hydrologic change and magnification of flood hazard on German Rivers

NASA (9/01-8/02). Assessing mass wasting and landslide susceptibility using GIS and remotely sensed imagery, Santa Cruz Island, California. (ESS Fellowship for E. Molander)

Association of State Floodplain Managers (9/01-8/02). Rapid revision of flood-hazard mapping. (Fellowship for R. Heine)

Missouri Coalition for the Environment (7/01-5/02). Hydrologic history of the Lower Missouri River.


USGS National Cooperative Geologic Mapping Program (6/99-5/00). Mapping coastal terraces and Quaternary cover on Santa Rosa and San Miguel Islands, California, using dual-frequency kinematic GPS positioning.

NSF Active Tectonics Program (3/97-2/00), (Supplement granted). Testing models of fault-related folding, Northern Channel Islands, California.
NASA (9/00-8/01). Assessing mass wasting and landslide susceptibility using GIS and remotely sensed imagery, Santa Cruz Islands, California. (ESS Fellowship for W.D. Vestal)

National Earthquake Hazards Reduction Program (7/97-12/99): Slip on the Channel Islands/Santa Monica Mountains Thrust. (Supplement granted)


National Earthquake Hazards Reduction Program (2/92-7/93). Latest Pleistocene to Holocene rupture history of the Santa Cruz Island fault. (with Ed Keller)

PUBLICATIONS


Remo, J.W.F., A. Khanal, and N. Pinter, 2013. Assessment of chevron dikes for the enhancement of physical-aquatic habitat within the Middle Mississippi River, USA. Journal of Hydrology, 501: 146-162.


Pinter, N., and M.T. Brandon, 1997. Comment l'erosion construit les montagnes. Pour La Science, 236: 78-84

**Theses:**


**Other:**


**ABSTRACTS AND PAPERS PRESENTED**
Below + numerous invited talks at universities, agencies, and organizations


Scott, A.C., M. Hardiman, N. Pinter, and R.S. Anderson, 2013. Late Pleistocene and Holocene fire history of the California Islands. American Geophysical Union Fall Meeting, San Francisco.

Huthoff, J. Remo, and N. Pinter, 2013. Using large eddy simulation to model impacts of river training structures on flood water levees. IAHR World Congress.


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Flor, A., and N. Pinter, 2008. Identifying the potential factors contributing to levee failures on the Mississippi River. Geological Society of America, North-Central meeting. (N)


Remo, J.W.F., and N. Pinter, 2008. Retro-modeling the Middle and Lower Mississippi Rivers to assess the effects of river engineering and land-cover changes on flood stages. Geological Society of America, North-Central meeting. (N)


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EXHIBIT

3
Impacts of 2011 Len Small levee breach on private and public Illinois lands

Kenneth R. Olson and Lois Wright Morton

Agriculture, the dominant land use of the Mississippi River Basin for more than 200 years, has substantively altered the hydrologic cycle and energy budget of the region (NPS 2012). Extensive systems of US Army Corps of Engineers (USACE) and private levees from the Upper Mississippi River near Cape Girardeau, Missouri, southward confine the river and protect low-lying agricultural lands, rural towns, and public conservation areas from flooding. The Flood of 2011 severely tested these systems of levees, challenging public officials and landowners to make difficult decisions, and led to extensive damage to crops, soils, buildings, and homes. One of these critical levees (figure 1), the Len Small, failed, creating a 1,500 m (5,000 ft) breach (figure 2) where fast-moving water scoured farmland, deposited sediment, and created gullies and a crater lake. The Len Small levee, built by the Levee and Drainage District on the southern Illinois border near Cairo to protect private and public lands from 20-year floods, is located between mile marker 21 and mile marker 35 (figure 1). It connects to Fayville levee that extends to Mississippi River mile marker 39, giving them a combined length of 34 km (22 mi) protecting 24,000 ha (60,000 ac) of farmland and public land, including the Horseshoe Lake Conservation area. The repair of the breached levee, crater lake, gullies, and sand deltas began in October of 2011 and continued for one year.

HISTORICAL GEOLOGICAL FEATURES OF THE WESTERN ALEXANDER COUNTY

The Mississippi River is a meandering river of oxbows and cutoffs, continuously eroding banks, redepositing soil, and changing paths. Its willful historic meandering is particularly apparent in western Alexander County, Illinois, where a topographical map shows swirls and curves and an oxbow lake, Horseshoe Lake, where the river once flowed south of Thebes and east of the modern day Len Small levee. The loess-covered upland hills (Fehrenbacher et al. 1986) of the Shawnee National Forest just north of Route 3 (figure 1) give way to a low-lying plain between the Mississippi and Ohio rivers. The ancient Ohio River drained through the Cache River valley during the Altonian and Woodfordian glacial advances (60,000 to 30,000 years B.P.) and converged with the Mississippi River waters just northwest of Horseshoe Lake. The Cache River valley is 3 km (1.9 mi) wide and carried a substantive flow of water from the eastern Ohio River Basin.

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in addition to the local waters from the Cache River valley into the Mississippi River valley. Historically, the region has been a delta, confluence and bottomlands dating back 30,000 to 800,000 years B.P., with many of the Illinois lands shown on the maps located on both sides of the Upper Mississippi River as its channel changed locations over time. As a result, the fertile farmland of western Alexander County soils formed in alluvial and lacustrine deposits.

Horseshoe Lake (figure 3), a former oxbow and remnant of a large meander of the Mississippi River, is now a state park of 4,080 ha (10,200 ac) (Illinois DNR 2012). This oxbow lake, formerly a wide curve in the river, resulted from continuous erosion of its concave banks and soil deposition on the convex banks. As the land between the two concave banks narrowed, it became an isolated body of water cutoff from the main river stem through lateral erosion, hydraulic action, and abrasion. With 31 km (20 mi) of shoreline, the 1.3 m (4 ft) deep lake is the northernmost natural range for Bald cypress (*Taxodium distichum* L.) and Tupelo (*Nyssa* L.) trees (figure 3) and has an extensive growth of American lotus (*Nelumbo lutea*), a perennial aquatic plant, and native southern hardwoods which grow well in lowlands and areas which are subject to seasonal flooding.

The agricultural lands which surround this oxbow lake are highly productive alluvial soils—mostly Weinbach silt loam, Karnak silty clay, Sciotoville silt loam, and Alvin fine sandy loam. Almost two-thirds of the area (16,000 ha [40,000 ac]) protected by the Len Small and Fayville levees is privately owned. Corn (*Zea mays* L.), soybeans (*Glycine max* L.), and wheat (*Triticum* L.) are the primary crops, with some rice (*Oryza sativa* L.) grown in this area.
THE COMMERCE TO BIRDS POINT, CAIRO, AND WESTERN ALEXANDER COUNTY LEVEES

In early May of 2011, the floodwaters at the Ohio River floodgates in Cairo, Illinois, had reached 18.7 m (61.7 ft) (NOAA 2012). The Ohio River was 6.7 m (22 ft) above flood stage and had been causing a back-up in the Mississippi River floodwater north of the Cairo confluence prior to the USACE opening of the Birds Point–New Madrid Floodway. For more than a month, the Mississippi River back-up placed significant pressure on the Len Small and Fayville levees (figure 1). As a result, approximately 1,500 m (5,000 ft) of the Len Small levee was breached (figure 2) near mile marker 29 (figure 1) on the morning of May 2, 2011.

The flood protection offered by the Len Small and Fayville levees is important to the landowners, homeowners, and farmers in southwestern Alexander County, Illinois. However, the Len Small and Fayville levees are not the mainline levees which control the width and height of the Mississippi River. The controlling mainline levees are the frontline Cairo levee located in Illinois (Olson and Morton 2012a) and the Commerce to Birds Point levee in Missouri (figure 4). These two frontline levees, by design, are much higher and stronger than the Len Small and Fayville levees. The Len Small and Fayville levees were built by the local levee district and are not part of the Mississippi River and Tributaries project for which USACE has responsibility (figure 5). The Cairo levee has a height of 19.4 m (64 ft), or 101.4 m (334.5 ft) above sea level, and levee failure would destroy the City of Cairo. The frontline Commerce to Birds Point levee has a height of 19.8 m (65.5 ft), and its failure would result in more than 1 million ha (2.5 million ac) of agricultural bottomlands in Missouri Bootheel and Arkansas on west side of the Mississippi River being flooded (figure 5). Commerce to Birds Point levee connects to a setback levee on the west side of the Birds Point–New Madrid Floodway, which extends the protection another 51 km (33 mi) to the south where it joins the frontline levee at New Madrid, Missouri, further extending the protection of the Bootheel bottomlands (Camillo 2012; Olson and Morton, 2012a, 2012b, 2013). The failure of the Hickman (Kentucky) levee on the east side of the Mississippi River would have resulted in the flooding of 70,000 ha (170,000 ac) of protected bottomlands in Tennessee and Kentucky (figure 5). The floodwater height and pressure on the Commerce to Birds Point and Birds Point to New Madrid levees has increased over the years during Mississippi River flooding events with the construction of the Len Small and Fayville levees and with a strengthening of the levee near Hickman, Kentucky, which had the effect of narrowing the Mississippi River Floodway corridor and removing valuable floodplain storage areas for floodwaters.

THE MISSISSIPPI RIVER COMMISSION AND ITS ROLE IN LEVEE CONSTRUCTION ALONG THE MISSISSIPPI RIVER AND TRIBUTARIES

The Mississippi River Commission (MRC) was established by Congress in 1879 to combine the expertise of the USACE and civilian engineers to make the Mississippi River and tributaries a reliable shipping channel and to protect adjacent towns, cities, and agricultural lands from destructive floods (Camillo 2012). The Mississippi River Commission has a seven-member governing body. Three of the officers are from the USACE, including the chairman who is the final decision maker when it comes to decisions like opening the floodways. Another member is an Admiral from National Oceanic and Atmospheric Administration (NOAA), and the other three members are civilians, with at least two of the civilian members being civil engineers. Each member is appointed by the President of the United States. Senate confirmation is no longer necessary. The MRC is the lead federal agency responsible for addressing the improvement and maintenance of the Mississippi River and Tributaries project, including flow and transportation systems.

Between 1899 and 1907, MRC assisted local levee districts in Missouri with construction of a federal levee between Birds Point, Missouri, and Dorena, Illinois. At that time, the MCR jurisdiction was limited to the areas below the confluence of the Ohio and Mississippi rivers (Camillo 2012; Olson and Morton 2012a, 2012b), which is at the southern tip of Illinois (Fort Defiance State Park). This levee is located approximately where the current frontline levee of the Birds Point–New Madrid Floodway was constructed between 1928 and 1932 after Birds Point to Dorena levee failed in 1927.

In 1902, the MRC helped Kentucky construct a levee from the Hickman,
Kentucky, bluff to Tennessee, where it connected with another levee to extend the levee system 7.8 km (5 mi) to Slough Landings, Tennessee. During this time period, a portion of the natural floodplain near Cape Girardeau was walled off by a local Missouri levee to provide protection of farmland adjacent to the river (figure 1). These two levees narrowed the river channel and during high-water events on the Mississippi River increased floodwater back-up, placing tremendous pressure on the existing systems of levees and floodwalls above and below the Cairo confluence (Camillo 2012; Olson and Morton 2012a, 2012b).

The Commerce to Birds Point levee (figure 5) has long been considered by the MRC and the USACE to be the most critical levee in the Mississippi River valley since it protects nearly 1 million ha (2.5 million ac) of prime agricultural bottomlands in Arkansas and Missouri Bootheel. The Commerce to Birds Point levee, shown in figures 1 and 4, had two major threats (1973 and 1993) from past major flooding events. During the 1973 flood, a 455 m (1,500 ft) section of the Commerce to Birds Point levee fell into the Mississippi River. The caving extended to the top of the levee. The USACE Memphis District placed 21,600 t (18,000 tn) of riprap stone carried in by barges to prevent additional caving (Camillo 2012). The Len Small levee on the Illinois side of the Mississippi River (figure 1) and across from the Commerce to Bird Point levee, Missouri, had historically overtopped or failed during larger flooding events, thereby reducing the pressure on the Commerce to Birds Point levee. The local levee and drainage district and owners of the Len Small levee strengthened their levee during the 1980s, which increased pressure on the Commerce to Birds Point levee when the river flooded. As a result, in the 1993 flood event, the Len Small levee held and the Mississippi remained confined as it climbed to within 1 m (3 ft) of the top of the Commerce to Birds Point levee. Sand boils developed in the Commerce levee were treated until the underseepage stabilized. In 1995, USACE Memphis District raised the height and strengthened the Commerce to Birds Point levee and installed relief wells.

LOCAL AND MISSISSIPPI RIVER FLOODING OF FARMLAND AND TOWNS LOCATED IN WESTERN ALEXANDER COUNTY

The 2011 flood and record peak on the Ohio River caused the Mississippi River near the confluence to back up for many kilometers to the north and affected all bottomlands in Alexander County, Illinois, that were located on the east side of Upper Mississippi River (figure 1). Since the gradient on the Mississippi River is between 12 and 25 cm km−1 (0.5 to 1 ft mi−1), the Mississippi River water rose an additional 5.5 m (18 ft) above the flood stage further north. This occurred at a time when the Ohio River was 6.7 m (22 ft) above flood stage and the Mississippi River north of Cape Girardeau, Missouri, was 3 m (9.9 ft) above flood stage. Cities farther to the north like St. Louis, Missouri, were only subjected to floodwaters 2 m (6.6 ft) above flood stage as a result of water flowing from the Upper Mississippi and Missouri rivers. The May 2nd topping and breach of the Len Small levee occurred just a few
hours before the pressure of record flood levels was relieved with the opening of the Birds Point–New Madrid Floodway at 10:00 p.m. Illinois farmers, landowners, and homeowners protected by the Len Small levee might have benefited if the floodway had been opened on April 28th or 29th (2011) when the first weather forecast was issued with a projected Ohio River peak level of 18.3 m (60.5 ft) or higher on the Cairo gage. This is the criteria set in 1986 USACE operational plan that needs to be met before the USACE can artificially breach the levee at Birds Point and use New Madrid Floodway to relieve river pressure and store excess floodwaters. There were a number of reasons why the USACE did not open the floodway on April 28, 2011, and waited until the evening of May 2, 2011. These reasons included the possibility that the forecasted peak would never happen and concern about the damage it would have caused to the 53,200 ha (133,000 ac) of farmland and buildings in the Birds Point–New Madrid Floodway. Consequently, the USACE continued to monitor the situation and waited a few more days before making the final decision to load the trinitrotoluene (TNT) (once loaded it would be difficult to remove if not exploded) into the Birds Point fuse plugs and blow it up on May 2, 2011 (Camillo 2012). The other reasons for the delay were the mega sand boil in Cairo, the heavy local rains in the area of the confluence of the Ohio and Mississippi rivers, and the new peak forecast of 19.2 m (63.5 ft) (Camillo 2012). All these events occurred on May 1, 2011, the day the Supreme Court rejected the Missouri Attorney General’s lawsuit filed in an attempt to block the USACE from opening the Birds Point–New Madrid Floodway in an effort to protect Missouri citizens and property.

Flooding of Alexander County from the Ohio and Cache rivers resulted in some flooding in the town of Olive Branch in late April and on May 1, 2011. This was before the Len Small breach occurred on May 2, 2011, and there was some damage to private and public lands prior to the breach. Floodwater from the Mississippi River added to the local flooding caused by the middle Cache River in late April when the record high Ohio River returned to its historic path and poured through the 2002 unrepaired Karnak levee breach into the middle Cache River valley and flooded the Olive Branch and Horseshoe Lake area. These floodwaters eventually drained back into the Mississippi River near Route 3 and through the diversion near mile marker 15 (figure 1) and through the Len Small levee breach.

As a result of Cache River valley floodwater flowing through the Karnak levee breach and the additional Mississippi River floodwaters pushing through the Len Small breach, 4,000 ha (10,000 ac) of farmlands lost the winter wheat crop or were not planted in 2011, and about half of that land (mostly Weinbach silt loam, Karnak silty clay, Sciotoville silt loam, and Alvin fine sandy loam) (Parks and Fehrenbacher 1968) had significant soil damages, including land scouring and sediment deposition, or was slow to drain. Crater lakes, land scouring (figure 6), gullies, and sand deltas were created when the Len Small levee breached and removed agricultural land from production (Olson 2009; Olson and Morton 2012b). Most of the other farmland in Alexander County dried out sufficiently to permit planting of wheat in fall of 2011. It appears that all of Alexander County soils dried sufficiently by spring of 2012 to allow the planting of corn and soybeans. It is not clear how much 2011 farm income replacement came from flood insurance since not all Alexander County, Illinois, farmers had crop insurance. In addition, roads and state facilities were impacted by floodwaters which passed through the Len Small breach.

Illinois agricultural statistics recorded that 1,800 fewer ha (4,500 ac) of corn and 2,600 less ha (6,500 ac) of soybeans were harvested in Alexander County in 2011 compared to 2010. The area produced 1,570,000 bu of corn in 2010 but only 710,000 bu in 2011. The soybean production level was 1,200,000 bu in 2010 but dropped to 865,000 bu in 2011 due to flooding, crop, and soil damage. The floodwaters also scoured the agricultural lands in some places and deposited sand at other locations.

**Flooding of Public and Private Bottomlands With and Without Levee Protection in Western Alexander County, Illinois**

All bottomlands north of the confluence between the Mississippi River and the western Alexander County levees with an elevation of less than 100.7 m...
(332 ft) above sea level were flooded when the Mississippi River backed up. Approximately 24,000 ha (60,000 ac) of public and private alluvial lands, both levee protected and without levees, were flooded along the east and north sides of the Mississippi River (figure 1) between mile markers 12 and 39. The 1957 to 1963 soil maps of the area show alluvial soils consisting of recently deposited sediment that varies widely in texture (from clay to sand) with stratified layers. The natural vegetation on these alluvial bottomlands ranges from recent growth of willows (Salix L.) and other plants to stands of cottonwood (Populus deltoides L.), sycamore (Platanus occidentalis L.), and sweet gum (Liquidambar styraciflua L.).

The map (figure 1) shows the public and private lands of the southwest Alexander County, Illinois, area that were impacted by the flood of 2011. Approximately one third of the area (8,000 ha [20,000 ac]) is in public lands, including uplands (the Shawnee National Forest and Santa Fe Hills) and bottomlands (Burnham Island Conservation, Horseshoe State Conservation area, Goose Island, Big Cypress, and the land adjacent to the Len Small and Fayville levees). The unleveed bottomlands and public conservation areas sustained flood damage but were more resilient than the private agricultural and urban lands inside the levees. The Mississippi bottomlands are riparian forests (transition ecosystems between the river and uplands) with fertile, fine textured clay or loam soils that are enriched by nutrients and sediments deposited during flooding (Anderson and Samargo 2007). Bottomlands that experience periodic flooding have hydrophytic plants and hardwood forests that provide valuable habitat for resident and migratory birds. The Illinois Department of Natural Resources has an extensive research program monitoring migratory birds and waterfowl at Horseshoe Lake. Although these alluvial river bottomland species are well adapted to periodic flood cycles which can last several days to a month or more (Anderson and Samargo 2007), the impact of the 2011 flood duration (2 to 4 weeks) on these wetlands habitat and woodlands has not been assessed.

There are a number of towns and villages in western Alexander County, including Olive Branch, Miller City, and Cache. Floodwaters covered roads and railroads and damaged some bridges, homes, and other building structures. In western Alexander County, floodwater destroyed 25 Illinois homes and damaged an additional 175 homes and building structures located on Wakeland silt loam and Bonnie silt loam soils (Parks and Fehrenbacher 1968) or similar alluvial floodplain soils. The Olive Branch area (figure 1) was one of the hardest hit according to Illinois Emergency Management Agency.

