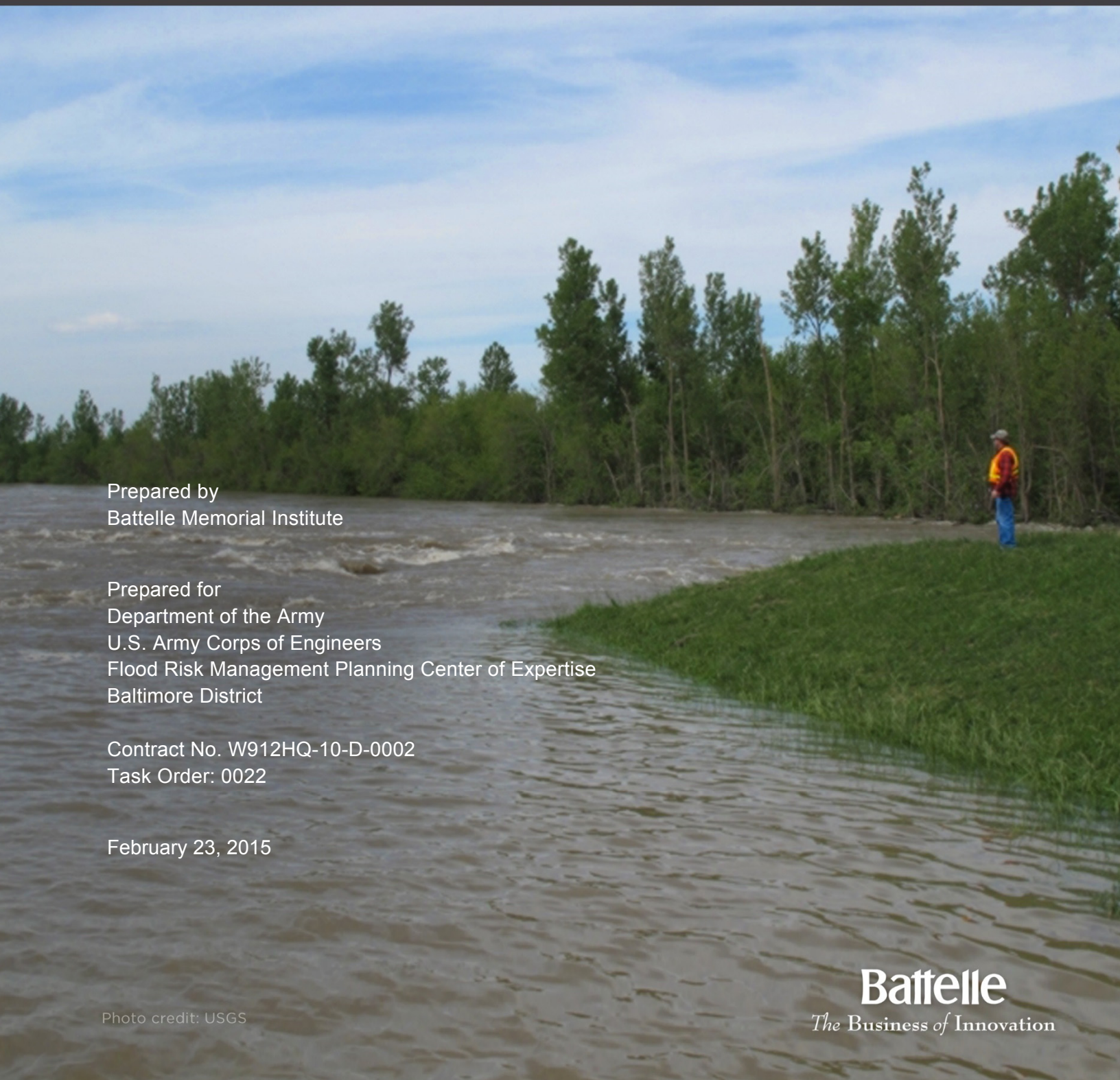
Final Independent External Peer Review Report St. Johns Bayou and New Madrid Floodway Project, Missouri, Working Final Environmental Impact Statement (Phase 4)



Prepared by
Battelle Memorial Institute

Prepared for
Department of the Army
U.S. Army Corps of Engineers
Flood Risk Management Planning Center of Expertise
Baltimore District

Contract No. W912HQ-10-D-0002
Task Order: 0022

February 23, 2015

Photo credit: USGS

Battelle
The Business of Innovation

This page is intentionally left blank.