Agricultural and forest lands on the riverside of the Len Small levee are not protected from flooding and store significant amounts of floodwater with minimal damage to the crops such as soybeans, which can be planted later in the spring or early summer. This farmland was under water prior to planting for the entire months of April and May, 2011. After both the Ohio and Mississippi rivers dropped and drained by late June of 2011, these fields were planted to soybeans. Late May and early June is the normal planting time for soybeans in the area, so a small soybean yield reduction was noted.

In the fall of 2011, local farmers and members of the Len Small Levee District patched the Len Small levee. They created a sand berm 1 m (3 ft) lower than the original levee. They hoped the USACE would cover the levee with a clay cap and restore it at least to the original height. The USACE agreed to do this in August of 2012 after receiving additional funds from Congress. The project was completed in 90 days. Some individual farmers created berms around their farmsteads (figure 7) to protect their farmsteads from any future flooding that might occur.

In June of 2012, the USACE received US$802 million in emergency Mississippi River flood-repair funding for up to 143 high-priority projects to repair levees, fix river channels, and repair other flood-control projects in response to the spring of 2011 flood, which set records from Cairo, Illinois, to the Gulf of Mexico. Both the Birds Point–New Madrid Floodway levee repair and the Cairo area restoration projects were high on the list with the USACE targeting US$46 million to repair the damage to Cairo area, including the Alexander County area flood-control systems (Camillo 2012; Olson and Morton...
2012a, 2012b). Improvements were completed throughout Alexander County, including work on pump stations, drainage systems, and small levees, some of which failed in April of 2011. These projects were funded by the county matching funds with the USACE and a combination of grants from the Delta Regional Authority and the State of Illinois (Koenig 2012). The creation of a larger drainage system running through northern Alexander and Union counties included large culverts and levees designed to better protect Illinois communities such as East Cape Girardeau, McClure, Gale, and Ware, and help keep water from collecting in low-lying bottomland areas.

CONCLUSIONS

In 2011, the record Ohio River flood resulted in the USACE blasting open the Birds Point levee fuse plug as waters reached a critical height on the Cairo gage. However, this unprecedented flood level at the confluence put tremendous pressure on and under the Mississippi levees to the north in western Alexander County. The delay in the decision to blow up the Birds Point fuse plugs and frontline levees had significant consequences for rural Illinois landowners, farmers, and residents in Alexander County near the Len Small levee that failed the morning of May 2, 2011, at a time when the peak flow on the Ohio River caused the Mississippi River water to back up many kilometers to the north. Local flooding and damage to building structures, crops, and soils initially occurred in late April of 2011 when the Ohio River at flood stage poured through the Post Creek cutoff and a previously unrepaird Karnak levee breach and rushed to the west through the middle Cache River valley. Consequently, the town of Olive Branch would have flooded even if the Len Small breach had not occurred. The Len Small levee situation does not seem to have been a factor in the USACE decision-making process or have affected the time of the opening of the Birds Point–New Madrid levee fuse plug. The USACE did consider the need to protect the Cairo mainline levee and floodwall and the Commerce to Birds Point main line levee from a breach, as well as potential impact on landowners in the Birds Point–New Madrid Floodway. The mega sand boil in Cairo, the heavy local rains on May 1st in the Mississippi River watershed, and the new peak forecast of 19.2 m (63.5 ft) on the Cairo gage proved opening the Floodway was the correct decision. The frontline Commerce to Birds Point levee did not fail, and more than 1 million ha (2.5 million ac) of agricultural bottomlands in Missouri Bootheel and Arkansas were protected from flooding. Even if the Birds Point–New Madrid levee had been opened four days sooner at a time when the record level floodwaters were 1.3 m (4 ft) lower, the prolonged record Mississippi River floodwater levels and pressure on the Len Small levee, which continued for weeks, would likely have still resulted in the Len Small levee breach a few days later.

ACKNOWLEDGEMENTS

This project was funded in part by the USDA National Institute of Food and Agriculture Integrated Water Program under agreement 2008-51130-19526, Heartland Regional Water Coordination Initiative.

REFERENCES

CERTIFICATE OF SERVICE

I hereby certify that on July 3, 2014, I electronically filed the Declaration of Nicholas Pinter, Ph.D. in Support of Plaintiffs’ Motion for Preliminary Injunction and Exhibits 1, 2 and 3 thereto with the Clerk of the Court using the CM/ECF system which will send notification of such filings to all registered counsel participating in this case. There are no non-registered participants in this case.

Respectfully submitted,

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IN THE UNITED STATES DISTRICT COURT  
FOR THE SOUTHERN DISTRICT OF ILLINOIS

NATIONAL WILDLIFE FEDERATION, PRAIRIE RIVERS NETWORK, MISSOURI COALITION FOR THE ENVIRONMENT, RIVER ALLIANCE OF WISCONSIN, GREAT RIVERS HABITAT ALLIANCE, and MINNESOTA CONSERVATION FEDERATION,

Plaintiffs,

vs.

UNITED STATES ARMY CORPS OF ENGINEERS; LT. GENERAL THOMAS P. BOSTICK, Commanding General and Chief of Engineers, LT. GENERAL DUKE DELUCA, Commander of the Mississippi Valley Division of the Army Corps of Engineers,

Defendants.

CASE NO. 14-00590-DRH-DGW

REPLY DECLARATION OF NICHOLAS PINTER, Ph.D. IN SUPPORT OF PLAINTIFFS’ MOTION FOR PRELIMINARY INJUNCTION

HEARING: TBD  
TIME: TBD

REPLY DECLARATION OF NICHOLAS PINTER, Ph.D.
I, Nicholas Pinter, declare as follows:

1. The facts set forth in this Declaration are based upon my personal knowledge. If called as a witness, I could and would testify to these facts. As to those matters that present an opinion, they reflect my professional opinion and judgment on the matter. I make this Declaration in support of plaintiffs National Wildlife Federation et al.’s reply memorandum of points and authorities in support of their motion for preliminary injunction halting construction of any new river training structures as part of the U.S. Army Corps of Engineers’ (‘Corps’”) management of the Upper Mississippi River System, including those planned as part of the Dogtooth Bend, Monsenthein/Ivory Landing, Eliza Point/Greenfield and Grand Tower projects.

2. I am a Professor in the Geology Department and Environmental Resources and Policy Program at the Southern Illinois University (“SIU”), and Director of the SIU’s Integrative Graduate Education, Research and Training (“IGERT”) program in “Watershed Science and Policy.” I have over 20 years’ experience in the fields of geology, geomorphology, fluvial geomorphology and flood hydrology. My qualifications, professional experience and background are set forth in my original June 24, 2014 (filed July 3) declaration (“Original Declaration” or “Pinter Declaration”), and Exhibit 1 thereto. Pinter Dec. ¶¶ 1-5 & Exh. 1.

**Documents Reviewed for this Declaration**

3. In preparing this Declaration, I reviewed the following documents in addition to the documents listed in paragraphs 6 and 7 of my original declaration: (1) Defendants’ Opposition to Plaintiffs’ Motion for a Preliminary Injunction (“Opposition Brief”), (2) the Declaration of Edward J. Brauer (“Brauer Declaration”), (3) the Declaration of Michael G. Feldman (“Feldman Declaration”) and Attachments 1 and 2 thereto, and (4) the Declaration of Jody H. Schwarz in Support of Defendants’ Opposition to Plaintiffs’ Motion for a Preliminary Injunction (“Schwarz Declaration”) and Exhibits 1 through 6 thereto.

**Analysis**

4. I was asked prior to preparing my Original Declaration to form an independent professional opinion as to whether building new river training structures, including those planned by the Corps in the Dogtooth Bend, Monsenthein/Ivory Landing, Eliza Point/Greenfield Bend and
Grant Tower projects, may pose a significant risk of irreparable harm to the natural environment and to people and the property of people who live, work, attend school and/or recreate in the floodplain, including by raising flood stage heights on the Mississippi River. As discussed below, my original conclusion remains the same after reviewing the Opposition Brief and the Brauer, Feldman and Schwarz declarations. I conclude that the Corps’ proposed projects, and river training structures generally, do pose a significant risk of irreparable harm to the natural environment, human safety and human property. As discussed in detail below, neither the Corps in its Opposition Brief nor Mr. Brauer, Mr. Feldman or Ms. Schwarz in their declarations provides evidence that river training structures do not raise flood levels.

5. I was also asked prior to preparing this Reply Declaration to review the Feldman Declaration and, to the extent he discusses topics within my area of expertise, to form an independent professional opinion as to his claims regarding the benefits of river training structures and the costs of delaying or permanently tabling the Dogtooth Bend, Monsenthein/Ivory Landing and Eliza Point/Greenfield Bend projects. As discussed in detail below, I conclude after reviewing Mr. Feldman’s Declaration that he overstates some of benefits of river training structures as well as the costs of delaying or permanently tabling the proposed the Dogtooth Bend, Monsenthein/Ivory Landing and Eliza Point/Greenfield projects.

A. The Information and Conclusions in My Original Declaration Remain Accurate and Unchanged.

6. As I attested in paragraph 9 of my Original Declaration, damages from floods worldwide have risen dramatically over the past 100 years (Munich Re Group, 2007). While much of this increase is due to economic development in floodplains (Pinter, 2005; Pielke, 1999), it is also clear that flooding itself has physically increased in magnitude and frequency on many rivers, including the Mississippi River. (Pinter et al., 2006a; Pinter et al., 2006b; Helms et al., 2002). Historical time series of stage data, which are unequivocally homogenous over time (Criss and Winston, 2008), show strong and statistically significant increases of flood heights on portions of
the Mississippi River over time. Neither the Corps in its Opposition Brief nor Mr. Brauer, Mr. Feldman or Ms. Schwarz in their declarations rebut these facts.

7. As I attested in paragraph 10 of my Original Declaration, a number of processes can lead to flood magnification or otherwise alter flood response on a river. These include climate change, agricultural practices, forestry practices, urbanization and construction of other impervious surfaces, loss of wetlands, decreases in floodplain areas, construction and operation of dams, and modifications and engineering of river channels. The range of these changes can alter the volume and timing of runoff (discharge or flow of water) entering and moving through river systems. In addition, other natural or human-induced changes to river channels and their floodplains can alter the conveyance of flow within the river channel, resulting in increases or decreases in water levels (including flood stages) for the same discharge. Neither the Corps in its Opposition Brief nor Mr. Brauer, Mr. Feldman or Ms. Schwarz in their declarations rebut these facts.

8. As I attested in paragraph 11 of my Original Declaration, the Mississippi River has been intensively engineered by the Corps over the past 50 to 150-plus years (depending on the reach), and some of these modifications are associated with large decreases in the river’s capacity to convey flood flows. Numerous scientific investigations, including Corps reports, some dating back to the early 1900s or earlier, have noted large increases in flood levels in association with wing-dike construction. For example, investigators recognized as early as 1933 that “bankful [sic] carrying capacity [of the Missouri River] would be permanently reduced by existing works, such as dikes and revetments used in shaping and controlling the stream for modern barge transportation” (Hathaway, 1933 (quote); Schneiders, 1996 at 346 (same)). Harrison (1953) likewise found that at discharges greater than 50,000 cubic feet per second the “controlled [channel of the Missouri River] has [a] smaller capacity, having 35% less discharge at bankfull stage,” one “principal reason” for which was the “increase in roughness” caused by “[t]raining dikes protruding into the flow.” These findings that river training structures increase flood levels have been confirmed worldwide and are considered accepted knowledge elsewhere. In the Netherlands, for example, the government has begun modifying river training structures on the Rhine River to lower flood levels (U.S. Government Accountability Office, “Mississippi River: Actions Are Needed to Help Resolve
Environmental and Flooding Concerns about the Use of River Training Structures, December 2011; “GAO Report”) at 41. To date, however, the Corps has never addressed in an EIS the vast body of peer-reviewed, independent research showing that river-training structures increase flood heights. 

9. The Corps and Mr. Brauer do both contend, however, that contrary to the weight of the published studies discussed above and below, the “results of . . . independent expert external reviews all lead to the conclusion that river training structure construction has not resulted in an increase in flood levels.” Brauer Dec. ¶ 8 (emphasis added); Opposition Brief at 13. But Mr. Brauer fails to describe or cite to the alleged “external reviews,” and thus provides no evidence on which to judge his assertion. Mr. Brauer also provides no evidence refuting, among other things, the aforementioned evidence discussed in Hathaway (1933) and Schneider (1996) that “the carrying capacity of the [Missouri] river has been decreased so materially by the [river training] work that floods have occurred at such points as Waverly, Boonville and Hermann, Mo., at lower gauge readings with smaller volumes of water than the 1929 flood stage.” Mr. Brauer asserts that Schneider (1996) does not “draw any conclusions on the impact of river training structure construction on flood levels.” Brauer Dec. ¶ 12. But his assertion is directly refuted by the quoted passage from Schneider (1996). It is only by ignoring or improperly discrediting the evidence I have cited that Mr. Brauer is able to claim that none of the “additional 11 references cited by Dr. Pinter . . . would lead the Corps to a different conclusion on the impacts of river training structure construction on flood levels and public safety than what was established in the EAs.” Brauer Dec. ¶ 13.

10. Mr. Brauer and the analysis in Appendix A to the environmental assessments (“EAs”) for the Dogtooth Bend, Monsenthein/Ivory Landing and Eliza Point/Greenfield projects are also wrong in concluding that 51 studies attached to the comments of the National Wildlife Federation, Izaak Walton League of America, Missouri Coalition for the Environment, Prairie Rivers Network and Sierra Club on the draft EAs, including many of my own studies, do not “support[] the conclusion that flood levels have . . . been increased as a result of construction of...
river training structures.”  Brauer Dec. ¶ 9.  For example, in discrediting many of “the 51 studies provided to the Corps” as only discussing “flow frequency, physical modeling and model scale distortion [or] levee construction” rather than “the construction of river training structures and/or increases in flood levels,” Mr. Brauer makes the unfounded and erroneous conclusion that any research study without “river training structure” in its title is not relevant to the effect of such structures on flood levels.  Brauer Dec. ¶ 10.  To the contrary, all of the topics covered by those studies are necessary for understanding the processes by which river training structures interact with flow and affect flood levels.  Increases in flood frequency, for example, are merely a statistical transformation of – meaning they are essentially the same as – increases in flood levels.  As discussed further below, Mr. Brauer is also wrong that the all of my research and others’ studies that “link river training structures to an increase in flood levels” contains “[m]ajor errors” that “put[] into question [the studies’] conclusion that the construction of river training structures impacts flood levels and consequently public safety.”  Brauer Dec. ¶ 16.

11.  As I attested in paragraph 12 of my Original Declaration, my research has looked extensively at the extent and causes of flood magnification, particularly on the Mississippi River.  This research documents that climate, land-use changes, and river engineering have contributed to statistically significant increases in flooding along portions of the Mississippi River system.  However, the most significant cause of flood height increases on the Middle Mississippi River and Lower Missouri River can be traced to the construction of wing dikes and other river training structures.  Indeed, flood height increases on those river segments exceed by a factor of ten the largest possible flood-stage increases due to observed increases in climate-driven and land-cover-driven flow (e.g., Pinter et al., 2008).  In addition, the large multivariate study by Pinter et al. (2010) identified the age, location, and extent of every large levee system added to the Mississippi-Lower Missouri system during the past century, documenting that levees do contribute some but not all of the observed flood-level increases on the Middle Mississippi and elsewhere (confirming modeling by Remo et al., 2009; see Exhibit 2 to my Original Declaration).  As discussed further below, Mr. Brauer wrongly discredits my research and others’ studies that reach similar conclusions for having allegedly “[m]ajor flaws,” including “use of inaccurate early discharge,” “use of
estimated daily discharge data,” “statistical errors,” “not counting for other physical changes within the channel,” and “the use of non-observed interpolated synthetic data points.”

12. As I attested in paragraph 13 of my Original Declaration, recent theoretical analysis has shown that increased flood levels caused by wing-dike construction are “consistent with basic principles of river hydro- and morphodynamics” (Huthoff et al., 2013). This study concluded that even with extremely conservative parameters used in modeling, “the net effect of wing dikes will be higher flood levels.” Id. Mr. Brauer criticizes Huthoff et al. (2013) as having “major errors” that “lead[] to incorrect conclusions on the magnitude of change in water surface by the author.” Brauer Dec. ¶ 22. Mr. Brauer is not only wrong, he overstates his own criticisms in his (Brauer and Duncan) comment letter to Journal of Hydraulic Engineering, in which Huthoff et al. (2013) was published after peer review. Huthoff et al. (2013) presents fluid dynamical calculations showing that increases in flood levels are consistent with wing-dike construction in river channels. Brauer and Duncan submitted a comment letter to the journal suggesting that Huthoff et al.’s method was “oversimplified” and “simplistic,” on which Mr. Brauer bases his criticism of the paper in his declaration. Huthoff et al., however, have submitted for publication a detailed rebuttal of Brauer and Duncan’s critique, concluding that “reasonable assumptions do lead to significant surcharges [stage increases due to wing dikes] . . . and Huthoff et al. (2013) reach the modest conclusion that wing-dike-induced stage increases ‘are consistent with basic principles of river hydro- and morphodynamics’” (Huthoff et al., 2014, submitted) (emphasis added).

13. As I attested in paragraph 14 of my Original Declaration, the theoretical analysis of Huthoff et al. (2013) is supported by empirical studies that have utilized hydrologic analyses; rigorous statistics; geospatial analyses; and 1D, 2D, and 3D hydraulic modeling to confirm, empirically as well as theoretically, the potential for significant increases in flood levels in response to the dense emplacement of wing-dike structures, such as employed on the Middle Mississippi River. Among this body of research, my research group was funded by the National Science Foundation to construct two large river-related databases to rigorously test for trends in flood magnitudes over time on over 4000 kilometers (over 2400 miles) of the Mississippi and Missouri
Rivers, and to quantify the impacts on flood levels from each unit of channel and floodplain infrastructure construction or other change.

14. As I attested in paragraph 15 of my Original Declaration, our hydrologic database consists of more than 8 million discharge and river stage values, including new synthetic discharges generated for 41 stage-only stations. This hydrologic database was used to test for significant trends in discharges, stages, and “specific stages.” We also conducted an extensive review of the validity of using discharge data taken from different types of measurement devices (float meters vs. other types of meters). Pinter (2010) tested whether it was appropriate to utilize older discharge measurements by examining 2150 historical discharge measurements digitized from the three principal stations on the Middle Mississippi River (“MMR”), including 626 float-based discharges and 1516 meter-based discharges, and including 122 paired measurements. All statistical tests we performed demonstrated that it was appropriate to utilize both older historical discharge data and newer discharge data as those different types of measurement tools produced accurate discharge measurements.

15. Mr. Brauer asserts that our conclusion in Pinter (2010) that older and newer discharge data alike produce accurate discharge measurements is invalid because “Pinter (2010) fails to go further in comparing [the pre-1933 discharge measurements] with the post-1933 [U.S. Geological Survey (‘USGS‘)] data to confirm that the two data sets can be used together.” Brauer Dec. ¶ 18. Mr. Brauer misrepresents Pinter (2010). The explicit purpose and methodology of the paper was to compare float-based discharge measurements with meter-based measurements, which the Corps has repeatedly singled out as the source of purported bias in the older discharge measurements.

16. Mr. Brauer further contends that “[e]arly discharge data collected before the implementation of standard instrumentation and procedures by the USGS in 1933 has been proven to be inaccurate (Ressegieu 1952, Dyhouse 1976, Dyhouse 1985, Dieckmann and Dyhouse 1998, Huizinga 2009, Watson et al. 2013a).” Brauer Dec. ¶ 18 (quote); Opposition Brief at 14 (same). Mr. Brauer is wrong. None of these sources prove that early discharge measurements – measurements made by the Corps’ St. Louis District – are incorrect. To the contrary, and as
outlined above, Pinter (2010) completed a detailed statistical analysis of side-by-side measurements (using velocity meters as well as floats, which is the point of contention here) and found that the early measurements are as reliable as and fully comparable with the later measurements. This conclusion reiterates the conclusions of a study in the 1970s by the Corps itself (Stevens, 1979). Mr. Brauer’s purportedly dispositive citations are not analyses and provide little or no new information on this subject. Ressegieu (1952) is an internal Corps memo. Dyhouse (1976) is an opinion letter critiquing an academic study. Dyhouse (1985) is an unpublished opinion article, without any analysis. Dieckmann and Dyhouse (1998) is an intergovernmental presentation that asserts flaws in early discharges without any supporting evidence. Huizinga (2009) and Watson et al. (2013) are both Corps-funded studies that question early discharge values without providing evidence that they are invalid. Pinter (2014) details thorough responses to Watson et al. (2013) demonstrating its shortcomings.

17. Mr. Brauer’s focus on and criticism of our use of pre-1933 discharge data is further undermined by the fact that the large majority of the 67 stations analyzed in Pinter et al. (2008, 2010) utilized only the later, post-1933 USGS discharge values. Analyses of these numerous USGS-only measurement gages show stage increases fully consistent with gages consisting of both early and later measurements.

18. In addition to Mr. Brauer’s erroneous claims that much of our hydrologic data is too early to be accurate, he also wrongly contends that our hydrologic database and subsequent analyses are flawed because they “use . . . daily discharge data” and data “fabricated using interpolation schemes.” Brauer Dec. ¶¶ 19 (first quote), 20 (second quote); Opposition Brief at 14 (same). I rebut each of these two erroneous claims in turn below.

19. Mr. Brauer asserts that a “major error in Dr. Pinter’s analyses is the use of daily discharge data.” Brauer Dec. ¶ 19. Our use of daily discharge data is not in error. Daily discharge values are published and used by the Corps, USGS and many other agencies and scientists worldwide, and are the accepted technical standard for a wide range of analyses and modeling, including by the Corps. With specific respect to their use in determining flood-level trends, daily discharge values (derived from daily stage measurements, combined with accepted rating curves)
produce the same overall results as do the much more limited number of direct measurements. Disqualifying all Corps and USGS daily discharge datasets as Mr. Brauer suggests would do nothing to prove that flood level trends have not increased. Instead of demonstrating some contrary trend, disqualifying these datasets would merely reduce the number of discharge values and thereby lower the statistical significance of the increasing flood level trends already found (see Pinter, 2014).

20. Mr. Brauer claims that a “majority of the hydrologic data” in our hydrologic database “(data at 49 of the 67 stations on the Mississippi River and Lower Missouri River) were fabricated using interpolation schemes developed by Jemberie et al. (2008), and they are not real data points.” Brauer Dec. ¶ 20. Mr. Brauer misrepresents the data used in Jemberie et al. (2008). That study created a numerical algorithm for utilizing nearby stations and the year-to-year pattern of hydrologic behavior in order to interpolate the shape of trends for the largest flows, which occur only every few years. As Jemberie et al. (2008) makes clear, the overall trends and conclusions therefrom are determined only by the measured values in large flood years, which are most events for assessing the relationship between flood stage and river training structures. The interpolations based on measurements for smaller floods help suggest the likely patterns during the intervening years. Jemberie et al. (2008) also uses flow measurements from nearby stations to infer discharges during select years, which improves the accuracy of the overall data. For example, one station may lack direct flood measurements in 1940, but another station just a few miles upstream may have full measurements for that year. On a river as large as the MMR, neighboring sites have nearly identical flows. Jemberie et al. (2008) creates these neighboring discharge estimates by scaling each site proportional to its drainage basin area, and explicitly excluding any pair of measurement sites separated by a major tributary input. Jemberie et al. (2008) and its discharge data and estimates are methodologically sound. Mr. Brauer offers no specifics to show otherwise, or demonstrate any flaws in our use of the study’s data.

21. As I attested in paragraph 16 of my Original Declaration, we developed a geospatial database alongside our hydrologic database. Our geospatial database consists of the locations, emplacement dates, and physical characteristics of over 15,000 structural features constructed along
the study rivers over the past 100 to 150 years. In developing this database we utilized: more than 4000 individual map and survey sheets; structure-history databases from six Corps Districts; databases from other agencies including the Coast Guard; and archival maps and surveys, all digitized and calibrated into a modern coordinate system and frame of reference. Within this database we parameterized 130 bridges, 54 dam structures, 25 artificial meander cut-offs, 1093 levees, and 13,231 wing-dam segments, among many other structures. Neither the Corps in its Opposition Brief nor Mr. Brauer, Mr. Feldman or Ms. Schwarz in their declarations disputes these facts.

22. As I attested in paragraph 17 of my Original Declaration, we used our hydrologic and geospatial databases together to generate reach-scale statistical models of hydrologic response. These models quantify changes in flood levels at each station in response to construction of wing dikes, bendway weirs, meander cutoffs, navigational dams, bridges, and other river modifications. Neither the Corps in its Opposition Brief nor Mr. Brauer, Mr. Feldman or Ms. Schwarz in their declarations disputes these facts.

23. As I attested in paragraph 18 of my Original Declaration, our analyses show that while climate and other land-use changes did lead to increased flows, the largest and most pervasive contributors to increased flooding on the Mississippi River system were wing dikes and related navigational structures. In contrast, large reaches of the Mississippi and Missouri Rivers with little or no dike construction showed no significant increases in flood levels. System-wide, the hydrologic pattern was that large-scale increases in flood levels occurred when and where large numbers of dikes and dike-like structures have been built. Progressive levee construction was the second largest contributor. While, as discussed elsewhere in this Declaration, the Corps and Mr. Brauer make several erroneous criticisms of our hydrologic data and analyses thereof, they do not contend that we did not make the stated conclusions from our analyses.

24. As I attested in paragraph 19 of my Original Declaration, our analyses demonstrate that wing dikes constructed downstream of a location were associated with increases in flood height (“stage”), consistent with backwater effects upstream of these structures. Backwater effects are the rise in surface elevation of flowing water upstream from, and as a result of, an obstruction to water
flow. These backwater effects were clearly distinguishable from the effects of upstream dikes, which triggered simultaneous incision and conveyance loss at sites downstream. On the Upper Mississippi River, for example, stages increased more than four inches for each 3,281 feet of wing dike built within 20 RM (river miles) downstream. These values represent parameter estimates and associated uncertainties for relationships significant at the 95 percent confidence level in each reach-scale model. The 95-percent level indicates at least a 95% level of certainty in correlation or other statistical benchmark presented, and is considered by scientists to represent a statistically verified standard. Our study demonstrated that the presence of river training structures can cause large increases in flood stage. For example, at Dubuque, Iowa, roughly 8.7 linear miles of downstream wing dikes were constructed between 1892 and 1928, and were associated with a nearly five-foot increase in stage. In the area affected by the 2008 Upper Mississippi flood, more than six feet of the flood crest is linked to navigational and flood-control engineering. While, as discussed elsewhere in this Declaration, the Corps and Mr. Brauer make several erroneous criticisms of our hydrologic data and analyses thereof, they do not contend that we did not make the stated conclusions from our analyses.

25. In addition, the Corps and Mr. Brauer wrongly contend that my Original Declaration is “fatally flawed” because I “discuss[] [my and others’ research on] many rivers and river reaches [not on the MMR] in an attempt to imply that dikes on the MMR . . . are increasing flood levels.” Opposition Brief at 14 (first quote); Brauer Dec. ¶ 24(a) (second quote). Different reaches of the Mississippi River do vary in some of their characteristics, but the same laws of physics apply to the MMR as to the other rivers and river reaches I discuss and allow for valid comparisons. Contrary to the Corps’ and Mr. Brauer’s opposite contention, understanding the impacts of Middle Mississippi River training structures can not be limited to looking only at the Middle Mississippi River. Understanding how different rivers and river reaches are managed (e.g., whether river training structures are used) and the resulting impacts from those management practices are critical to assessing how river training structures impact flood stage height. Our research and studies by other researchers show that while there are little or no increasing flood trends on stretches of the Mississippi and other rivers with few or no river training structures, there are large increases in
flood trends at locations (like on the MMR) where and at times when many new river training structures are built.

26. As I attested in paragraph 20 of my Original Declaration, more than 143 linear miles of wing dikes have been constructed on the Middle Mississippi River over the past 100 years (Remo and Pinter 2007; Remo et al. 2008). This represents about 3,960 feet of wing dikes per mile (or about 2,460 feet per kilometer) of channel. Wing dikes have also been heavily utilized on the Lower Missouri River, with over 383 linear miles constructed since 1890. This represents nearly 3,700 feet of wing dike per mile (or about 2,300 feet per kilometer) of channel in the Lower Mississippi River. These and similar river training structures are utilized to assist in river bank protection and stimulate channel scour which can reduce the amount of dredging required to maintain adequate navigation depths (e.g. COPRI 2012). Neither the Corps in its Opposition Brief nor Mr. Brauer, Mr. Feldman or Ms. Schwarz in their declarations rebuts these facts.

27. As I attested in paragraph 21 of my Original Declaration, the effects of wing dikes and other structures during flooding should not be confused with effects during periods of low flow. There is general agreement that during low in-channel flows, wing dikes lead to lowered water levels at most locations. This happens because the dikes cause channel incision, in which flow removes sediment from the stream bed and ultimately establishes a lower bed elevation. Channel incision is a process that has been well documented after dike construction in many (but not all) areas of the alluvial Mississippi and Missouri Rivers (e.g., Pinter and Heine 2005; Maher 1964). Neither the Corps in its Opposition Brief nor Mr. Brauer, Mr. Feldman or Ms. Schwarz in their declarations rebuts these facts.

28. As I attested in paragraph 22 of my Original Declaration, incision has caused water levels during periods of low flow (not floods) to decrease over time at the St. Louis, Chester, and Thebes measurement stations, as well as at other, intermediate locations. For all flood flows (flows equal to four or more times the average annual discharge level), however, water levels have increased by three to ten feet or more at all of these locations along the MMR. At Grand Tower, Illinois, water levels for just average flows have increased by almost three feet due to dike and weir construction. Near Grand Tower, bedrock underlies parts of the Middle Mississippi channel and
limits incision (Jemberie et al. 2008). The majority of these facts are unrebutted by both the Corps in its Opposition Brief and Mr. Brauer, Mr. Feldman or Ms. Schwarz in their declarations. However, as discussed and rebutted below, Mr. Brauer erroneously claims that there is no bedrock near the proposed Grand Tower project location. Brauer Dec. ¶ 24(g).

29. As I attested in paragraph 23 of my Original Declaration, many other studies confirm and corroborate these findings on the flow-dependent effects of river training structures. Particularly after the record-breaking floods on the Middle Mississippi, researchers sought to answer why such large increases in flood levels had occurred for the same discharges (volumes of flow) that had been observed in the past. (e.g., Belt 1975; Stevens et al. 1975). Since then, multiple studies involving hydrologic time-series analyses, statistical analyses, geospatial analyses, and hydraulic modeling have correlated the timing and spatial distribution of dike construction with increases in flood stages (e.g., Criss and Shock 2001; Wasklewicz et al. 2004; Jemberie et al. 2008; Pinter et al. 2008; Remo et al. 2009; Pinter et al. 2010, and others).

30. As I attested in paragraph 24 of my Original Declaration, wing dikes and other river training structures increase flood heights during high water because of the way they interact with river flow and the way they change the shape and form of the river channel. Since the beginning of historical “training” (engineering of the river to facilitate navigation) of the Mississippi and Missouri rivers, construction of dikes has narrowed large portions of these river channels to one-half or less of their original width. In addition, construction of dikes, bendway weirs, and other in-channel navigational structures has increased the "roughness" of the channel, leading to decreased flow velocities during floods.

31. Mr. Brauer responds by suggesting that I “may be referring to a river other than the MMR” in my statement that dike construction on the Mississippi and Missouri rivers has narrowed large portions of their channels to one-half or less of their original width. Brauer Dec. ¶ 24(c). I am not. And my original statement is correct. Wing dikes can reduce flow conveyance during floods and thereby increase flood levels either by reducing a river’s cross-sectional area, by increasing the roughness of the channel or both. Extensive width reductions occurred on the MMR
during the late 19th and early 20th centuries, with little long-term change thereafter. As shown by Figure 1 below, some portions of the MMR were narrowed to half or less of their original width.

**Figure 1.** Mississippi River at St. Louis, as surveyed by Robert E. Lee in 1837 (left), and compared with the modern width of the channel (right). The original survey has been superimposed on the right panel. The current channel is shown by the red lines on the right panel. The red-lined channel boundaries shown in the right panel demonstrate that, indeed, this portion of the MMR is half or less the width today as it was in 1837. Historical channel geometry, including depths, digitized from original survey maps.

Mr. Brauer also asserts that although the MMR channel “has been narrowed due to river training structure construction,” studies “have shown (Maher 1964, Biedenharn et al. 2000)” that “the cross sectional area of the deeper channel is preserved and the [channel’s] ability to pass flow (conveyance) is the same or in some cases increased.” Brauer Dec. ¶ 24(c). He claims that
“[f]ield data taken on the MMR have shown that the narrower and deeper channel will have the same cross sectional area and average velocity as before the placement of the structure.” Brauer Dec. ¶ 14. But his assertion contradicts published analyses demonstrating that the actual response of the MMR to river training structures over time has been a reduction in both cross-sectional area and velocity during large flood events due to, among other things, increased channel “roughness” (e.g. Pinter et al., 2000; Remo et al., 2009). Mr. Brauer’s contention that the MMR channel’s conveyance has either remained the same or increased is true only for small non-flood flows.

33. As I attested in paragraph 25 of my Original Declaration, channel roughness is a measure of objects and processes that cumulatively resist the flow of water through a given reach of a river, including drag effects of sedimentary grains, bedforms (e.g., ripples and dunes on the bed), vegetation, turbulence, eddy circulation, and many others. A rough river bed exerts more resistance than a smooth river bed, resulting in slower flow of water. All other factors being equal, a flood that passes through a river reach with half the average flow velocity will result in average water depths that are double what they would otherwise be. Mr. Brauer claims that my “description of the relationship between velocity and depth” is “oversimplified and misleading” because in “rivers that are natural, compound channels, all factors are not equal.” Brauer Dec. ¶ 24(d). But Mr. Brauer ignores the fact that the velocity-depth relationship I describe is a physical law of hydrodynamics. Before analyzing how other factors affect that relationship, it is essential to start with a description and understanding of first principles, which is precisely what I have done.

34. As I attested in paragraph 26 of my Original Declaration, recent modeling studies demonstrate the significant effects of river training structures during flood events on flow turbulence and large-scale vertical and horizontal eddy circulation (Huthoff et al., 2013). Other recent studies have focused on flow dynamics around submerged wing dikes and their impact on channel flow resistance (e.g., Yossef 2005; Yossef and de Vriend 2011; Azinfar and Kells 2011). These studies show that submerged wing dikes create flow mixing in their wake zones (e.g., Yossef 2005; Yeo and Kang 2009; Jamieson et al. 2011). These recirculating flows consume energy from the bulk flow field, causing increases in effective resistance near wing dikes and through wing-dike fields. The impact of wing dikes on flow resistance was quantified by Yossef (2004, 2005), whose
proposed relationship allows for an initial assessment of wing-dike impact on water levels (e.g., Azinfar 2010). According to Yossef’s laboratory experiments, the effective cumulative hydraulic roughness of the bank zone relates to the size and longitudinal distance between the wing dikes.

35. Neither the Corps nor Mr. Brauer disputes that river training structures cause flow resistance. Brauer Dec. ¶ 24(e). Mr. Brauer does, however, contend that “the flow resistance is greatest at stages in which the dikes are the least submerged (stages below flood stages).” Id. Mr. Brauer’s contention states his interpretation of hydraulic theory; in fact no laboratory, numerical, or field study has comprehensively tested if such a relationship exists or quantified how the depth of flow over overtopped dikes alters the effective resistance. Contrary to such theory, empirical studies show that the stage increases caused by new wing dike fields are proportionally greater for larger flows (e.g., Belt 1975; Criss and Shock 2001; Wasklewicz et al. 2004; Jemberie et al. 2008; Pinter et al. 2008; Remo et al. 2009; Pinter et al. 2010, and others). Additional data-based research is needed to reconcile hydraulic theory with observations. Reasonable hypotheses for the observed pattern include effects of flow velocity, which increases dramatically with increasing discharge, on net resistance. The Corps and Mr. Brauer consistently turn the scientific method on its head by beginning with a conclusion – the assumption that river training structures do not increase flood levels – and fashioning arguments to fit that assumption.

36. The Corps and Mr. Brauer also attempt to discount the applicability of a small subset of the studies demonstrating that river training structures increase channel roughness, reduce conveyance and increase flood stage levels on the grounds that they are “fixed bed physical flume studies (Azinfar and Kells 2009, 2008, 2007, and Azinfar 2010).” Brauer Dec. ¶ 23 (quote); Opposition Brief at 14. But they ignore the fact that experimental studies in controlled circumstances are still relevant evidence that river training structures can increase flood stage heights, along with hydrologic analyses, statistical analyses, geospatial analyses, fluid dynamical calculations, and 1D, 2D and 3D hydraulic modeling. Each of these types of research has its advantages and limitations, which is why accurate scientific synthesis looks at the conclusions from the full corpus of scientific research. Fixed-bed physical models are imperfect simulations of water flow over river training structures, but they are nonetheless relevant. Indeed, physical modeling
like that done in the Azinfar and Azinfar and Kells studies that the Corps and Mr. Brauer criticize as irrelevant is the primary tool used by the Corps’ St. Louis District, albeit with a sedimentary bed, for the design and prototyping of all new river training structures.

37. As I attested in paragraph 27 of my Original Declaration, the role of river training structures in increasing flood heights is well recognized. For example, in the Netherlands, the impacts of wing dikes (navigational “groynes”) on flood levels have both been recognized and taken into account in flood protection strategies. The government of the Netherlands recently completed a €45 million program to lower 450 wing dikes (groynes) on the Rhine system as part of its strategy to reduce flood levels.

38. Mr. Brauer questions the relevancy of the Dutch example to the Mississippi River, contending that the “structures used on the MMR are much different in size, spacing, and top elevation than those used by the Dutch.” Brauer Dec. ¶ 24(f). Yet while Dutch groynes do differ from MMR dikes in some details, Mr. Brauer fails to cite a single study showing that the Dutch groynes are more likely to cause flood stage increases that the MMR dikes.