CONTRACT NO. W912HQ-10-D-0002
Task Order: 0022

Final Independent External Peer Review Report St. Johns Bayou and New Madrid Floodway Project, Missouri, Working Final Environmental Impact Statement (Phase 4)

Prepared by

Battelle
505 King Avenue
Columbus, Ohio 43201

for

Department of the Army
U.S. Army Corps of Engineers
Flood Risk Management Planning Center of Expertise
Baltimore District

February 23, 2015

This page is intentionally left blank.

Final Independent External Peer Review Report St. Johns Bayou and New Madrid Floodway Project, Missouri, Working Final Environmental Impact Statement (Phase 4)

Executive Summary

PROJECT BACKGROUND AND PURPOSE

The St. Johns Bayou and New Madrid Floodway Project, Missouri, is an authorized project with a portion of it already constructed. Due to environmentally based litigation, the U.S. District Court for the District of Columbia halted construction and ordered constructed work restored to pre-construction conditions. In response to this litigation, a current environmental impact statement (EIS) is being prepared to address the requirements of the National Environmental Policy Act (NEPA). The purpose of this Independent External Peer Review (IEPR) is to ensure that the scope of the current EIS is complete and scientifically accurate.

The St. Johns Bayou Basin and New Madrid Floodway Project area is located in Mississippi and New Madrid counties in southeastern Missouri along the right descending bank of the Mississippi River floodplain. The project area encompasses portions of two drainage basins separated by the Mississippi River and Tributaries Project's Birds Point-New Madrid Setback Levee.

The EIS focuses on Flood Risk Management (FRM) within the St. Johns Bayou Basin and the New Madrid Floodway. Agriculture is the primary economic resource within the project area. According to recent data, the 2-year backwater flood occurrence in the New Madrid Floodway inundates 33,391 acres, of which approximately 25,000 acres are agricultural lands. At high Mississippi River stages, the St. Johns Bayou Basin control gates are closed to prevent backwater flooding. However, closing the gates prevents interior drainage and leads to impounded interior runoff. The 2-year flood event under these circumstances inundates approximately 11,900 acres, of which 7,110 are agricultural lands.

Independent External Peer Review Process

Independent, objective peer review is regarded as a critical element in ensuring the reliability of scientific analysis. The U.S. Army Corps of Engineers (USACE) is conducting an IEPR of the St. Johns Bayou and New Madrid Floodway Project, Missouri, Working Final EIS (Phase 4) (hereinafter: St. Johns Phase 4 IEPR). As a 501(c)(3) non-profit science and technology organization, Battelle is independent, is free from conflicts of interest (COIs), and meets the requirements for an Outside Eligible Organization (OEO) per guidance described in USACE (2012). Battelle, which has experience in establishing and administering peer review panels for USACE, was engaged to coordinate the IEPR of the St. Johns Project for the draft (Phase 3) and final (Phase 4) EISs. The IEPR was external to the agency and conducted following USACE and Office of Management and Budget (OMB) guidance described in USACE (2012) and OMB (2004). This final report presents the Final Panel Comments of the IEPR Panel (the Panel). Details regarding the IEPR (including the process for selecting panel members, the panel members' biographical

information and expertise, and the charge submitted to the Panel to guide its review) are presented in appendices.

The St. Johns Phase 4 review is a continuation of the contract under which the Phase 3 review was also conducted. The contract's Performance Work Statement requested that, when possible, the panel members who participated during the Phase 1 and 2 IEPR efforts be used to "ensure the continuity, validity, and expert opinion remains intact for the IEPR Phases 3 and 4." Prior to the Phase 3 review, Battelle contacted the original Phase 1 and 2 panel members, evaluated them for COIs and availability, and informed USACE that the panel members from Phases 1 and 2 would be used for Phases 3 and 4. The Panel provided expertise in the following key technical areas: water quality, fish biology, hydrologic and hydraulic engineering, economics, NEPA, waterfowl biology, shorebird biology, and wetland ecology.

The Panel received electronic versions of the St. Johns Phase 4 review documents (Working Final EIS and associated documentation of 1,623 pages in total), along with a charge that solicited comments on specific sections of the documents to be reviewed. USACE prepared the charge questions following guidance provided in USACE (2012) and OMB (2004), which were included in the draft and final Work Plans.

The USACE Project Delivery Team briefed the Panel and Battelle during a mid-review teleconference during the Phase 4 review. This meeting provided the Panel an opportunity to ask questions of USACE and clarify uncertainties. Other than Battelle-facilitated teleconferences, there was no direct communication between the Panel and USACE during the peer review process. The Panel produced individual comments in response to the charge questions.

IEPR panel members reviewed the St. Johns Phase 4 documents individually. The panel members then met via teleconference with Battelle to review key technical comments and reach agreement on the Final Panel Comments to be provided to USACE. Each Final Panel Comment was documented using a four-part format consisting of (1) a comment statement, (2) the basis for the comment, (3) the significance of the comment (high, medium/high, medium, medium/low, or low), and (4) recommendations on how to resolve the comment. Overall, 26 Final Panel Comments were identified and documented. Of these, one was identified as having high significance, 13 were identified as having medium/high significance, six had a medium significance, three had medium/low significance, and three had low significance.

Battelle received from USACE a summary Excel spreadsheet of the public comments on the St. Johns Draft EIS document along with a document containing 1,960 pages of public comments. These documents, along with questions from the St. Johns New Madras Interagency Team, were provided to the IEPR panel members as supplemental information.

Results of the Independent External Peer Review

The panel members agreed on their "assessment of the adequacy and acceptability of the economic, engineering, and environmental methods, models, and analyses used" (USACE, 2012; p. D-4) in the St. Johns Phase 4 review documents. Table ES-1 lists the Final Panel Comment statements by level of significance. The full text of the Final Panel Comments is presented in Section 4.2 of this report. The following summarizes the Panel's findings.

Based on the Panel's review, the Working Final EIS follows the NEPA process, and provides a thorough historical description of the project. From a water quality standpoint, the models are conceptually sound

and reasonable for the overall project. The Panel also notes that the approach to the shorebird model was redesigned, making it much more site-specific and repeatable. However, the Panel finds the Working Final EIS, including its appendices, to be lacking information that would allow the Panel to determine whether the assumptions and information used in the models and analyses are adequate for the project. The Panel identified several elements of the project that should be clarified or revised.

Economics: The Panel notes that the Working Final EIS provides some economics uncertainty analysis that had not been included in previously reviewed documents (Phase 3). It is clear that USACE has tried to describe a distribution of the project benefits and costs; however, little documentation is provided upon which the panel members could interpret how the benefits and costs were derived. For example, the main benefit USACE provides is increased profit to producers in the region; however, not enough detailed information is provided, even in the appendices, to understand how the economic analyses and projections have been calculated and whether profits increase or not and why. The Panel also notes that future crop yields and future without-project conditions for agriculture might not be taking into account climate change, changes in commodity prices, and changes in U.S. government policies. In addition, it appears that the economic analysis has not taken into account the value of changes in environmental amenities associated with impacts of the project itself.

Hydrogeomorphic (HGM) Model: The HGM model is the primary means by which wetland functions and impacts throughout the project area are calculated. Based on the information provided regarding the assumptions, data, and use of the HGM model to determine and compare wetland functions, the Panel is concerned that the modeling does not correctly represent the area and impacts. For instance, significant ecosystem functions and services are not being represented because of the functions chosen for use in the HGM model. For those functions chosen, the data collected are based on a very small percentage of the project area, collected during the driest time of the year, and only assess impacts on a subset of wildlife species, resulting in less than total impacts being accounted for in the habitat loss. In addition, impacts due to changes in wetland classifications and wetland function have not been correctly quantified and mitigated, resulting in underestimation of the impacts. Based on the information provided, it is not clear to the Panel whether the HGM approach is appropriate for assessing wetland functional loss and mitigation for this project.