39. As I attested in paragraph 28 of my Original Declaration, changes in channel geometry and roughness related to river engineering tools employed for improved navigation and flood control appear to be the principal drivers behind changes in flood stage on the Mississippi River. The increases in flood stage are caused by both the direct effects of wing dikes, meaning interaction with flow, and the indirect effects of wing dikes, meaning the effects of the wing dike in changing the shape or form of the river bed. Hydrodynamic simulations of indirect and direct effects of wing dikes show decreases in velocity, increases in roughness, and corresponding increases in flood stage. Neither the Corps in its Opposition Brief nor Mr. Brauer, Mr. Feldman or Ms. Schwarz in their declarations specifically addresses paragraph 28 of my Original Declaration. I rebut elsewhere in this Declaration the Corps’ and Mr. Brauer’s general criticisms of my research and the other studies supporting my conclusion that river training structures increase flood stage heights and that the new dike construction projects here – at Dogtooth Bend, Monsenthein/Ivory Landing, Eliza Point/Greenfield Bend, and Grand Tower – will do the same and threaten public safety.
40. As I attested in paragraph 29 of my Original Declaration, river training structures constructed by the Corps to help maintain the nine-foot navigation channel have caused large-scale increases in flood levels, including increases of six to ten feet over broad stretches of the river where these structures are prevalent. Such large increases in flood heights in these rivers have occurred when and where – and only when and where – wing dikes, bendway weirs, and other river training structures have been built. These structures have led to significant increases in the frequency and magnitude of large floods. Neither the Corps in its Opposition Brief nor Mr. Brauer, Mr. Feldman or Ms. Schwarz in their declarations specifically addresses paragraph 29 of my Original Declaration. I rebut elsewhere in this Declaration the Corps’ and Mr. Brauer’s general criticisms of my research and the other studies supporting my conclusion that river training structures increase flood stage heights and that the new dike construction projects here – at Dogtooth Bend, Monsenthein/Ivory Landing, Eliza Point/Greenfield Bend, and Grand Tower – will do the same and threaten public safety.

41. As I attested in paragraph 30 of my Original Declaration, the projects now proposed on the Middle Mississippi River are particularly problematic for several reasons. First, as mentioned above, bedrock underlies parts of the Middle Mississippi channel near the Grand Tower project, which limits incision (Jemberie et al. 2008). In such locations, the ameliorating effect of new wing dikes in causing bed incision is reduced or eliminated, leading in the past to the largest observed increases in flood levels.

42. Mr. Brauer asserts that “[t]here is no support for the claim by Dr. Pinter” that there is bedrock underlying parts of the channel near the Grand Tower Project. Brauer Dec. ¶ 24(g). He contends that the “nearest bedrock formation (at an elevation capable of having an impact) to the Grand Tower work area is approximately five and a half miles upstream and over twenty miles downstream.” Id. Mr. Brauer is wrong. Bedrock is present in this river reach, and it is alarming that the Corps’ St. Louis District has designed and modeled (in their table-top physical model) the proposed new Grand Tower dikes in apparent ignorance of such a fundamental and important characteristic of the MMR channel. Specifically, historical surveys show that bedrock crops out at the channel-bottom surface, or in the shallow subsurface just beneath, forming a ledge along the
western margin of the channel around river mile (“RM”) 68.7, and between RM 70.0-70.3 and RM 71.1-72.7 – i.e. through a significant portion of the Grand Tower project area. Mr. Brauer contends to the contrary that “bed samples taken in the Grand Tower reach confirm that the bed material is a combination of medium to coarse sands and pebbles up to one inch in diameter.” Id. He is mistaken. In a river like the MMR, which transports an active sedimentary bed load at all times throughout its length, isolated channel grab samples will always yield sand and gravel, even on river reaches with an underlying bedrock substrate. Such samples in no way “confirm” that the channel is only underlain by sediment.

43. The presence of bedrock in the Grand Tower project area helps explain why observed flood stage increases have been so severe along this portion of the MMR. As discussed above, new wing dikes raise flood levels, but they also induce scour of the bed, which creates additional cross-sectional area within the central portion of the channel and reduces the net increases. However, where, as in the section of the MMR in the Grand Tower project area, a bedrock substrate inhibits scour, there is less or no cross-sectional area increase to reduce the flood stage increases. In these circumstances, the risk of large flood stage increases and the corresponding risk to public safety are at their peak.

44. As I attested in paragraph 31 of my Original Declaration, the new dike construction projects now proposed on the Middle Mississippi are also problematic because they threaten nearby levees that already have identified deficiencies. The Dogtooth Bend Project is immediately downstream of one of the sites where the Len Small levee failed during floods in 2011 (Dogtooth Bend EA at E2). This 5,000-foot breach yielded to fast-moving water that “scored farmland, deposited sediment, and created gullies and a crater lake” (K.R. Olson and L.W. Morton, “Impacts of 2011 Len Small levee breach on private and public Illinois lands,” Journal of Soil and Water Conservation, Vol. 68:4, attached as Exhibit 3 to my Original Declaration). Neither the Corps in its Opposition Brief nor Mr. Brauer, Mr. Feldman or Ms. Schwarz in their declarations rebuts these facts.

45. As I attested in paragraph 32 of my Original Declaration, the proposed Grand Tower project spans approximately 7 River Miles along the Big Five Levee Drainage and Levee Districts,
including the Preston, Clear Creek, East Cape, and Miller Pond levees, together protecting over 49,000 acres of Illinois floodplain. The proposed Grand Tower wing dike project also lies just downstream of the Degognia/Fountain Bluff and Grand Tower Drainage and Levee Districts, protecting a further 56,000 acres. Currently, all segments of these levee systems have "Unacceptable" ratings following Corps inspections and assessment. The Dogtooth Bend Project likewise poses an unusually high potential for flood damage. The Cairo levee system ("Mississippi and Ohio Rivers Levee System at Cairo & Vicinity") is located a few miles downstream of the Dogtooth Bend Project. Although the greatest effects of wing dikes occur upstream, statistically significant increases in flood levels have also been identified downstream. Corps inspections have identified major deficiencies in the Cairo levee system, leading to its current "Unacceptable" rating in the National Levee Database. The majority of these facts are unrebutted by both the Corps in its Opposition Brief and Mr. Brauer, Mr. Feldman and Ms. Schwarz in their declarations.

46. The one thing in paragraph 32 of my Original Declaration that Mr. Brauer disputes is my conclusion that statistically significant increases in flood levels have also been identified downstream. Brauer Dec. ¶ 24(b). My conclusion is based on two of my published studies, Pinter et al. (2008) and (2010), which identify both large increases in flood levels upstream of new river training structures and smaller, but statistically significant, increases downstream of new structures. Mr. Brauer declares this to be impossible, but he bases his opinion solely on his interpretation of hydraulic theory, not any published research. In fact, turbulence and eddy circulation downstream of wing dikes represent a plausible mechanism for empirical increases in flood stages after dike construction. Mr. Brauer cannot wish away observed empirical trends based on his understanding of hydraulic theory.

47. As I attested in paragraph 33 of my Original Declaration, my work with local levee commissioners and other informed officials has revealed deep concern and widespread discussion about levee safety and performance during future floods, even without additional stresses. For at least the past decade, local stakeholders have repeatedly called for the St. Louis District of the Corps of Engineers to rigorously and independently assess the cumulative impacts of wing-dike construction in the Middle Mississippi River. Instead, a new wave of dike construction has been
undertaken, with each new project evaluated – perfunctorily – on an individual basis and without regard to cumulative effects. Neither the Corps in its Opposition Brief nor Mr. Brauer, Mr. Feldman or Ms. Schwarz in their declarations rebuts these facts.

B. Reply to the Feldman Declaration

48. As discussed in detail below, I conclude after reviewing the Feldman Declaration that Mr. Feldman overstates some of benefits of river training structures as well as the costs of delaying or permanently tabling the proposed the Dogtooth Bend, Monsenthein/Ivory Landing and Eliza Point/Greenfield projects.

49. Mr. Feldman asserts that “under the Upper Mississippi River Biological Opinion issued by the U.S. Fish and Wildlife Service and the Upper Mississippi River Restoration-Environmental Management Program, new river training structures are constructed for the purpose of providing environmental benefits for fish and wildlife.” Feldman Dec. ¶ 4. Yet little or no benefit of river training structures to endangered fish species on the MMR has ever been demonstrated. The Corps has touted many of its navigational dike projects as having environmental benefits (e.g. DuBowy, P.J., 2012 and cover of same magazine issue), but rigorous monitoring has shown no actual species benefits associated with these activities (e.g., Papanicolaou et al., 2011).

50. Mr. Feldman claims that “[a]s the Mississippi River is a dynamic system due to natural variances that affect sedimentation, impacts associated with delay of not awarding the contracts or constructing the features provided in those contracts will increase the length of that delay.” Feldman Dec. ¶ 8. Mr. Feldman is mistaken that any large change in the Mississippi River’s sediment flux or geomorphic conditions would occur if the proposed river training structure projects are delayed. For many decades, the Corps’ St. Louis District has maintained the 9-foot navigation channel through dredging. In the absence of new river training structures, the Corps could continue to maintain the navigation channel through dredging. And outside factors being equal, no large change in the river’s sediment flux would occur, nor, contrary to Mr. Feldman’s conclusion, would there be any increased costs due to sediment accumulation.
51. Mr. Feldman contends that “[s]ignificant delays in awarding contracts and/or not constructing any new training structures will delay the overall Regulating Works Project completion date.” Feldman Dec. ¶ 17. But in assuming that the construction of additional river training structures could eliminate the need for future dredging, Mr. Feldman ignores growing anecdotal evidence suggesting that recent river training structure construction is largely just shifting locations of the required dredging instead of reducing or eliminating the long-term need for dredging.

52. Mr. Feldman asserts that the “benefit to cost ratio for the Regulating Works Project construction completion is 18 to 1,” and that the project “is one of the most valuable projects in the nation in terms of returns on investment.” Feldman Dec. ¶ 17. But Mr. Feldman’s claim is based on the erroneous assumption that new river training structures have zero impact on flood levels. As discussed thoroughly above and in my Original Declaration, and as document by Pinter et al. (2012), even small increases in flood levels cause large increases in flood risk that can overwhelm any purported cost-savings from reduced dredging. Furthermore, as just discussed, Mr. Feldman ignores the growing anecdotal evidence suggesting that recent river training structure construction is largely just shifting locations of the required dredging instead of reducing or eliminating the long-term need for dredging.

Conclusion

53. The new dike construction projects here – at Dogtooth Bend, Monsenthein/Ivory Landing, Eliza Point/Greenfield Bend, and Grand Tower – pose significant threats of increased flooding and flood risk. They are the latest manifestations of a flawed process that has allowed construction of hundreds of new dikes and dike-like structures that are causing elevated flood stages throughout the Middle Mississippi River. Unless these new dike construction projects are halted to allow their reconsideration based on a comprehensive and independent Supplemental Environmental Impact Statement that takes the foregoing studies and analyses into consideration, needless and potentially severe flooding will likely occur. The costs of halting the projects would be much less than Mr. Feldman claims in his declaration. Indeed, halting the projects would
significantly reduce taxpayer expenditures – along with societal and environmental hardship – by reducing long-term flood risk and flood damages.

54. I declare under penalty of perjury that the foregoing facts are true of my personal knowledge, that the foregoing expressions of professional judgment are honestly held in good faith, that I am competent to and if called would so testify, and that I executed this declaration on August 13, 2014 in Chicago, Illinois.

Nicholas Pinter, Ph.D
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CERTIFICATE OF SERVICE

I hereby certify that on August 13, 2014, I electronically filed the Reply Declaration of Nicholas Pinter, Ph.D. in Support of Plaintiffs’ Motion for Preliminary Injunction with the Clerk of the Court using the CM/ECF system which will send notification of such filings to all registered counsel participating in this case. There are no non-registered participants in this case.

Respectfully submitted,

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Discussions and Closures

Discussion of “Analysis of the Impacts of Dikes on Flood Stages in the Middle Mississippi River” by Chester C. Watson, David S. Biedenharn, and Colin R. Thorne

DOI: 10.1061/(ASCE)HY.1943-7900.0000786

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Thanks to Watson and colleagues (original paper) for bringing further attention to the issue of flood magnification on portions of the Mississippi and other navigable rivers. Unfortunately, their article does more to cloud this issue than clarify it. The original paper claims to present an “objective review” (p. 1072, 1077) of the specific gauge technique and the hydraulic impacts of navigational dikes. It should be understood that this article is functionally identical to Watson and Biedenharn (2009), a consulting report commissioned by the St. Louis District of the U.S. Army Corps of Engineers for the purpose of refuting previous studies showing rising flood levels linked to ongoing dike construction on the Middle Mississippi River (MMR).

Watson et al.’s review of the broader issues here—empirical increases in flood levels and frequencies on the Mississippi River system, and the causal mechanisms thereof—is a highly incomplete analysis. It ignores the large breadth of methodologies, study rivers, locations, and years of record in previous studies. Instead, Watson et al. limit their analyses to a single station (St. Louis, MO) on a single river, using a truncated data record (Pinter 2010, 2015), and their criticisms target a single methodology (specific gauge analysis) largely in a single 12-year-old paper (Pinter et al. 2001). Nonetheless, Watson et al. repeatedly assert that their statistical trends, including the effects of sediment concentrations and water temperature, do not mean that we have shown that there is no difference (Dallal 2001). Nonetheless, Watson et al. repeatedly assert that their statistics prove that MMR specific stages are invariant over time.

Furthermore, between rejecting $H_0$ for $p$ values $<0.01$ and erroneously accepting $H_0$ for $p > 0.1$, the authors create a new statistical outcome of “inconclusive.” Where Watson et al.’s own analyses show significant increases in flood stages (above the 99% confidence level), the authors use “visual inspection of the data” to infer secondary mechanisms and use post facto subdivisions of their time series in order to mask the statistical trend. In fact, our research group long ago reviewed such secondary factors, including the effects of sediment concentrations and water temperature on stages, and quantified these effects on MMR stages (e.g., Pinter et al. 2000; Remo and Pinter 2007). Statistical trends, when significant, represent long-term driving forces, such as wing-dike impacts, rising up from the many known sources of short-term variability.

It is hard to deny that some process is driving flood levels higher on rivers such as the MMR and Lower Missouri River. Historical time series of stage data, which are unequivocally homogenous over time (e.g., Criss and Winston 2008), show strong and statistically significant increases, and these increases exceed by $\sim 10x$ the maximum credible increases in climate-driven and land-cover-driven flows (e.g., Pinter et al. 2008). Watson et al. obliquely acknowledge the upward trend in flood magnitudes and frequencies, but conjecture that levee construction is the cause. In reaching this conclusion, Watson et al. present no evidence, but instead speculate about enhanced momentum losses due to channel-overbank flow shear and about voluminous “sediment accumulation . . . between the channel and the levee”; speculative
processes that are contradicted by real-world measurements (e.g., Bhowmik and Demissie 1982; Heine and Pinter 2012). In fact, the large multivariate study by Pinter et al. (2010) identified the age, location, and extent of every large levee system added to the Mississippi–Lower Missouri system during the past 100+ years, documenting that levees do contribute some but not all of the observed flood-level increases on the MMR and elsewhere (confirming modeling by Remo et al. 2009). These issues are too important to be addressed by unsupported speculation, especially when voluminous data exist to rigorously test these hypotheses.

Despite protestations to the contrary, the Watson et al. paper reveals broad areas of agreement with earlier studies on wing-dike impacts. They acknowledge that the “USACE has constructed numerous river engineering structures in and along the MMR.” In fact, Watson et al. significantly underestimate the number of such structures by starting their count around 1930. Most dike construction on the Mississippi River near St. Louis was early, with 26,500 linear meters of dikes built prior to 1930 in the 10 river miles (16.5 km) centered on St. Louis. Wing dikes and similar training structures have been, and continue to be, the dominant tool for navigation engineering on the MMR, with a total of 1,200 linear meters of dikes per 1.0 km of channel. Watson et al. state that stages for the lowest, in-channel flows trend downward over time after wing-dike construction, which has been noted at St. Louis and other gauging stations by all previous studies. Dike-induced flow acceleration in the navigation channel stimulates bed scour, which lowers the water-surface elevation for low flows. Watson et al. also note that stage trends for larger in-channel flows go flat (become statistically “inconclusive”), as flow retardation by dike balances the increased depths. And for flood flows, they acknowledge a statistically significant upward trend overall. In fact, measured flood stages at St. Louis in 1993 were ~1.2 m higher than for equal flows in the 1940s, even though most dike construction was earlier. Where we differ is that Watson et al. ignore the very large range of other research quantitatively showing how much of this increase, and similar and larger increases at numerous other stations, is linked to levee construction and how much is attributable to wing-dike construction.

There are legitimate discussions that researchers could have, for example the advantages of different approaches to specific gauge analysis (e.g., Watson’s “rating curve” and “direct step” approaches), but instead Watson et al. limit themselves to reviewing a single technique on a single river at a single station using a truncated period of record (Pinter 2010, 2015). There is clear empirical evidence of statistically significant increases in flood magnitudes and frequencies on the Mississippi and other rivers, and extensive research and broad-based evidence that river-training structures have contributed to these increases. Current dike construction projects on the Mississippi River rely on the Watson et al. paper and the corresponding consulting report (Watson and Beidenharn 2009) as the central demonstration that large-scale new dike fields will not impact flood levels. Sound engineering design, environmental assessment, and flood-risk management should be based on vigorous science rather than advocacy and misdirection.

References

Discussions and Closures

Discussion of “Mississippi River Streamflow Measurement Techniques at St. Louis, Missouri” by Chester C. Watson, Robert R. Holmes Jr., and David S. Biedenharn

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Thanks to the authors of the original paper for another manuscript addressing pressing issues of hydrology and flooding on the Middle Mississippi River (MMR). Like another paper (Watson et al. 2013) and discussion (Pinter 2014), the authors of the original paper present findings from studies funded by the St. Louis District of the U.S. Army Corps of Engineers (USACE), in this case presenting elements of the Watson and Biedenharn (2009) and Huizinga (2009) reports. The original paper reviews historical discharge measurements and measurement techniques on the MMR, and in particular, discharge measured by the USACE prior to circa 1940. Unfortunately, the authors of the original paper present this review without necessary background and literature review, for example with no mention of Pinter (2010), a statistical study that tested the same issues. Outside readers will not understand the context or the purpose of the Watson et al. (2013) paper without additional background.

The seemingly arcane question of historical discharge measurements has been the focus of extensive discussion on the MMR. These discussions began with studies identifying rising trends in flood magnitudes and frequencies on the MMR and selected other river reaches. The long-term hydrologic effects of climate change, land use, and upstream dam storage on MMR flooding have also been documented and quantified (e.g., Pinter et al. 2002, 2008, 2010), but multiple studies have identified in-channel navigational construction (a variety of dikes and dike-like structures; see review in Pinter et al. 2010; Pinter 2014) as the largest influence on MMR flood trends over time. Put simply, this is the source of contention driving USACE investment in this issue and driving ongoing work on both sides.

After record flooding in 1973, Belt (1975) and Stevens et al. (1975) published studies linking flood-level increases over time with ongoing construction of navigational channel works. The MMR appears to be the most densely diked river reach in the United States, and perhaps of any river worldwide, with an average of about 1,370 m (linear) of dikes and weirs constructed per kilometer of MMR channel. The Belt (1975) and Stevens et al. (1975) papers stimulated vigorous discussion, in particular four letters responding to the Stevens et al. (1975), as follows: (1) Dyhouse (1976), (2) Stevens (1976), (3) Strauser and Long (1976), and (4) Westphal and Munger (1976), and various opinion articles disseminated by the St. Louis District of the USACE (e.g., R. L. Munger et al., Contract DACW-43-75-C-0105, presented at U.S. Army Corps of Engineers, St. Louis, Missouri, 1976; Dyhouse 1985, 1995). Critiques included the argument that early discharge data on the Mississippi River cannot be compared with recent data because early discharge measurements (<1933 at St. Louis) used floats to measure flow velocity rather than Price current meters. In order to test this assertion, “[t]he Corps commissioned the University of Missouri Rolla to evaluate historical methods of discharge measurement, investigating the accuracy of the techniques and the need for any adjustments to historical discharge data” (Dyhouse 1985). Stevens (1979) completed same-day measurements of velocity and discharge near Chester, Illinois, using Price current meters and several varieties of floats.