Mitigation: The St. Johns Bayou and New Madrid Floodway Project relies on mitigation to compensate for significant impacts on the surrounding area and species due to project construction and operation. Currently, the mitigation plan does not account for uncertainty. USACE has proposed an adaptive management approach to account for this uncertainty. However, the Panel believes that insufficient data are being used to develop the plan and therefore the adaptive management plan will not fully compensate for the impacts. Development of the current mitigation plan downplays the importance of ecosystems and uses methods, designs, and studies that are inadequate to determine the amount of mitigation that should be conducted. For instance, part of the shorebird model is used to develop the mitigation plan; however, the mitigation plan does not take into consideration reductions in habitat values due to relatively static water levels reducing the availability of food resources. Part of the mitigation plan is the development of new wetlands; however, the mitigation plan does not take into account the loss of habitat during the time that it will take the new wetland to become fully functioning. Impacts on fish spawning and rearing are based on a study that is limited in scope and average annual habitat units (AAHUs) have been overvalued during transition periods, again resulting in a potential for underestimating the amount of mitigation needed.

Many of the details regarding the environmental models are missing from the appendices. In the mitigation appendix, a reference to the main document is provided, however, the information is not in the main document.

Environmental Modeling: This project relies on a number of models to support the impact assessment. The Panel is not able to determine the adequacy and acceptability of some environmental models because sufficient detail is not provided regarding the methodology and results of modeling used to estimate project impacts and mitigation. For instance, the Panel could not determine whether use of the State of Missouri Stream Mitigation Method (MSMM) to evaluate impacts or mitigation related to ditch alterations is accurate because the methodology and specific application is not well-documented. In other instances, such as the SPAtially Referenced Regression on Watershed Attributes (SPARROW) model, 2014 data are released that, if used in place of the 2009 data, would result in a decrease in the significance of the environmental benefits of the authorized project. The current methods are insufficient for evaluating the full range of species in the ecosystems being affected such as reptiles, amphibians, and mussels.

Table ES-1. Overview of 26 Final Panel Comments Identified by the St. Johns Phase 4 IEPR Panel

No.	Final Panel Comment
Significance – High	
1	The adequacy and acceptability of the economic analysis and projections cannot be determined because sufficient information regarding agricultural economic modeling has not been provided.
Significance – Medium/High	
2	The methods used to determine the shorebird habitat value of the mitigation sites in Appendix R are inadequate because they do not consider reductions in habitat value due to relatively static water levels.
3	Impacts on HGM wetland function as a result of changes to wetland classifications caused by reducing hydrologic activity have not been correctly quantified and mitigated.
4	The design of a stable water management plan for mitigation of waterfowl resource impacts will lead to inadequate mitigation of waterfowl resources.
5	The potential for economic impacts from climate change in future years (e.g., 2069) has apparently not been considered in projecting future crop yields.
6	The mitigation does not appear to be annualized and therefore does not account for the period of time required for functions of mitigation wetlands to fully develop.
7	Relying solely on the HGM Guidebook to select the six wetland functions used in the HGM model appears to have resulted in significant ecosystem functions and services not being included.

Table ES-1. Overview of 26 Final Panel Comments Identified by the St. Johns Phase 4 IEPR Panel (continued)

No.	Final Panel Comment
8	The HGM model does not account for habitat losses to other wildlife that are not assessed in the other environmental models, therefore, the total loss of function associated with the project is not being evaluated.
9	It is not clear how the pre-project estimates and post-project predictions for assessing the Provide Habitat for Fish and Wildlife function in the HGM were derived and whether the parameters not directly associated with hydrology change from pre- to post-project can be predicted.
10	The data collected for the HGM Functional Capacity Index appear to be inadequate because they are based on a very small percentage of the project area and were collected during the driest time of the year.
11	The mitigation plan is not based on sufficient data to ensure that the adaptive management plan can fully manage uncertainty.
12	Cumulative impacts on shorebird habitat are not adequately considered because it is assumed that wildlife can relocate if habitat is lost.
13	Fish spawning and rearing impacts and associated mitigation may be underestimated due to the limited scope of the fish passage study conducted for the St. Johns Bayou Basin and New Madrid Floodway.
14	The impacts on and mitigation planning for fish spawning and rearing habitat have not been adequately quantified due to AAHUs being overvalued during the transition periods.
Significance – Medium	
15	The dates and the water levels used in the various scenarios of the waterfowl analysis (Appendix F) are not consistent with those in the recommended plan.
16	The overall assessment of the flood pulse and statements throughout the Working Final EIS suggesting that there is little to no value associated with river connectivity or flood pulse for environmental resources in the floodways are not well supported.
17	The current methods used are insufficient for evaluating the full range of species in the ecosystems being affected because the HSI and other models do not adequately address reptiles, amphibians, terns, and mussels

Table ES-1. Overview of 26 Final Panel Comments Identified by the St. Johns Phase 4 IEPR Panel (continued)

No.	Final Panel Comment
18	The assumption that the future without-project conditions for agriculture will be stable may not be realistic, given that the agriculture commodity prices in recent years have been greatly influenced by productivity growth and by U.S. government ethanol policy.
19	Values for environmental amenities from the project have not been used in the economic analysis.
20	The reduction in use of moist soil management techniques may reduce the wildlife habitat value of the mitigation sites.
Significance – Medium/Low	
21	The adequacy and acceptability of some environmental models cannot be determined because sufficient detail is not provided regarding the methodology and results of modeling used to estimate project impacts and mitigation.
22	The adequacy and acceptability of the State of Missouri Stream Mitigation Method (MSMM) to evaluate impacts or mitigation related to ditch alterations cannot be determined because the methodology and specific application are not well documented.
23	Residual flood risks associated with extreme flood events are not addressed in detail in the Working Final EIS.
Significance – Low	
24	The carbon sequestration benefits discussion references a non-peer-reviewed report despite a significant volume of peer-reviewed literature on this subject.
25	The SPARROW model results (2009) relied upon in the nutrient export analysis have been superseded by more recent results (2014) that decrease the significance of the environmental benefits of the authorized project.
26	The beneficial impacts of nitrogen loading reductions on the Mississippi River over the 50-year life of the project are greatly overstated in terms of their significance to hypoxia in the Gulf of Mexico.

Table of Contents

Page

Executive Summary iii

1. INTRODUCTION 1

2. PURPOSE OF THE IEPR 1

3. METHODS FOR CONDUCTING THE IEPR 2

4. RESULTS OF THE IEPR 3

4.1 Summary of Final Panel Comments 3

4.2 Final Panel Comments 5

5. REFERENCES 51

Appendix A. IEPR Process for the St. Johns Phase 4 Project

Appendix B. Identification and Selection of IEPR Panel Members for the St. Johns Phase 4 Project

Appendix C. Final Charge to the IEPR Panel as Submitted to USACE on December 18, 2014, for the St. Johns Phase 4 Project

List of Tables

Page

Table ES-1. Overview of 26 Final Panel Comments Identified by the St. Johns Phase 4 IEPR Panel. vi

Table 1. Major Milestones and Deliverables of the St. Johns Phase 4 IEPR 2

LIST OF ACRONYMS

AAHU	Average Annual Habitat Units
ATR	Agency Technical Review
BLH	Bottom Land Hardwood
CAR	Coordination Act Report
COI	Conflict of Interest
DEIS	Draft Environmental Impact Statement
DEM	Digital Evaluation Model
DrChecks	Design Review and Checking System
EC	Engineer Circular
EIS	Environmental Impact Statement
ER	Engineer Regulation
ERDC	Engineer Research and Development Center
FCI	Functional Capacity Indices
FCU	Functional Capacity Units
FRM	Flood Risk Management
GIS	Geographic Information System
H&H	Hydrologic and Hydraulic
HGM	Hydrogeomorphic Model
HSI	Habitat Suitability Index
HTRW	Hazardous, Toxic, and Radioactive Waste
HU	Habitat Units
ICA	Incremental Cost Analysis
IEPR	Independent External Peer Review
IPCC	International Panel on Climate Change
LGRB	Low Gradient Riverine Backwater
LGRO	Low Gradient Riverine Overbank
MARB	Mississippi-Atchafalya River Basin
MDC	Missouri Department of Conservation
MDNR	Missouri Department of Natural Resources
MSMM	State of Missouri Stream Mitigation Method

NEPA	National Environmental Policy Act
NRCS	Natural Resource Conservation Service
OEO	Outside Eligible Organization
OMB	Office of Management and Budget
PDT	Project Delivery Team
PCX	Planning Center of Excellence
SJNM	St. Johns New Madrid
SPARROW	SPAtially Referenced Regression on Watershed Attributes model
TN	Total Nitrogen
TP	Total Phosphorus
USACE	United States Army Corps of Engineers
U.S. EPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Services
WAA	Wetland Assessment Area
WRP	Wetland Reserve Program

This page is intentionally left blank.