Watson et al. repeat a now familiar assertion that Stevens (1979) identified systematic and significant differences between float-based and meter-based measurements. That is not the case. Stevens (1979) concluded that “an experienced person, using accepted techniques, can obtain excellent discharge determinations using any of the velocity measuring vehicles.” Watson et al. points to differences between float-based and meter-based measurements, but the only broad differences in the Stevens (1979) results involved surface floats (as opposed to other varieties of floats), a technique used for only 10 of the thousands of early MMR discharge measurements. All 10 surface-float measurements were made in 1881 during very low flows at St. Louis (no surface-float measurements at the other gaging stations; i.e., Chester or Thebes). Furthermore, Stevens (1979) explicitly conclude that their results “do not substantiate correction of all recorded past discharges that have been determined using floats.” And yet exactly such data modifications have been made, justified by citing Stevens (1979).

The Upper Mississippi River System Flow Frequency Study (UMRSFFS) was initiated in 1997 to update flow frequencies previously quantified in 1975 along the Upper Mississippi, Missouri, and Illinois River systems. When the UMRSFFS was released in 2004, areas of increased flood frequencies were identified in other USACE districts, but the new flood profiles were lower through the St. Louis District, including drops of up to 52 cm (1.7 ft) for the 100-year flood. These decreases were puzzling given the empirical hydrologic trends, and remained enigmatic despite detailed review of the UMRSFFS methodology and results. A Freedom of Information Act request for additional UMRSFFS documentation (Missouri Coalition for the Environment v. U.S. Army Corps of Engineers, 07–2218) was refused by the USACE on the basis of “deliberative process privilege,” a ruling subsequently upheld by a U.S. District Court. The St. Louis District results became clear only with the discovery of Dieckmann and Dyhouse (1998), a presentation made at a United States interagency meeting. Dieckmann and Dyhouse (1998) reported that “flood peak discharges at St. Louis prior to 1931 [and at the Chester and Thebes gages prior to c. 1940] were adjusted downward to reflect over-estimates made throughout the period when floats were primarily used for velocity measurements,” citing Stevens (1979). These post facto data changes are nowhere presented in the public UMRSFFS methodology. More recent hydrologic measurements also were altered (Pinter 2010). Together these modified input data were used to calculate UMRSFFS flow frequencies and are now the basis for flood profiles and new flood-hazard maps throughout the St. Louis District. Similarly, the USGS Missouri Water Science Center has now altered its flood peak dataset, reducing the 1844 flood flow at St. Louis from 38,200 to 28,300 m³/s (1.35 million to 1 million ft³/s), based on Dyhouse (1995) and Dieckmann and Dyhouse (1998), and despite detailed analysis of 1844 measurements by Stevens (1979) suggesting a flow of 38,500 m³/s (1.36 million ft³/s) at St. Louis. Most scientists would argue for much greater caution before altering original data.
The effect of modifying early discharge measurements, as suggested by Dieckmann and Dyhouse (1998) and Watson et al., is to erase temporal trends in MMR rating curves (including rising flood stages) that previous researchers had ascribed primarily to construction of navigational structures in and along the MMR channel (Fig. 1). In the process, flood frequencies and magnitudes calculated using these input discharges are significantly reduced. The Dieckmann and Dyhouse (1998) data modifications reduced the UMRSFFS output flood magnitudes by up to 10% and more, for example a reduction of > 3,100 m³/s (> 110,000 ft³/s) for the 100-year flood at St. Louis (Pinter 2010). Pinter et al. (2012) completed flood-loss modeling on the MMR, quantifying losses with and without the data adjustment mentioned previously; flood damages modeled based on the adjusted input discharges were up to 79% less than calculated using the original and unaltered annual flow maxima.

Pinter (2010) presented the issue of data adjustment in the UMRSFFS and set out to test the hypothesis that older discharge measurements were systematically overestimated relative to later USGS measurements. The study tested this hypothesis using 2,150 historical discharge measurements digitized from the three principal stations [(1) St. Louis, (2) Chester, and (3) Thebes] on the Middle Mississippi River, including 626 float-based discharges and 1,516 meter-based discharges, and including 122 paired measurements (pairs of meter-based and float-based measurements taken at the same locations on the same days). In all statistical tests, the hypothesis that early discharges were overestimated was rejected; on the contrary, in the cases where differences between early and later discharges were significant, the pre-USGS discharge measurements averaged slightly less (not more) than the later measurements. These statistical tests included separate analyses of the paired values and of all floats versus all meters, and separate tests at all three gaging stations.

The authors of the original paper provide no new data, and their one new analysis is a statistical comparison in one paragraph spanning pp. 1067–1068. The rest of their review discusses sources of variability in streamflows (e.g., temperature-based and bed-related hysteresis), largely duplicating Watson et al. (2013); see reply in Pinter (2014). That statistical comparison evaluates discharge values from Stevens (1979) and Ressegieu (Memo to division engineer, presented at Upper Mississippi Valley Division, U.S. Army Corps of Engineers, St. Louis, Missouri, 1952). Assessment of this comparison is impossible, because the authors of the original paper provide neither these data nor any indication of which data they looked at. One concern is that the authors of the original paper utilize the very small number of measurements in Stevens (1979) and Ressegieu (Memo to division engineer, presented at Upper Mississippi Valley Division, U.S. Army Corps of Engineers, St. Louis, Missouri, 1952), eschewing the several thousand meter-based and float-based discharges, including numerous paired measurements, assembled in Corps (1935). A copy of Ressegieu (Memo to division engineer, presented at Upper Mississippi Valley Division, U.S. Army Corps of Engineers, St. Louis, Missouri, 1952), which is a memo and internal assessment by the St. Louis District dated May 27, 1952, was recently obtained from the St. Louis District. Ressegieu (Memo to division engineer, presented at Upper Mississippi Valley Division, U.S. Army Corps of Engineers, St. Louis, Missouri, 1952) followed Congressional hearings in which “A House committee Thursday blasted the army engineers for their navigation work on the lower Missouri River, asserting that a 250-million dollar program appears actually to have increased flooding” (Sioux City Journal 1952), just as Stevens (1979) was initiated by the St. Louis District just after publication of Belt (1975). Ressegieu (Memo to division engineer, presented at Upper Mississippi Valley Division, U.S. Army Corps of Engineers, St. Louis, Missouri, 1952) looked at Mississippi discharge measurements and reached the same conclusion as Stevens (1979), that USACE “‘rod float’ measurements … for all practicable purposes may be considered equal” to USGS metered discharges,” exactly contrary to the Dieckmann and Dyhouse (1998) rationale for altering pre-USGS discharge measurements.

Until now, most USACE workers and consultants have ascribed the source of purported heterogeneity in historic discharge data to the use of floats for velocity measurements (Dyhouse 1976, 1985, 1995; Stevens 1976; Strauser and Long 1976; Westphal and Munger 1976; Dieckmann and Dyhouse 1998; P. R. Munger, et al., Contract DACW-43=75-C-0105, presented at U.S. Army Corps of Engineers, St. Louis, Missouri, 1976). Pinter (2010) showed that the large majority of early discharges were based on Price current meters, and that float-based charges are not systematically higher (if anything lower) than meter-based measurements. Watson et al. now shift stance and assert that historical discharge bias results from changes in Price current meter design and measurements made from boats versus bridges. The finding of the authors of the original paper, that “pre-1930s discrete streamflow measurement data are not of sufficient accuracy to be compared with modern streamflow values” seems to be a conclusion in search of supporting evidence. Even Ressegieu (Memo to division engineer, presented at Upper Mississippi Valley Division,
U.S. Army Corps of Engineers, St. Louis, Missouri, (1952) concluded that “it is not recommended that the C. of E. measured discharges be revised.” At a minimum, the narrow analysis in the original paper does not justify redacting or altering thousands of discharge measurements, which represent key evidence of the hydrologic, hydraulic, and geomorphic response of the Mississippi River to its early engineering history.

Watson et al. concludes that “previous attempts ... to assign a positive trend in stage ... for a particular streamflow across the 1933 date boundary are incomplete without accounting for the pre-1933 measurement bias.” Again, this is a familiar assertion, and several previous publications (Criss and Winston 2008; Criss et al. 2001, 2002, 2008) have shown that stage data alone provide a useful so-called empirical reality check that is independent of any question of discharge data homogeneity (Fig. 2). Stage data are dense, precise, and unequivocally homogenous (once any datum shifts have been noted). Criss and Winston (2008) examined the long and homogenous stage record for the Mississippi River at Hannibal, Missouri, with the period 1973–2013 experiencing 14 floods at or above the predicted 10-year level in the past 40 years, seven above the 25-year level, four at the ≥50-year level, and two at the ≥200-year level [Criss and Winston (2008), data updated through 2013]. Criss (2009) tested records of peak stages at stations on the Missouri, Mississippi, and other rivers, and found that observed flood stages pervasively exceeded UMRSFFS predictions, with significance levels ranging from 90–99.9%. Stage time series are sufficiently long, dense, and precise that rising trends clearly exceed the quantified effects of climate change and levee construction alone. Watson et al. focuses solely on pre-USGS versus post-USGS discharges (pre-1933 and post-1933 at St. Louis, 1942 at Chester, and 1941 at Thebes), but the large majority of the 67 stations analyzed in Pinter et al. (2008, 2010) utilized only USGS discharge values. All of those results showed rising stage trends in heavily diked river reaches (e.g., Fig. 3). Watson et al. carefully limit their discussion to the St. Louis location alone, when their conclusion that rising stage trends are “simply the result of mixing two discrete observation data sets” is negated, by definition, at locations where all discharges are from the USGS; in fact, the majority of all sites studied.

Pinter (2010) was a technical analysis, but the paper and subsequent discussions (e.g., Wald 2010) raised troubling questions. The UMRSFFS report and its appendices exceed several thousand pages but included no explanation of the large-scale adjustment of input data in the St. Louis District’s portion of the study. These adjustments remained unknown until the discovery of the Dieckmann and Dyhouse (1998) report, although the data modifications affected resulting flood frequencies more than any other study assumption (e.g., choice of statistical distribution, or skew values), which are outlined in the UMRSFFS in great detail. No quantitative analysis was done to justify this data manipulation, which instead apparently was based on Stevens (1979) and on flume experiments; “adjustments in the data made by the corps were correct [because] flow tests using scale models determined that actual water flows in floods occurring in 1844 and 1903 could not possibly have been as high as were estimated using instruments of the time” [G. Dyhouse, quoted in Wald (2010)]. The Watson et al. paper serves to provide post facto justification for altering historical input data in the UMRSFFS and other applications. Even putting aside the specific technical question of historical data homogeneity, scientists and engineers should agree that the highest possible thresholds for (1) rigorous analysis, (2) transparency, and (3) burden of proof should apply before original measurement data are manually altered. Those thresholds should be highest of all for hydrologic data and flood-frequency analyses, which directly impact floodplain and river management projects, policies, and public safety.

References


Attachment C

National Wildlife Federation Comments

Scoping Comments on Supplement II to the Final Environmental Impact Statement, Mississippi River and Tributaries Project, Mississippi River Mainline Levees and Channel Improvement

Submitted October 15, 2018
River Management and Flooding: The Lesson of December 2015–January 2016, Central USA

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ABSTRACT: The huge winter storm of December 23–29, 2015 delivered heavy rainfall in a broad swath across the USA, deluging East-Central Missouri. Record high river levels were set at many sites, but damages were most pronounced in developed floodplain areas, particularly where high levees were built or river channels greatly narrowed. An average of 20 cm of rain that mostly fell in three days impacted the entire 10 300 km² Meramec Basin. Compared to the prior record flood of 1982, the highest relative stage (+1.3 m) on Meramec River occurred at Valley Park proximal to (1) a new levee, (2) a landfill in the floodway, (3) large floodplain construction fills, and (4) tributary creek basins impacted by suburban sprawl. Even though only a small fraction of the 1.8 million km² Mississippi River watershed above St. Louis received extraordinary rainfall during this event, the huge channelized river near and below St. Louis rapidly rose to set the 3rd-highest to the highest stages ever, exhibiting the flashy response typical of a much smaller river.

KEY WORDS: floods, Mississippi River, levees, floodplain development.

0 INTRODUCTION

Human modification of landscapes and climate are profoundly impacting rivers and streams. Urbanization with its attendant impervious surfaces and storm drains is known to accelerate the delivery of water to small streams, causing flash flooding, channel incision and widening, and loss of perennial flow. The landscapes of large river basins in the central USA have been profoundly modified by agricultural activities and development. Meanwhile, large river channels have been isolated from their floodplains by progressively higher levees, and dramatically narrowed by wing dikes and other navigational structures (e.g., Pinter et al., 2008; Funk and Robinson, 1974). Direct consequences are higher, more frequent floods and underestimated flood risk (Criss, 2016; Belt, 1975). In many areas rainfall is becoming heavier, exacerbating flood risk (e.g., Pan et al., 2016), while new floodplain developments greatly magnify flood damages (Pinter, 2005).

The extraordinary winter storm of December 23–29, 2015 provides additional evidence for progressive climate change, while delivering more tragic examples of record flood levels and underestimated flood risk. What is perhaps most remarkable is that the flood on the middle Mississippi River had a much shorter duration than its prior major floods, and closely resembled the flashy response of a small river. This paper discusses how the Meramec River and the middle Mississippi River responded to this massive storm, and examines how their recent response differed from prior events.

1 STORM SYNOPSIS

Very strong El Niño conditions developed during fall 2015, bringing some welcome relief to the California drought as well as anomalously warm temperatures to much of the USA. An extraordinary winter storm, appropriately named “Goliath”, delivered heavy rainfall in a broad belt across the central USA, as a long cold front developed parallel to, and south of, a southwest to northeast-trending part of the jet stream. Rain delivery was greatest in the central USA, particularly southwest of St. Louis, Missouri (Fig. 1). The three-day rainfall delivered by Goliath is considered to be a “25-year” to “100-year” event at most meteorological stations in this region (NOAA, 2013). With this huge addition of late December precipitation, the record-high annual rainfall total (155.5 cm) was recorded at St. Louis in its official record initiated in 1871 (NWS, 2016a), although less reliable records suggest that annual rainfall was greater in 1848, 1858 and 1859. Flooding associated with Goliath resulted in great property damage and caused at least 12 fatalities in Missouri, 7 in Illinois, 2 in Oklahoma and 1 in Arkansas.

The extraordinary rainfall that fell at St. Louis on Dec. 26–28 closely followed significant rainfall on Dec. 21–23. The earlier storm saturated the ground, so runoff from the second pulse was greatly amplified.

2 MERAMEC RIVER FLOOD

Meramec River drains a 10 300 km² watershed in East-Central Missouri, and enters the Mississippi River 30 km south of St. Louis (Fig. 2). This river has very high wildlife diversity.
and is one of the very few un-impounded rivers in the USA (Criss and Wilson, 2003; Frederickson and Criss, 1999; Jackson, 1984). Population density is low, except for the lower basin near St. Louis. Intense rainfall events cause flash flooding of the basin, as recorded by numerous long-term gauging stations (Fig. 2). Winston and Criss (2002) described one such flash flood, and the references cited in the aforementioned publications provided abundant information on the basin.

Figure 1. Map showing the observed, 7-day precipitation for December 22–29, 2015, according to NWS (2016a). Superimposed on this map are the boundaries of the upper Mississippi and Missouri watersheds (labeled) and other major river basins. Goliath delivered an average of 20 cm of rain to the entire Meramec River Basin (Fig. 2), but extraordinary rainfall exceeding 10 cm (orange, red and purple shading) impacted only a small fraction of the huge Mississippi-Missouri watershed upstream of St. Louis (blue dot near center).

Figure 2. Map of East-Central Missouri showing the 10 300 km² Meramec River Basin (dark outline) and contours for precipitation delivered from December 22–29, 2015 according to NWS (2016a). Labeled dots are river gauging stations; stage hydrographs for the stations along the main stem of Meramec River (#1 to #7) are shown in Fig. 3. Water levels at Union (#15), Eureka (#5), Valley Park (#6) and Arnold (#7) set new records, while that at Pacific (#4) came close. The index map of Missouri shows the area of detail, and the location of river gauges at St. Louis (StL), Chester (C), Cape Girardeau (CG) and Thebes (T) along the middle Mississippi River (cf. Fig. 6).
Goliath delivered an average of 20 cm of rain, mostly in 3 days, to the Meramec River Basin (Fig. 2). The resultant flood wave rapidly grew as it propagated downstream (cf. Yang et al., 2016), moving at a rate of about 3 km/h in the lower basin, where it set all-time record high stages (Fig. 3).

Runoff after storm Goliath was extraordinary, with flows attaining a value approaching 4 500 m^3/s, as documented by direct field measurements at the Eureka gauging station on December 30 (USGS, 2016). Of the precipitation delivered above Eureka by Goliath, 85% returned as runoff at Eureka in only 14.3 days. For comparison, the average, long-term annual flow at Eureka is only 92 m^3/s for a basin that receives an average of about 109 cm of precipitation per year, indicating an average runoff fraction of only 27% that is similar to the ~30% average for the USA.

3 COMPARISON TO 1982

The prior flood of record in most of the lower Meramec Basin occurred on December 6, 1982, during another very strong El Nino condition, although at some basin sites the flood of August 1915 was more extreme. Given the strong similarities in time-of-year, ENSO condition and basin response, it is very useful to compare the peak water levels of 1982 to those of 2015 (Fig. 4). The river stage at Pacific was slightly lower in 2015 than in 1982; this site is not rated for discharge, but the observed stage is consistent with the recent combined peak flows upstream at Sullivan and Union also being slightly lower in 2015. Big River enters the main stem of Meramec River about 4.8 km above the Eureka gauging station, and the peak flow at the lowermost station along it (#13 on Fig. 2) was about 150 m^3/s greater in 2015 than in 1982. Given these small differences, one might expect that the 2015 peak flow at Eureka would closely match that of 1982, but direct field measurements at Eureka on Dec. 30, 2015 suggest that the peak flow was 4 500 m^3/s (USGS, 2016), when it was only 4 100 m^3/s in 1982 (USGS, 1983). Taking this 400 m^3/s difference at face value, and using the rating curves (USGS, 2016, 1983), the associated river stage at Eureka should have been only about 0.5 to 0.6 m higher at Eureka in 2015 than in 1982, when the observed difference was 0.97 m.

Alternatively, the estimated difference between the 2015 and 1982 stages at Eureka would be only about 0.25 m if it is assumed that the flow at Pacific was identical in the two years, and the ~150 m^3/s difference for the flows on the lower Big River is accounted for. That the observed 2015 stage at Eureka was much higher than suggested by these two estimates (crosses, Fig. 4) demands explanation.

An even greater difference between the 2015 and 1982 river levels occurred at Valley Park (Fig. 4). This area has changed in the following way between these floods: (1) the size and height of a landfill at Peerless Park (cover photo) was greatly increased, significantly restricting the effective width of the Meramec River floodway mapped by FEMA (1995); (2) the 5.1 km-long Valley Park levee (Fig. 5) was constructed in 2005, restricting the width of the inundation area of the regulatory “100-year flood” (see FEMA, 1995) by as much as 70%, while reducing floodwater storage capacity; (3) the adjacent basins of three small tributaries, Williams, Fishpot and Grand Glaze Creeks, experienced rapid suburban development, destroying the riparian border, increasing the impervious surface, and making flash floods frequent (Hasenmueller and Criss, 2013); and (4) the floodplain area experienced continued commercial development on construction fill, impeding overbank flow while amplifying flood damages. It would appear
that these changes added at least 1.0 m to the 2015 water levels at Valley Park, and at least 0.4 m upstream at Eureka, compared to what levels would have been in the 1982 landscape condition. Water levels may also have increased at Arnold due to such changes, but this is not clear, because the Mississippi River level was nearly 2 m higher in 2015 than in 1982 at the mouth of Meramec River during its flooding. This higher level at the confluence would impede the flow of the lowest Meramec River, and flatten and elevate its water surface.