1. INTRODUCTION

The St. Johns Bayou and New Madrid Floodway Project, Missouri, is an authorized project with a portion of it already constructed. Due to environmentally based litigation, the U.S. District Court for the District of Columbia halted construction and ordered constructed work restored to pre-construction conditions. In response to this litigation, a current environmental impact statement (EIS) is being prepared to address the requirements of the National Environmental Policy Act (NEPA). The purpose of this Independent External Peer Review (IEPR) is to ensure that the scope of the current EIS is complete and scientifically accurate.

The St. Johns Bayou Basin and New Madrid Floodway Project area is located in Mississippi and New Madrid counties in southeastern Missouri along the right descending bank of the Mississippi River floodplain. The project area encompasses portions of two drainage basins separated by the Mississippi River and Tributaries Project's Birds Point-New Madrid Setback Levee.

The EIS focuses on Flood Risk Management (FRM) within the St. Johns Bayou Basin and the New Madrid Floodway. Agriculture is the primary economic resource within the project area. According to recent data, the 2-year backwater flood occurrence in the New Madrid Floodway inundates 33,391 acres, of which approximately 25,000 acres are agricultural lands. At high Mississippi River stages, the St. Johns Bayou Basin control gates are closed to prevent backwater flooding. However, closing the gates prevents interior drainage and leads to impounded interior runoff. The 2-year flood event under these circumstances inundates approximately 11,900 acres, of which 7,110 are agricultural lands.

Independent, objective peer review is regarded as a critical element in ensuring the reliability of scientific analysis. The objective of the work described here was to conduct an IEPR of the St. Johns Bayou and New Madrid Floodway Project, Missouri, Working Final EIS (hereinafter: St. Johns Phase 4 IEPR) in accordance with procedures described in the Department of the Army, U.S. Army Corps of Engineers (USACE), Engineer Circular (EC) *Civil Works Review* (EC 1165-2-214) (USACE, 2012) and the Office of Management and Budget (OMB) *Final Information Quality Bulletin for Peer Review* (OMB, 2004). Supplemental guidance on evaluation for conflicts of interest (COIs) was obtained from the *Policy on Committee Composition and Balance and Conflicts of Interest for Committees Used in the Development of Reports* (The National Academies, 2003).

This final report presents the Final Panel Comments of the IEPR Panel (the Panel) on the existing engineering, economic, environmental, and plan formulation analyses contained in the St. Johns Phase 4 documents (Section 4). Appendix A describes in detail how the IEPR was planned and conducted. Appendix B provides biographical information on the IEPR panel members and describes the method Battelle followed to select them. Appendix C presents the final charge to the IEPR panel members for their use during the review; the final charge was submitted to USACE on December 18, 2014.

2. PURPOSE OF THE IEPR

To ensure that USACE documents are supported by the best scientific and technical information, USACE has implemented a peer review process that uses IEPR to complement the Agency Technical Review (ATR), as described in USACE (2012).

In general, the purpose of peer review is to strengthen the quality and credibility of the USACE decision documents in support of its Civil Works program. IEPR provides an independent assessment of the

engineering, economic, environmental, and plan formulation analyses of the project study. In particular, the IEPR addresses the technical soundness of the project study's assumptions, methods, analyses, and calculations and identifies the need for additional data or analyses to make a good decision regarding implementation of alternatives and recommendations.

In this case, the IEPR of the St. Johns Phase 4 (Working Final EIS) was conducted and managed using contract support from Battelle, which is an Outside Eligible Organization (OEO) (as defined by EC 1165-2-214). Battelle, a 501(c)(3) organization under the U.S. Internal Revenue Code, has experience conducting IEPRs for USACE.