One final difference is that water temperatures measured by USGS (2016) were higher in 1982 (~13 °C) than in 2015 (~6 °C) near the times of peak flooding, so both the density and viscosity of water were higher in 2015. The associated effects on river levels are complex and not easy to determine. Nevertheless, if the 2015 peak stage and flow at Pacific were both similar to those in 1982, as is seemingly demanded by available data, temperature effects at Eureka are probably small.

Eight great floods (site stage >11 m) occurred at Eureka since 1915. For the six that occurred prior to 1995, the local stage at Valley Park was 0.96 to 1.40 m lower (avg. 1.20 m) than the local stage at Eureka. Only two >11 m floods occurred at Eureka since, in 2008 and 2015, and for those the local stage at Valley Park was only 0.68 and 0.59 m lower than that at Eureka. These relative differences clearly indicate that the stages of large floods at Valley Park have recently increased, relative to stages at Eureka, by about 0.8±0.5 m. New developments such as the 2005 Valley Park levee are the probable cause for this large difference.

4 THE JANUARY 2016 FLOOD ON THE MIDDLE MISSISSIPPI RIVER

Only a day after the peak flooding on the lower Meramec River, water levels on the Mississippi River at St. Louis were the 3rd highest ever recorded, and only a few days later, record stages were set downstream at Cape Girardeau and Thebes (Fig. 6). This flood is truly remarkable in several respects.

First, the Mississippi River at St. Louis was above flood stage for only 11 days during this recent flood, compared to 104 successive days in 1993 and 77 days in 1973, the only years with higher floods at St. Louis. We have found a good trend between peak stage and flood duration, with the greatest anomaly being this recent flood, and the next greatest being the brief 2013 flood which ranks 7th. Clearly, during January 2016 the middle Mississippi River experienced what might be considered a flash flood, as it exhibited a response similar to rivers whose basins are a hundred times smaller.

Second, the January 2016 flood occurred at the wrong time of year. Great floods on large midwestern rivers have historically occurred during spring, when heavy precipitation is

![Figure 4](image-url) Relative difference between the peak water levels of December 30–31, 2015 and those of December 6, 1982 at different sites in the lower Meramec Basin (cf. Fig. 2). This difference was greatest close to Valley Park, where a large levee was built in 2005; this and other changes appear to have increased stages at Valley Park as well as upstream and downstream. Two estimates (crosses) suggest what the stage difference between these floods should have been at Eureka, had the 2015 flood occurred under the 1982 landscape condition (see text). Big River (arrow) enters the Meramec River from the south, 4.8 km upstream of Eureka.

![Figure 5](image-url) The Valley Park levee looking south, only 1 hour after the flood gates were reopened on January 2, 2016. The floodwater level (dark) almost breached the levee and exceeded the estimated level for a “100-year flood” (FEMA, 1995) by nearly 2 m, forcing evacuation of the protected area to the left. Bicyclist (circled) on levee top shows scale. Photo by Robert E. Criss.

![Figure 6](image-url) Stage hydrographs at St. Louis (StL), Chester (C), Cape Girardeau (CG) and Thebes, showing propagation of the 2015–2016 flood wave down the middle Mississippi River (cf. Fig. 2). The official stages depicted for each station are relative to its local datum, except that 1 m was added to the data at Thebes (top curve) for clarity. Numbers on curves are distance in kilometers above the Ohio River. The effect of a downstream levee being overtopped is evident near the flood crest at Thebes. This flood is remarkable for its short duration, time of year, and for the new record levels set at Cape Girardeau and Thebes. Data from USGS (2016).
added to rivers swollen with snowmelt. A partial exception was the August 1 peak of the great 1993 flood, but the protracted period of flooding was initiated during late spring. The other significant exception was the 10th highest flood at St. Louis, which occurred on December 7, 1982. Just like the current event, the 1982 flood peak on the Mississippi at St. Louis occurred only one day after the lower Meramec flood peak of December 6, 1982, discussed above. Ehleman and Criss (2006) proved that the lower Missouri and middle Mississippi Rivers are becoming more chaotic and unpredictable in their time of flooding, height of flooding, and magnitude of their daily changes in stage. This chaotic behavior is primarily the result of extreme channelization of the river, and its isolation from its floodplain by levees (e.g., Criss and Shock, 2001; GAO, 1995; Belt, 1975). The channels of the lower Missouri and middle Mississippi Rivers are only half as wide as they were historically, along a combined reach exceeding 1 500 km, as clearly shown by comparison of modern and historical maps (e.g., Funk and Robinson, 1974).

Third, while the area of extreme precipitation during December 26–28, 2015 spanned the entire Meramec Basin, only 5% of the gigantic watershed of the Mississippi River above St. Louis experienced 7-day rainfall greater than 10 cm (Fig. 1). Nevertheless, because the Mississippi and Missouri rivers are so channelized and leveed proximal to St. Louis, the rainfall that was rapidly delivered to the nearby part of the watershed had nowhere to go, so river levels surged. Downstream, river stages were even higher because of the addition of floodwaters from Meramec River, affecting Chester, and then from the addition of Kaskaskia River, affecting the narrow Mississippi at Cape Girardeau and Thebes. For these sites, the fraction of their upstream watersheds affected by great December precipitation was only slightly larger than for St. Louis.

Finally, the record high water levels just set at Cape Girardeau and Thebes would have been even higher, but for the damaging surge of overbank floodwater that followed the overtopping of the Len Small Levee north of Cairo. The stage hydrograph for Thebes clearly shows that a sharp, 0.5 m reduction occurred when the water was still rising (Fig. 6), so the stage recorded just prior to that drop underestimates what the peak level would have been. A smaller but similar effect occurred slightly later at Cape Girardeau.

5 DISCUSSION

The aftermath of storm Goliath provides another example in an accelerating succession of record floods, whose tragic effects have been greatly magnified by man. The heavy rainfall was probably related to El Nino, and possibly intensified by global warming. Heavy rainfall impacted the entire Meramec basin, which accordingly flooded. But new record stages were set only in areas that have undergone intense development, which is known to magnify floods and shorten their timescales.

The Mississippi River flood at St. Louis was the third highest ever, yet it occurred at the wrong time of year, and its brief, 11-day duration was truly anomalous. Basically, this great but highly channelized and leveed river exhibited the flashy response of a small river, and indeed resembled the response of Meramec River, whose watershed is smaller by 160×. Yet, only a few percent of the watershed above St. Louis received truly heavy rainfall during this event; the river rose sharply because the water simply had nowhere else to go.

Further downstream, new record stages on the middle Mississippi River were set. Those record stages would have been even higher, probably by as much as 0.25 m, had levees not failed and been overtopped. The sudden drop of the water level near the flood crest at Thebes clearly demonstrates how levees magnify floodwater levels. In this vein, it is very significant that the water levels on the lower Meramec River were highest, relative to prior floods, proximal to a new levee and other recent developments.

Forthcoming calls for more river management, including higher levees and other structures, must be rejected. Additional “remediations” to this overbuilt system will only aggravate flooding in the middle Mississippi Valley (see Walker, 2016).

Finally, this event provides abundant new examples of greatly underestimated flood risk. During this event, water levels on the lower Meramec River were 1 to 2 m above the official “100-year” flood levels (e.g., FEMA, 1995), while those that at Cape Girardeau and Thebes were 0.5 and 0.7 m higher, respectively. New commercial and residential developments in floodplains are foolhardy.

6 CONCLUSIONS

The huge winter storm of Dec. 23–29, 2015 delivered heavy rainfall in a broad swath across the USA, with as much as 25 cm of rain falling on East-Central Missouri in three days. The entire 10 300 km² Meramec Basin received an average of ~20 cm of rain during this event, and the river responded with a dramatic pulse that grew as it propagated downstream at ~3 km/h. Record high water levels were set at several sites, all in areas where the floodplain was developed, runoff was accelerated, high levees were built, or the floodway was restricted. In particular, compared to the prior record flood of 1982 on the Meramec River, the highest relative stage (+1.3 m) was seen proximal to a landfill in the floodway and to a new levee and that restricted the effective width of the “100-year” water surface by as much as 65%.

In contrast, Goliath’s extraordinary rainfall impacted only a tiny fraction of the huge, 1.8 million km² Mississippi River Basin above St. Louis, yet flooding occurred which was truly remarkable for the high water level, time of year, and brief duration. This continental-scale river exhibited the flashy response typical of a much smaller river such as the Meramec. This unnatural response is clearly consistent with the dramatic channelization of the middle Mississippi River and its isolation from its floodplain by levees, as clearly pointed out by Charles Belt more than 40 years ago. It is time for this effect to be accepted and for flood risk and river management to be reassessed.

ACKNOWLEDGMENTS

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REFERENCES CITED
Attachment D

National Wildlife Federation Comments

Scoping Comments on Supplement II to the Final Environmental Impact Statement, Mississippi River and Tributaries Project, Mississippi River Mainline Levees and Channel Improvement

Submitted October 15, 2018
A New Subsidence Map for Coastal Louisiana

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Coastal Louisiana has experienced catastrophic rates of wetland loss over the past century, equivalent in area to the state of Delaware. Land subsidence in the absence of rapid accretion is one of the key drivers of wetland loss. Accurate subsidence data should therefore form the basis for estimates of and adaptations to Louisiana’s future. Recently, Jankowski et al. (2017) determined subsidence rates at 274 sites along the Louisiana coast. Based on these data we present a new subsidence map and calculate that, on average, coastal Louisiana is subsiding at 9 ± 1 mm yr⁻¹.

COASTAL SUBSIDENCE

Low-elevation coastal zones (LECZs) are among the most vulnerable landscapes within the context of climate-driven accelerated sea-level rise, often exacerbated by other human impacts as well as high subsidence rates. Predictions of rates of relative sea-level rise (RSLR) in such settings depend to a considerable extent on our ability to monitor present-day subsidence rates—including their spatial pattern—at the land surface. Obtaining such data is challenging; space-based techniques (e.g., InSAR) struggle in non-urbanized landscapes and to date only few of such studies have provided useful results (e.g., Strozzi et al., 2013). Here we combine recently published subsidence data, collected by different yet complementary methods, to produce a novel subsidence map for coastal Louisiana, one of the world’s most vulnerable LECZs.

While a variety of factors have contributed to Louisiana’s wetland loss problem, the fundamental culprit is the isolation of the sediment-delivery system (the Mississippi River) from its delta plain and the adjacent coastal zone due to the construction of flood-protection levees. As a result, the majority of the sediment carried by this system is funneled into the deep waters of the Gulf of Mexico, rather than offsetting the naturally occurring high subsidence rates. A landmark study (Blum and Roberts, 2009) has shown that this problem is likely to worsen in the future due to limited sediment loads and accelerated sea-level rise.

SUBSIDENCE DATA

Tide gauges are frequently used to obtain records of RLSR. However, tide gauges in coastal Louisiana, and likely many other LECZs, have major limitations because they typically measure RSLR with respect to benchmarks anchored tens of meters below the land surface. Subsidence rates are highest in the uppermost 5–10 m, but the average depth of the benchmarks associated with National Oceanic and Atmospheric Administration (NOAA) tide gauges in coastal Louisiana (n = 31) is ~23 m. Tide gauges therefore do not capture the component that accounts for 60%–85% of the total subsidence as observed at the land surface (Jankowski et al., 2017).

Our recent work (Jankowski et al., 2017) offers a novel approach to determining total subsidence rates at 274 sites along the Louisiana coast, based on data collected through the Coastwide Reference Monitoring System (CRMS) program. The centerpiece of this analysis consists of rod surface-elevation–marker horizon records, 6–10 years long, enabling us to calculate present-day shallow subsidence rates (i.e., shallow compaction) by subtracting the rate of surface-elevation change from the vertical accretion rate at each site (Cahoon, 2015). Recently published GPS time series (Karegar et al., 2015) complement this information; because these GPS stations (n = 13) are typically anchored >15 m below the land surface, they capture the “deep” subsidence component that includes glacial and sedimentary isostatic adjustment (Wolstencroft et al., 2014) plus compaction and faulting in deeper strata.

A NEW SUBSIDENCE MAP

Our subsidence map (Fig. 1) shows a spatially continuous pattern of subsidence rates as recorded at the land surface, based on the sum of the two data sources discussed above. While spatial variability between our discrete monitoring sites is high, the map shows that the expected average subsidence rate is relatively uniform across coastal Louisiana, with a mean rate of 9 mm yr⁻¹ and a standard error of the mean of 1 mm yr⁻¹. It should be noted, however, that uncertainties at individual monitoring sites are significantly higher, and we therefore stress that both model (Fig. 1C) and data (Fig. 1D) uncertainties should be taken into account when estimating subsidence rates at specific localities, including those that coincide with CRMS sites. The map predicts slightly higher than average subsidence rates in the eastern Chenier Plain, the Atchafalaya and Wax Lake Deltas, and along the Mississippi River downstream of New Orleans. The lowest rates are found in the western portion of the Chenier Plain, the region with the lowest vertical accretion rates (Jankowski et al., 2017). These two findings are in all likelihood related;

shallow compaction rates are known to be highly sensitive to overburden loading. The high subsidence rates in coastal Louisiana likely mostly reflect natural processes that have operated over the past millennia. Despite the associated high rates of RSLR, the abundant sediment supplied by the Mississippi River allowed its delta to evolve into one of the world's largest.

The new subsidence map should be considered a first step; substantial efforts are needed to refine this analysis. For example, our findings are not relevant for embanked urban settings with artificial drainage and localized groundwater extraction (Jones et al., 2016), most notably the New Orleans metropolitan area, as well as the agricultural land that occupies well-drained alluvial ridges. We omitted these areas from our subsidence map. Other caveats include the possibility of underestimated rates in the birdfoot delta around the mouth of the Mississippi River, which is known to exhibit anomalously high subsidence rates (Fisk et al., 1954). We also cannot rule out that active growth faults and hydrocarbon extraction may locally cause higher rates not captured by the GPS stations.

Our newly calculated present-day subsidence rates are considerably higher than what has been reported by recent studies that relied partly or entirely on tide gauges and that inferred rates of 1–6 mm yr⁻¹ for the past few decades (Kolker et al., 2011; Karegar et al., 2015). As a result, “worst case scenarios” with subsidence rates of 8–10 mm yr⁻¹ that have been used in predictions for the Mississippi Delta throughout the 21st century (Blum and Roberts, 2009; Kim et al., 2009) are in fact reflecting the conditions that exist in coastal Louisiana today. Perhaps worst case scenarios should be considered the new normal in other LECZs worldwide as well.

ACKNOWLEDGMENTS

This study would not have been possible without funding from the Coastal Wetland Planning, Protection, and Restoration Act (CWPPRA) Program and the State of Louisiana to support the Coastalwide Reference Monitoring System (CRMS). The Coastal Protection and Restoration Authority of Louisiana and the United States Geological Survey jointly implement the CRMS Program on behalf of CWPPRA. Funding for this study was also provided by the National Science Foundation (EAR-1349311), the National Institute for Climatic Change Research Coastal Center of the Department of Energy, and The Water Institute of the Gulf. We would like to thank Marc Bierkens for his advice on spatial interpolation. We appreciate the constructive comments from Luigi Tosi and an anonymous reviewer.

REFERENCES CITED


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October 15, 2018

U.S. Army Corps of Engineers, Memphis District
ATTN: Mr. Mike Thron, NEPA Coordinator
167 North Main Street, Room B-202
Memphis, TN 38103-1894

Re: Mississippi River & Tributaries Project, Mississippi River Levees Supplemental Environmental Impact Statement II

Dear Mr. Thron and Corps Team:

This statement is presented as part of the U.S. Army Corps of Engineers (Corps) preparation of Supplement II to the Final Environmental Impact Statement (SEIS II) for the Mississippi River Mainline Levees of the MR&T Project.

Considering the information following and attached and the current direction and intent of the Congress and the Administration we request that the Corps complete the subject SEIS II within 18 months.

Since 1998 the Corps and the local Levee Boards have partnered to enlarge the deficient levees using "avoid and minimize" design techniques. These levee enlargement projects provide critical flood control, flood protection and environmental gains in all categories.

We request that the Corps expeditiously complete the design and enlargement of the remaining deficient Mainline Mississippi River Levee. We ask that the Corps use an engineering practitioners approach considering the relevant conditions of the local area and conditions for the design criteria and to avoid and minimize environmental considerations that have been used for 20 years. Expediency is imperative for the local landowners who provide their land for the construction of the projects that benefit the federal flood control system. The local land owners and local sponsors must continue to have input into the design process and the location of borrow areas. We cannot over emphasize that the local people are giving up their land for the comprehensive federal project.

The Levee Enlargement & Berms Projects need to move to completion because our Mainline Mississippi River Levee is not currently built to the federally authorized project design and will be overpowered and/or overtopped during a Project Design Flood (PDF). If the levee overtops and/or fails because it is not completed, millions of acres are subject to flooding, millions of people will be displaced, homes, interstate and roads, airports, petroleum refineries, power generation facilities, farms, regionally and other significant regional and national infrastructure along with wildlife and their essential habitat will be impacted, resulting in hundreds of billions of dollars of damages and an environmental catastrophe.
We value our 90-years of work and partnership with the Corps and we appreciate the opportunity to make this statement in support of the SEIS II and the completion of the remaining federally authorized work for the Mississippi River Levees of the Mississippi River & Tributaries Project. The longer it takes to build the project to its authorized federal design ... the longer the inner-coast of the United States is exposed to extreme economic, life safety risks, and adverse environmental impacts.

Thank you for what you do every day to help provide the protection and productivity of the local people along the God-given Alluvial Valley known as the Mississippi River Watershed. Our nation’s interests’ and future productivity are at stake.

If you have questions or comments, please contact our office.

Yours,

W. Dustin Boatwright
Chief Engineer

WDB:rh
Enclosure
CC: MG Kaiser (MVD), COL Clancy (MVN), COL Derosier (MVK), COL Ellicott (MVM), COL Sizemore (MVS)

Via e-mail: MRL-SEIS-2@usace.army.mil; John.M.Thron@usace.army.mil; Daniel.C.Sumerall@usace.army.mil
Information Paper
Mississippi River & Tributaries Project, Mississippi River Levees
Supplemental Environmental Impact Statement II

The Nation can realize the extreme benefits of building the MR&T project to design by 2028, within 10 years, the 100th anniversary of the 1928 Flood Control Act that authorized the project known as the greatest “public works” undertaking in America. In order for this to happen the SEIS II would have to be completed in 18 months and we would need to secure the funding (~$7B) within 3 years to build to design.

When the SEIS II is completed in 18 months then the design of the deficient parts of the system and the concurrent building of the system would require 5 to 7 years at best while local sponsors secure right-of-way, borrow material and other land agreements. This requires focused energy to have the funding in place to efficiently and effectively pursue the work.

When Congress directs a date certain -- as they did for the Red River Waterway Navigation project currently known as the J. Bennett Johnston Waterway ($2B, Dec 1994) -- it happens.

When the Corps directs a date certain -- as it did for assuring a flood protection date for Greater New Orleans ($14B, Sep 2011) -- it happens.

Targeted water infrastructure investments like the MR&T and the ones described don’t just happen, leaders set the conditions for them and focused responsive professionals are able to proudly deliver them for the public good, national security, and global economic gain. We must assure that our Nation realizes the impressive benefits of more than 70 to 1 return on investment in the MR&T by building it to design by May 15, 2028. Let’s do this before an overpowering of the system occurs.

A brief synopsis of the MR&T EIS/SEIS: Following the devastating 1927 Flood, Congress passed the 1928 Flood Control Act which established the Mississippi River & Tributaries (MR&T) Project and set the Corps up to design and construct levee enlargement projects. The local Levee Boards are the local sponsors and provide right-of-way and maintenance for completed levee projects based on legally binding signed Levee Assurances.

Following the 1973 Flood, the Corps evaluated the performance of the Mainline Mississippi River Levee system and discovered that there were areas along the levee system that were deficient in grade and section. The Corps performed an Environmental Impact Statement (EIS) in 1976. In 1998 the Corps performed a Supplemental Environmental Impact Statement (SEIS) for the Mainline Mississippi River Levee Enlargement and Berms Project. The riverside batture land includes significant and important habitat for waterfowl, fisheries and wildlife. As part of the 1998 SEIS the Corps adopted “avoid & minimize” criteria within the design parameters in an effort to help eliminate and lessen impacts to the environment.
Fyi

From: Gretchen Benjamin [mailto:gbenjamin@TNC.ORG]
Sent: Thursday, October 18, 2018 1:53 PM
To: Lambert, Edward P CIV USARMY CEMVN (US) <Edward.P.Lambert@usace.army.mil>
Subject: [Non-DoD Source] SEIS MR&T

Hello Ed,

How are you doing, it’s been a while. I’m sure you noticed the LMR Feasibility Study in the most recent WRDA so I expect we will be seeing each again on more regular basis.

I messed up and did not get TNC letter on the scoping process for the SEIS for MR&T to you on time. I wanted to let you know that TNC has a keen interest in this process and would like to be included in stakeholder distribution list and appropriate meetings that will held during the scoping/writing process for the preparation of the SEIS.

As you well know, The Nature Conservancy has partnered extensively with the Corps to advance policies and projects that can effectively and efficiently deliver environmental benefits while meeting the needs of people. Within WRDA 2016 there is the language from Congress directing the Corps to consider natural and nature-based features, alone or in combination with “grey” infrastructure, when studying the feasibility of flood risk management, storm damage reduction, and ecosystem restoration projects. The framework to the Prepare Supplement II to the Final Environmental Impact Statement, Mississippi River and Tributaries (MR&T) Project, Mississippi River Mainline Levees and Channel Improvement provides a strategic opportunity to include co-benefits of nature-based approaches with traditional gray infrastructure elements to improve flood risk management while protecting our natural resources, supporting economic and recreational opportunities, and enhancing community resilience for future generations. TNC would like to be a trusted partner during the SEIS drafting to expand options for the benefit of people and nature during this important process.

Ed, I look forward to reengaging with you and your Team.

Best Regards,

Please consider the environment before printing this email.
Gretchen Benjamin
Large River Specialist
gbenjamin@tnc.org
608-397-1140

nature.org <Blockedhttp://nature.org/>

The Nature Conservancy
La Crosse Home Office
La Crosse, Wisconsin
Loren,

In Illinois it looks like the following work will be investigated:

- We will look at potential replacement of over 2 miles of the floodwall in Cairo.
- Several segments of the levee between Mound City and Cairo have grade deficiencies of ~1-2 ft. in height.
- There are grade deficiencies where the levee ties into Hwy. 51 at Cairo where we will investigate solutions.
- There is a seepage issue inside the North Mound City sump to the pump station where we may look at installing a couple relief wells.

There is a potential for some modifications as we get further along in the study, but this is a quick summary of the problem areas. Just let me know if you have any more questions.

Thanks,
Mike Thron
Upper Delta Environmental Compliance Section
Regional Planning and Environmental Division South, USACE
167 N. Main St., Rm-B202
Memphis, TN 38103
Office: (901) 544-0708
Email: john.m.thron@usace.army.mil
Subject: FW: USACE - Public Scoping Meetings - Mississippi River Mainline Levees Supplemental Environmental Impact Statement II

FYI

-----Original Message-----
From: Thron, John M (Mike) CIV USARMY CEMVN (US) <John.M.Thron@usace.army.mil>
Sent: Thursday, August 23, 2018 4:48 PM
Subject: [External] USACE - Public Scoping Meetings - Mississippi River Mainline Levees Supplemental Environmental Impact Statement II

The U.S. Army Corps of Engineers (USACE) will host four public scoping meetings for the preparation of a supplemental environmental impact statement to address the impacts associated with the construction of remaining authorized work on the Mississippi River mainline levees of the Mississippi River and Tributaries project, as detailed in the attached document. These scoping meetings will present information to the public followed by an opportunity to provide comments. All are invited to attend one of these meetings. Comments may also be submitted by regular mail or e-mail as described in the attachment. The scoping comment period will continue through October 15, 2018.

The four public meetings are scheduled from 7-9 p.m. as follows:

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

More information about the project can be found at the following website: Blockedhttp://www.mvk.usace.army.mil/MRLSEIS/. Feel free to contact me with any questions.

Thanks,
Mike Thron
Upper Delta Environmental Compliance Section Regional Planning and Environmental Division South, USACE
167 N. Main St., Rm-B202
Memphis, TN 38103
Office: (901) 544-0708
Email: john.m.thron@usace.army.mil

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Dear US Corps of Engineers,

Please accept the following from comments on behalf of the Gulf Restoration Network regarding the Scoping for Supplement II (SEIS II) to the Final Environmental Impact Statement, Mississippi River and Tributaries (MR&T) Project, Mississippi River Mainline Levees and Channel Improvement of 1976 (1976 EIS). We are submitting these in addition to comments delivered by Matt Rota at the New Orleans public meeting held on September 13, 2018.

No wetlands should be utilized for borrow material for this project

The USACE is charged with the protection of our nation’s water resources, which includes wetlands. It would go against the mission of the USACE if wetlands were destroyed for this project if other sources of borrow are available. Precedent has been set for this, as, even under alternative NEPA arrangements, the repairs and construction of the Hurricane & Storm Damage Risk Reduction System (HSDRRS) after Hurricanes Katrina and Rita.

No additional wetlands should be enclosed by levees

Levees do not protect wetlands. Wetlands, however can protect levees. Wetlands should not be cut off from hydrologic flow because of this project. Cutting wetlands off from flows degrades the wetland, and creates a different "kind" of wetland, in the sense of in-kind mitigation. Wetland mitigation for impacts outside of levee systems should not be made inside of levee systems. Wetland mitigation for impacts inside of levee systems should be made inside of levee systems if there will be additional flood mitigation values (say, absorption of heavy rain within a polder) preserved.

October 15, 2018

US Army Corps of Engineers
ATTN: CEMVN-PDC-UDC
167 North Main Street
Room B-202
Memphis, TN 38103-1894
MRL-EIS-2@usace.army.mil

RE: Scoping Comments for Supplement II (SEIS II) to the Final Environmental Impact Statement, Mississippi River and Tributaries (MR&T) Project, Mississippi River Mainline Levees and Channel Improvement of 1976 (1976 EIS)
Old River Control Structure improvements and operations should be addressed in this SEIS

The Old River Control structure, completed in 1963, currently is required to maintain a 70-30 percent flow division between the Mississippi and Atchafalaya Rivers. However, hydrographs show that while this may be maintained on a yearly basis, it is very inconsistent on monthly and daily time frames. Not only does this make flows unpredictable for crawfishermen and others dependant upon the Atchafalaya, but also can push more sediment into the Atchafalaya, which is silting up at an alarming rate.

This SEIS should include three issues regarding the Old River Control Structure:
1. Optimization to reduce sediment in the Atchafalaya and increase sediment in the Mississippi, thus reducing sedimentation in the Atchafalaya and increasing sediment in the Mississippi that could be used for coastal restoration.
2. Mechanical Removal of sediment north of Baton Rouge should be incentivised, as it is in the Bonnet Carre Spillway. Large scale Sediment traps should be evaluated for their environmental and cost saving qualities.
3. "Pulsing" of a diversion structure has been found to increase the sediment to water ratio in a diversion channel--And so accidental or purposeful "pulsing" of Old River Control must be avoided, as it aggravates the sediment issues in the lower River. The Operation of the structure must be planned to avoid "pulsing".
4. A reexamination of the 70-30 percent flow division to assess if this is appropriate for ecological and coastal restoration purposes.
5. There needs to be an assessment of the structural integrity of the Old River Control Structure.
6. The Corps must consider opening the Floodway levees with gates in ABFS west and east guide levees, in order to restore the natural flow and sediment patterns, and preserve the function of the ABFS.

The Corps must consider how structures like the Plaquemines Liquids Terminal add to the Corps' dredging costs by hindering land-building diversions like Mid-Barataria.
1. "Pulsing" of a diversion structure has been found to increase the sediment to water ratio in a diversion channel. Placing transportation like barge moorings and pilings is not only unsafe, it removes sediment from restoration projects, and reduces their environmental benefit. Removing that environmental benefit adds to the Corps' costs of dredging Southwest Pass and other ports south of RM 61.
2. The Corps must evaluate the additional costs to dredging the MR&T by requiring that this be done for the Applicant for MVN 2012-0123, Port of Plaquemines Harbor and Terminal District.

Beneficial use of dredged sediment must be integrated into MR&T construction and operation

The sediment in the Mississippi River is an extremely valuable resource for coastal restoration in Louisiana, among other commercial uses. It is also a nuisance to
navigation for large lengths of the river, destroying swamps of the Atchafalaya Basin, a dredging expense, and a risk to Old River Control. These costs must be assumed and evaluated by the Corps. By default, any sediment dredged during this process should be floated by barge to the coast for beneficial use, rather than merely re-suspended in the River, which will only add to the Corps' cost of dredging Southwest Pass. A Cost / Benefit Analysis that includes a quantitative analysis of the above costs must be done if the Corps is to avoid beneficial use of sediment.

**Full mitigation must be completed concurrently with construction**

We expect the Corps to abide by the hierarchy of Avoid, Minimize, and Mitigate when it comes to impacts to water resources, including wetlands. When mitigation is necessary, in order to fully replace wetland functions, mitigation should take place concurrently with construction, not after the project is complete.

**Environmental justice must be evaluated**

The MR&T project protects many citizens, but we are concerned that it may protect some and leave others out. THE USACE must perform a Block Group-level analysis of persons protected and impacted by the MR&T to show that it is being designed with all US residents in mind.

**Climate change must be addressed**

A changing climate is bringing new challenges and stresses to the MR&T. We are experiencing more extreme wet-weather events in the Mississippi River Basin. Since 2005, the Mississippi River Valley has sustained successive 100, 200, and 500-year rainfall events, a 50-year drought, Hurricane Katrina, Hurricane Rita, and Hurricane Isaac. In fact, the Mississippi River is out of its banks as these comments are written (see photos below). While not in the MR&T, flooding this time of year is not typical, but may become so.

This EIS must include the fact that we will be seeing more rain and more droughts, which may overwhelm the design flow.

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Photo of Mississippi River out of its banks on October 11, 2018. Hannibal, MO. Photo credit: Robert Hoke.

Levee and river alignments should be considered

It appears that a large percentage of the levees south of New Orleans and St. Bernard suffer from a grade deficiency (see attachment). Costs of dredging Southwest Pass are considerable and increasing. This is an excellent opportunity to examine if the Corps should continue to maintain the current channel, or if other, shorter alignments could be considered. The Corps should consider a shortened channel, in order to avoid shipping and maintenance costs, restore land-building flows, and prepare for a changed climate.

Respectfully submitted,

Matt Rota
Senior Policy Director
A21-3 U.S. Fish and Wildlife Service Planning Aid Letter

A21-1 U.S. Fish and Wildlife Service Planning Aid Letter, dated March 5, 2019..........................371
Dear Colonel Derosier:

The U.S. Fish and Wildlife Service (Service) has reviewed the Department of the Army, Corps of Engineers (USACE), Notice of Intent (NOI) to prepare a Draft Supplemental II Environmental Impact Statement (DSEIS II) that will address remaining work on the Mississippi River mainline levee feature (MRL). The NOI was published in the Federal Register (Volume 83, No. 135, pg. 32462) on July 13, 2018 (Department of Interior No. ER 2018-0330). Currently the MRL has sections that are structurally deficient to protect against the Project Design Flood (PDF). The Service submits the following comments to aid your project planning in accordance with the National Environmental Policy Act of 1969 (83 Stat. 852, as amended; 42 U.S.C. 4321 et seq.), the Migratory Bird Treaty Act (MBTA, 40 Stat. 755, as amended; 16 U.S.C. 703 et seq.), the Endangered Species Act (ESA) of 1973 (87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.), and the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.).

USACE goal for the SEIS II is to provide flood protection from the PDF and develop and environmentally sustainable project. Alternatives to restore the structural integrity of the project will include raising and widening levees, stabilizing floodwalls, and seepage control (e.g., berms, relief wells, and cutoff trenches). Other alternatives can be developed through the scoping process.

The most significant fish and wildlife related problem in the study area is the loss of forested habitat and the alteration of riverine process. The Mississippi Alluvial Valley (MAV) once supported approximately 24 million acres of floodplain forest, swamps, sloughs and riverine habitat. However, more than 75 percent of its forest has been lost since European settlement, mostly to agriculture, and much of the remnant forest occurs in small, isolated tracts with decreased conservation value. Cotton, soybeans, corn, winter wheat are common crops but rice, sorghum, and sugar cane are also cultivated. Although cleared of natural vegetation, flooded agricultural fields can provide important habitat for migrating shorebirds and wintering waterfowl.
Implementation of flood control measures and the resulting system of levees, dikes, diversions and canals have significantly altered the landscape. Much of the MAV has been isolated from the Mississippi River’s natural flood cycles, which further impairs its ecological functions and also impacts the Gulf of Mexico and coastal ecosystems by altering hydrologic regimes and sediment budgets that sustain Gulf habitats.

The MAV is critically important as a major migration corridor for many bird species with more than 40 percent of the waterfowl that breed in North America using the MAV as migratory stopover, wintering or breeding habitat; the alluvial land located between the river at low-water stage and the levees (i.e., batture) is an important corridor for songbird migration. In addition, at least 107 species of landbirds breed in the MAV, with 70 of those depending upon bottomland hardwood forests for most or all of their life cycle. Furthermore, more than 100 species of fish occur in the Lower Mississippi River, and several threatened and endangered species (e.g. the pallid sturgeon, and the interior least tern) depend on these valuable habitats.

Restoration in the MAV has focused largely on the restoration of forested wetlands to benefit breeding landbirds, and consumptive wildlife recreation; hydrologic restoration of wetland habitats to support migrating shorebirds and wintering waterfowl; and modification of the flood control infrastructure along the mainstem river to benefit at-risk and threatened and endangered species.

The Lower Mississippi River Conservation Committee and the Service have cooperated extensively with state and other federal agencies (notably the USACE) in riverine restoration that would help implement restoration and recovery plans for the interior least tern, the fat pocketbook mussel and the pallid sturgeon. As these habitats are primarily instream and work on the MRL is typically farther from the river and often on the protected side of the levee, these habitats, species and restoration efforts will not be addressed within this document.

While the total acreage of potentially impacted habitats from the MRL work may not represent a significant acreage in relation to the overall size of the MAV, the cumulative loss of habitat could result in the continued decline of species dependent on those habitats; especially, those priority conservation species (e.g., at-risk, listed species, species of conservation concern). Therefore, the Service still has concerns about the long-term potential adverse impacts to fish and wildlife resources, public lands, and ongoing species conservation and habitat restoration efforts within the project area. In order to address the above concerns the Service has identified the following resources/issues that should be addressed during planning efforts and within the SEIS.

Public Lands and Lands Designated for Conservation

The Service, state park and conservation agencies, and the Forest Service all have lands within the MAV that are in close proximity to the MRL feature. These lands have been purchased for the conservation of fish and wildlife habitats and resources and/or recreational enjoyment of those resources. The National Resource Conservation Service has undertaken habitat restoration in cooperation with landowners via the Wetland Reserve Enhancement Program and the Conservation Reserve Program. These programs focus on restoring native vegetation species. Avoiding and/or minimizing impacts to the above mentioned conservation lands should be a
planning objective. If not feasible, USACE should establish and continue coordination with agencies managing public lands that may be impacted by a project feature until construction of that feature is complete and prior to any subsequent maintenance. If public lands are impacted, the Service recommends that such impacts be mitigated on the impacted public lands. If mitigation lands are purchased for inclusion within a managed area, those lands may need to meet certain requirements; therefore the proposed managing agency should be contacted early in the planning phase regarding any such requirements. If applicable, a General Plan should be developed by the Corps, the Service, and the managing natural resource agency in accordance with Section 3(b) of the FWCA for mitigation lands.

**Threatened and Endangered Species**

Below is a list of federally-listed threatened and endangered species that could potentially be affected by the MRL construction. Should the proposed action directly or indirectly affect any of the listed species further consultation with the Service will be necessary. Because construction details are not fully known at this time the Service recommends USACE address potential impacts in a programmatic manner until such time when actual impacts have been determined.

<table>
<thead>
<tr>
<th>Species</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interior least tern (<em>Sternula antillarum</em>)</td>
<td>Threatened</td>
</tr>
<tr>
<td>Pallid sturgeon (<em>Scaphirhynchus albus</em>)</td>
<td>Endangered</td>
</tr>
<tr>
<td>Wood stork (<em>Mycteria Americana</em>)</td>
<td>Threatened</td>
</tr>
<tr>
<td>Fat pocket book mussel (<em>Potamilus capax</em>)</td>
<td>Endangered</td>
</tr>
<tr>
<td>Indiana bat (<em>Myotis sodalis</em>)</td>
<td>Endangered</td>
</tr>
<tr>
<td>Northern long eared bat (<em>Myotis septentrionalis</em>)</td>
<td>Threatened</td>
</tr>
<tr>
<td>Gray bat (<em>Myotis grisescens</em>)</td>
<td>Endangered</td>
</tr>
</tbody>
</table>

To ensure that any species listed or critical habitat designated after the date of this letter are addressed in future planning documents USACE should either coordinate with the local Service Office or consult the Service’s website ([https://ecos.fws.gov/ipac/](https://ecos.fws.gov/ipac/)) throughout the planning and construction phases.

**At-Risk Species**

The Service’s Southeast Region has defined “at-risk species” as those that are:

1) Proposed for listing under the ESA by the Service;
2) Candidates for listing under the ESA, which means the species has a "warranted but precluded 12-month finding"; or
3) Petitioned for listing under the ESA, which means a citizen or group has requested that the Service add them to the list of protected species.

Petitioned species include those for which the Service has made a substantial 90-day finding as well as those that are under review for a 90-day finding. To the extent practicable, within 90 days after receiving a petition the Service is required to make a finding as to whether the petition
presents substantial scientific and commercial information indicating that the petitioned action may be warranted.

A positive 90-day finding does not indicate that the results from a 12-month status review (i.e., finding) will likewise be positive. The final determination of whether a petitioned action is warranted is not made until the Service has completed a thorough status review of the species. Thus, while petitioned species are designated as at-risk species, the biological status may or may not warrant listing the species as federally threatened or endangered and affording protections under the ESA.

The Service’s goal is to work with private and public entities to proactively conserve at-risk species in an effort to improve conservation status and preclude the need to federally list as many at-risk species as possible. In developing proactive conservation strategies with partners for at-risk species, the states’ Species of Greatest Conservation Need (defined as species with low or declining populations) may also be considered and included in our conservation recommendations under the FWCA.

Discussed below are species currently designated as “at-risk” that may occur within the project area.

**Eastern Black Rail**
The eastern black rail (*Laterallus jamaicensis ssp.*), an at-risk species, is the smallest of North America’s rail species. It has a broad distribution inhabiting higher elevations of tidal marshes and freshwater wetlands throughout the Americas. The eastern black rail breeds from New York to Florida along the Atlantic Coast and in Florida and Texas along the Gulf Coast. There is little known about the spring and fall migration as well as wintering distribution of the eastern black rail, but it has been documented to winter on the Gulf Coast from southeast Texas to Florida. The black rail is believed to use habitats within the MAV during migration.

On October 9, 2018, the Service announced a proposal to list the Eastern black rail as a threatened species and to provide measures under section 4(d) of the ESA that are tailored to our current understanding of the conservation needs of the eastern black rail. Section 7(a)(4) of the ESA provides a mechanism for identifying and resolving potential conflicts between a proposed Federal action and proposed species or proposed critical habitat at an early planning stage. A conference is required if a proposed action is likely to jeopardize the continued existence of a proposed species, or adversely modify or destroy proposed critical habitat; however Federal action agencies may request a conference on any proposed action that may affect proposed species or proposed critical habitat to ensure the conservation of that species. In the interest of conserving the Eastern black rail, we encourage the Corps, in coordination with the Service, to implement identified conservation measures that would minimize impacts to this proposed species.

**Alligator Snapping Turtle**
The alligator snapping turtle (*Macrochelys temminckii*) may be found in large rivers, canals, lakes, oxbows, and swamps adjacent to large rivers. It is most common in freshwater lakes and bayous, but also found in coastal marshes and sometimes in brackish waters near river mouths. Typical habitat is mud bottomed waterbodies having some aquatic vegetation. The alligator
snapping turtle is slow growing and long lived. Sexual maturity is reached at 11 to 13 year of age (Ernst et al. 1994). Because of this and its low fecundity, loss of breeding females is thought to be the primary threat to the species.

Golden-Winged Warbler
The golden-winged warbler breeds in higher elevations of the Appalachian Mountains and northeastern and north-central U.S. with a disjunct population occurring from southeastern Ontario and adjacent Quebec northwest to Minnesota and Manitoba. Wintering populations occur in Central and South America. The loss of wintering habitat in Central and South America and migratory habitat may also contribute to its decline. The golden-winged warbler is also known to hybridize with the blue-winged warbler (Vermivora cyanoptera).

This species may be found in forested habitats throughout the MAV during spring and fall migrations. This imperiled songbird depend on forested habitats to provide food and water resources before and after trans-Gulf and circum-Gulf migration. Population declines correlate with both loss of habitat owing to succession and reforestation and with expansion of the blue-winged warbler into the breeding range of the golden-winged warbler.

Monarch Butterfly
On June 20, 2014, President Obama signed a Presidential Memorandum, “Creating a Federal Strategy to Promote the Health of Honey Bees and Other Pollinators,” outlining an expedited agenda to address the devastating declines in honey bees and native pollinators, including the monarch butterfly (Danaus plexippus plexippus). Recent research has shown dramatic declines in monarchs and their habitats leading conservation groups to petition the Service to list the species under Endangered Species Act (ESA). Ensuring adequate and sustainable habitats, meeting all the life history needs of these species is of paramount importance. The Service and its partners are taking immediate actions to replace and restore monarch and pollinator habitat on both public and private lands across the U.S. landscape. Therefore, we recommend revegetation of disturbed grassland areas with native plant species, including species of nectar-producing plants and milkweed endemic to the area, we recommend consultation with Service and conservation agency botanists to determine appropriate species where possible.

Migratory Birds

Bird nesting colonies are present in the project area; we recommend that a qualified biologist inspect proposed work sites for the presence of undocumented nesting colonies during the nesting season. Avoidance of nesting sites should be identified as a planning objective. In addition, we recommend that during construction, on-site contract personnel be informed of the need to identify colonial nesting birds and their nests, and should avoid affecting them during the breeding season. We recommend that you coordinate with the Service’s state offices and state conservation agencies early in the planning phase to avoid and minimize impacts to nesting bird habitat and ensure that potential constraints with nesting birds are considered in the design of the project and unnecessary delays are avoided. The Service is willing to help identify additional measures that could be incorporated in the project design and construction timeline to minimize impacts to nesting birds while also avoiding impacts to the project construction sequence and timeline.
In addition to the direct loss of grassland and forested habitat, the proposed project may indirectly impact migratory birds of conservation concern because construction of projects within forested habitats typically results in habitat fragmentation. Forest fragmentation may contribute to population declines in some avian species because fragmentation reduces avian reproductive success (Robinson et al. 1995). Fragmentation can alter the species composition in a given community because biophysical conditions near the forest edge can significantly differ from those found in the center of a forest. As a result, edge species could recruit to the fragmented area and species that occupy interior habitats could be displaced. The fragmentation of intact forests could have long-term adverse impacts on some forest interior bird species. To help minimize impacts to migratory birds, forest clearing associated with project features should be conducted during the fall or winter to minimize impacts to nesting migratory bird habitat, when practicable.

Bald Eagle
The proposed project area may provide nesting habitat for the bald eagle (Haliaeetus leucocephalus), which was officially removed from the List of Endangered and Threatened Species as of August 8, 2007. However, the bald eagle remains protected under the MBTA and BGPEA. Comprehensive bald eagle survey data have not been collected by the Louisiana Department of Wildlife and Fisheries (LDWF) since 2008, and new active, inactive, or alternate nests may have been constructed within the proposed project area since that time.

Bald eagles typically nest in large trees located near coastlines, rivers, or lakes that support adequate foraging from October through mid-May. Major threats to this species include habitat alteration, human disturbance, and environmental contaminants. Furthermore, bald eagles are vulnerable to disturbance during courtship, nest building, egg laying, incubation, and brooding. Disturbance during these periods may lead to nest abandonment, cracked and chilled eggs, and exposure of small young to the elements. Human activity near a nest late in the nesting cycle may also cause flightless birds to jump from the nest tree, thus reducing their chance of survival.

The Service developed the National Bald Eagle Management (NBEM) Guidelines to provide landowners, land managers, and others with information and recommendations to minimize potential project impacts to bald eagles, particularly where such impacts may constitute “disturbance,” which is prohibited by the BGPEA. A copy of the NBEM Guidelines is available at: http://www.fws.gov/southeast/es/baldeagle/NationalBaldEagleManagementGuidelines.pdf. Those Guidelines recommend: (1) maintaining a specified distance between the activity and the nest (buffer area); (2) maintaining natural areas (preferably forested) between the activity and nest trees (landscape buffers); and (3) avoiding certain activities during the breeding season. During any project construction, on-site personnel should be informed of the possible presence of nesting bald eagles in the vicinity of the project boundary, and should identify, avoid, and immediately report any such nests to this office. If a bald eagle nest occurs or is discovered within 660 feet of the proposed project area, then an evaluation must be performed to determine whether the project is likely to disturb nesting bald eagles. That evaluation may be conducted on-line at: http://www.fws.gov/southeast/es/baldeagle. Following completion of the evaluation, that website will provide a determination of whether additional consultation is necessary.
On September 11, 2009, the Service published two federal regulations establishing the authority to issue permits for non-purposeful bald eagle take (typically disturbance) and eagle nest take when recommendations of the NBEM Guidelines cannot be achieved. Permits may be issued for nest take only under the following circumstances where: 1) necessary to alleviate a safety emergency to people or eagles, 2) necessary to ensure public health and safety, 3) the nest prevents the use of a human-engineered structure, or 4) the activity or mitigation for the activity will provide a net benefit to eagles. Except in emergencies, only inactive nests may be permitted to be taken. The Division of Migratory Birds for the Southeast Region (i.e. Louisiana, Mississippi, Arkansas, Tennessee, and Kentucky) of the Service (phone: 404/679-7051, e-mail: SEmigratorybirds@fws.gov) has the lead role in conducting consultations and issuance of permits. Should you need further assistance interpreting the guidelines, avoidance measures, or performing an on-line project evaluation, please contact Ulgonda Kirkpatrick (phone: 321/972-9089, e-mail: ulgonda_kirkpatrick@fws.gov). For the states of Illinois and Missouri in our Midwest region please contact Mr. Ryan Anthony (phone: 309-757-5800 Ext. 205, e-mail: ryan_anthony@fws.gov).

Fish and Wildlife Conservation Measures

The President’s Council on Environmental Quality regulations for implementing the National Environmental Policy Act define mitigation to include: (1) avoiding the impact; (2) minimizing the impact; (3) rectifying the impact; (4) reducing or eliminating the impact over time; and (5) compensating for impacts. The Service supports and adopts this definition and considers the specific elements to represent the desirable sequence of steps in the mitigation planning process. Through this process, the Service strives to make the project’s hurricane protection goals co-equal to fish and wildlife resource conservation.

The Service’s Mitigation Policy (Federal Register, Vol. 46, pp. 7644-7663, January 23, 1981) has designated four resource categories which are used to ensure that the level of mitigation recommended will be consistent with the fish and wildlife resources involved. The mitigation planning goals and associated Service recommendations should be based on those four categories, as follows:

**Resource Category 1** - Habitat to be impacted is of high value for evaluation species and is unique and irreplaceable on a national basis or in the ecoregion section. The mitigation goal for this Resource Category is that there should be no loss of existing habitat value.

**Resource Category 2** - Habitat to be impacted is of high value for evaluation species and is relatively scarce or becoming scarce on a national basis or in the ecoregion section. The mitigation goal for habitat placed in this category is that there should be no net loss of in-kind habitat value.

**Resource Category 3** - Habitat to be impacted is of high to medium value for evaluation species and is relatively abundant on a national basis. The Service’s mitigation goal here is that there be no net loss of habitat value while minimizing loss of in-kind habitat value.
Resource Category 4 - Habitat to be impacted is of medium to low value for evaluation species. The mitigation goal is to minimize loss of habitat value.

Considering the high value of forested wetlands and marsh for fish and wildlife and the relative scarcity of that habitat type, those habitat types are designated as Resource Category 2, the mitigation goal for which is no net loss of in-kind habitat value. Non-wetland forests would also be considered Resource Category 2. Scrub-shrub habitat that may be impacted, however, is a Resource Category 3 due to their reduced value to wildlife, fisheries and often reduced wetland functions. The mitigation goal for Resource Category 3 habitats is no net loss of habitat value.

To achieve fish and wildlife resource conservation and help the Corps address the above concerns the Service recommends the Corps adopt the following planning to guide future project planning efforts.

1. Avoid and/or minimize impacts to wetlands in the project area.

2. Avoid and/or minimize impacts to public lands and conservation/habitat restoration lands in the project area.

3. Avoid impacts to endangered or threatened species and their habitats within the study area, when feasible project features (including mitigation) should be located and/or include measures that would aid in the conservation of listed species.

4. Avoid or minimize impacts to migratory bird habitat to the extent feasible.

5. Avoid or minimize impacts to at-risk species and species of concern and their habitats. When feasible project features (including mitigation) should be located and/or include measures that would aid in the conservation of such species.

6. Coordinate with the Service and other conservation resource agencies in planning borrow areas and techniques and assessment of impacts and mitigation.

7. Coordinate further detailed planning of project features (e.g., Design Documentation Report, Engineering Documentation Report, Plans and Specifications, or other similar documents) with the Service, the respective state wildlife agencies and the Environmental Protection Agency (EPA). The Service shall be provided an opportunity to review and submit recommendations on the all work addressed in those reports.

Borrow Area Considerations
In the previous SEIS a single hierarchy for identifying borrow areas was used for the entire MRL, however, in recent discussions with USACE the Service agrees that use of more than one hierarchy to address locality differences in the habitat value of lands located on the protected side versus the floodside of the levees. The Service is willing to discuss the development of additional geographically specific borrow area hierarchies. Also in the previous SEIS environmental features were recommended for inclusion within borrow sites (e.g., sloping shorelines); the Service still recommends that such features be included in the design of borrow pits. Ongoing studies by the Engineering Development and Research Center regarding borrow
pits associated with the MRL project may identify borrow pit environmental features or characteristics that promote the existence of exotic carp within the river. Therefore, revisions to the proposed borrow pit environmental features may be necessary later in the study or during project implementation.

Klimas (1987) determined that a 300-foot-wide forest buffer would sufficiently reduce floodwater velocities to protect adjacent levees from erosive water flows. Dwyer, et al. (1997) reported that a 300-foot-wide forested corridor between the Missouri River and the adjacent levees reduced the chance of levee failure during flood events. Allen et al. (2003) determined that during the 1993 flood 83 percent of levee failures occurred where the forest corridor was less than 500-feet-wide and that the median length of levee failures was significantly wider along the riverbanks that had no forested corridor. Geyer, et al. (2000) concluded that forested buffers along the Kansas River were highly beneficial in protecting the riverbank from erosion during that same flood. U.S. Army, Corps of Engineers, Engineers Manual (EM) 1110-2-1913 Section 7-6(3) Protection of Riverside Slopes states, “The riverside slope may be shielded from severe wave attack and currents by timber stands and wide space between the riverbank and the levee.”

A forested buffer can reduce the need for structural levee slope protection and is consistent with Implementation Guidance for Section 1184 of the Water Resources Development Act of 2016. In order to reduce the floodside slope protection needed on some levee reaches the Service recommends that the Corps investigate the use of forested buffers; this would help maintain additional forested areas and grassed areas for wildlife species. Grassed areas, especially if seeded with native species, could help provide foraging areas for grassland birds species as well as pollinators.

Mitigation Planning for Unavoidable Habitat Impacts

Project features should be located and designed to avoid impacts to wetlands and non-wetland forested habitat. Should unavoidable impacts occur, those impacts should be minimized to the greatest extent possible. Any remaining unavoidable impacts must then be mitigated. Mitigation planning, including site selection and design, should be closely coordinated with the Service and other interested natural resource agencies. Full, in-kind compensation should be quantified and should be provided for unavoidable net adverse impacts on forested areas, wetlands, marsh, and associated submerged aquatic vegetation. Mitigation measures that would provide habitat for at-risk species in the project area should be included in any mitigation plan and project features; the Service can assist in development of such measures.

Mitigation measures should be constructed concurrently with the features that they are mitigating (i.e., mitigation should be completed no later than 18 months after levee construction has begun). If mitigation is provided via an in-lieu fee program or mitigation bank, completed mitigation would be achieved when credits were purchased from either source. If mitigation is not implemented concurrent with levee construction, the amount of mitigation needed should be reassessed and adjusted to offset temporal habitat losses. The Service may elect to assess impacts utilizing recently completed local/regional habitat models; while the Service recognizes that USACE must use models they have certified, those models may not fully capture all aspects of impacts or local/regional mitigation needs. Currently, USACE has mitigated most of the anticipated impacts determined for the previous SEIS with some mitigation occurring prior to the
impacts, however, there still remains some mitigation required. The Service recommends that completion of the previous SEIS required mitigation be made a priority.

For the last SEIS the Service recommended that mitigation areas contain a high proportion (i.e., 75%) of red oaks to fully offset lost wintering waterfowl habitat (i.e., duck use days). While the Service maintains its concern about the loss of feeding habitat for wintering waterfowl, the Service no longer recommends that high proportion of red oaks but recommends an adequate mixture of varying hard mast species suited to the mitigation site based on soils and hydrology. For projects within Louisiana the Service recommends a minimum of 50 percent hard mast species.

In coordination with the Service and other fish and wildlife conservation agencies, the Corps should address the Environmental Protection Agency’s and the Corps of Engineers’ 12 requirements for each mitigation measure (Attachment).

We look forward to assisting the USACE in the assessment of impacts and the development of mitigative measures and alternatives. Should you have any questions regarding our comments, please contact David Walther (337/291-3122) of this office.

Sincerely,

Joseph A. Ranson
Field Supervisor
Louisiana Ecological Services Office

Attachment

DOI, OEPC, Albuquerque, NM (Attn.: Steven Spencer)
FWS, BAP & HC (ERT), Arlington, VA (Attn.: Stefanie Nash)
FWS, Atlanta, GA (Attn.: Christine Willis)
FWS, ES, Jackson, MS
FWS, ES, Columbia, MO
FWS, ES, Conway, AK
FWS, ES, Cookeville, TN
FWS, ES, Frankfort, KY
FWS, ES, Marion, IL
TWELVE REQUIREMENTS FOR MITIGATION PLANNING
(from the U.S. Army Corps of Engineers & EPA 2008 Final Mitigation Rule in
the
FEDERAL REGISTER Vol. 73, No. 70, April 10, 2008)

Twelve Requirements for a Compensatory Mitigation Plan

1. **Objectives.** A description of the resource type(s) and amount(s) that will be provided, the method of compensation (restoration, establishment, preservation etc.), and how the anticipated functions of the mitigation project will address watershed needs.

2. **Site selection.** A description of the factors considered during the site selection process. This should include consideration of watershed needs, onsite alternatives where applicable, and practicability of accomplishing ecologically self-sustaining aquatic resource restoration, establishment, enhancement, and/or preservation at the mitigation project site.

3. **Site protection instrument.** A description of the legal arrangements and instrument including site ownership, that will be used to ensure the long-term protection of the mitigation project site.

4. **Baseline information.** A description of the ecological characteristics of the proposed mitigation project site, in the case of an application for a DA permit, the impact site. This may include descriptions of historic and existing plant communities, historic and existing hydrology, soil conditions, a map showing the locations of the impact and mitigation site(s) or the geographic coordinates for those site(s), and other characteristics appropriate to the type of resource proposed as compensation. The baseline information should include a delineation of waters of the United States on the proposed mitigation project site. A prospective permittee planning to secure credits from an approved mitigation bank or in-lieu fee program only needs to provide baseline information about the impact site.

5. **Determination of credits.** A description of the number of credits to be provided including a brief explanation of the rationale for this determination.
   - For permittee-responsible mitigation, this should include an explanation of how the mitigation project will provide the required compensation for unavoidable impacts to aquatic resources resulting from the permitted activity.
   - For permittees intending to secure credits from an approved mitigation bank or in-lieu fee program, it should include the number and resource type of credits to be secured and how these were determined.

6. **Mitigation work plan.** Detailed written specifications and work descriptions for the mitigation project, including: the geographic boundaries of the project; construction methods, timing, and sequence; source(s) of water; methods for establishing the desired plant community; plans to control invasive plant species; proposed grading plan; soil management; and erosion control measures. For stream mitigation projects, the mitigation work plan may also include other relevant information, such as planform geometry, channel form (e.g., typical channel cross-sections), watershed size, design discharge, and riparian area plantings.

7. **Maintenance plan.** A description and schedule of maintenance requirements to ensure the continued viability of the resource once initial construction is completed.

8. **Performance standards.** Ecologically-based standards that will be used to determine whether the mitigation project is achieving its objectives.
9. **Monitoring requirements.** A description of parameters monitored to determine whether the mitigation project is on track to meet performance standards and if adaptive management is needed. A schedule for monitoring and reporting monitoring results to the DE must be included.

10. **Long-term management plan.** A description of how the mitigation project will be managed after performance standards have been achieved to ensure the long-term sustainability of the resource, including long-term financing mechanisms and the party responsible for long-term management.

11. **Adaptive management plan.** A management strategy to address unforeseen changes in site conditions or other components of the mitigation project, including the party or parties responsible for implementing adaptive management measures.

12. **Financial assurances.** The DE may require additional information as necessary to determine the appropriateness, feasibility, and practicability of the mitigation project.

**Other information.** The DE may require additional information as necessary to determine the appropriateness, feasibility, and practicability of the mitigation project.