3. METHODS FOR CONDUCTING THE IEPR

The methods used to conduct the IEPR are briefly described in this section; a detailed description can be found in Appendix A. Table 1 presents the major milestones and deliverables of the St. Johns Phase 4 IEPR. Due dates for milestones and deliverables are based on the receipt of the charge questions from USACE on December 8, 2014. Note that the work items listed under Task B6 occur after the submission of this report. Battelle anticipates submitting the pdf printout of USACE's Design Review and Checking System (DrChecks) project file (the final deliverable) on March 24, 2015.

Table 1. Major Milestones and Deliverables of the St. Johns Phase 4 IEPR

Task	Action	Due Date
B1[a]	Award/Effective Date	9/29/2011
	Review documents available	11/14-19/2014
B3	Battelle convenes kick-off meeting with USACE	11/17/2014
	Battelle convenes kick-off meeting with panel members	11/13-14/2014
	Battelle convenes mid-review teleconference for panel members to ask clarifying questions of USACE[b]; State agencies permitted to present to panel members (10 minute presentations for each agency)	1/8/2015
B4	Panel members complete their individual reviews	1/16/2015
	Panel members provide draft Final Panel Comments to Battelle	2/3/2015
B5	Battelle submits Final IEPR Report to USACE	2/23/2015
B6[c]	Battelle convenes Comment-Response Teleconference with panel members and USACE	3/13/2015
	Battelle submits pdf printout of DrChecks project file to USACE	3/24/2015
	Contract End/Delivery Date	6/30/2015

[a] Task numbers are numbered "B" consistent with the September 2011 USACE PWS for conducting both Phases 3 (A tasks) and 4 (B tasks) IEPRs.

[b] The original scope of work included a kickoff meeting, but did not include a mid-review teleconference. Because the Panel had participated in three previous IEPRs on the project Battelle substituted the mid-review teleconference for the kickoff meeting.

[c] Task B6 occurs after the submission of this report.

The St. Johns Phase 4 review is a continuation of the contract under which the Phase 3 review was also conducted. The contract's Performance Work Statement requested that, when possible, the panel members who participated during the Phase 1 and 2 IEPR efforts be used to "ensure the continuity, validity, and expert opinion remains intact for the IEPR Phases 3 and 4." Prior to the Phase 3 review, Battelle contacted the original Phase 1 and 2 panel members, evaluated them for COIs and availability, and informed USACE that the panel members from Phases 1 and 2 would be used for Phases 3 and 4. The Panel provided expertise in the following key technical areas: water quality, fish biology, hydrologic and hydraulic engineering, economics, NEPA, waterfowl biology, shorebird biology, and wetland ecology.

The Panel reviewed the St. Johns Phase 4 documents and produced 26 Final Panel Comments in response to 32 charge questions provided by USACE for the review. Battelle instructed the Panel to develop the Final Panel Comments using a standardized four-part structure:

1. Comment Statement (succinct summary statement of concern)
2. Basis for Comment (details regarding the concern)
3. Significance (high, medium/high, medium, medium/low, or low; in accordance with specific criteria for determining level of significance)
4. Recommendation(s) for Resolution (at least one implementable action that could be taken to address the Final Panel Comment).

Battelle reviewed all Final Panel Comments for accuracy, adherence to USACE guidance (EC 1165-2-214, Appendix D), and completeness prior to determining that they were final and suitable for inclusion in the Final IEPR Report. There was no direct communication between the Panel and USACE during the preparation of the Final Panel Comments. The Panel's findings are summarized in Section 4.1; the Final Panel Comments are presented in full in Section 4.2.

4. RESULTS OF THE IEPR

This section presents the results of the IEPR: a summary of the Panel's findings and the full text of the Final Panel Comments.

4.1 Summary of Final Panel Comments

The panel members agreed on their "assessment of the adequacy and acceptability of the economic, engineering, and environmental methods, models, and analyses used" (USACE, 2012; p. D-4) in the St. Johns Phase 4 review documents. The following summarizes the Panel's findings.

Based on the Panel's review, the Working Final EIS follows the NEPA process, and provides a thorough historical description of the project. From a water quality standpoint, the models are conceptually sound and reasonable for the overall project. The Panel also notes that the approach to the shorebird model was redesigned, making it much more site-specific and repeatable. However, the Panel finds the Working Final EIS, including its appendices, to be lacking information that would allow the Panel to determine whether the assumptions and information used in the models and analyses are adequate for the project. The Panel identified several elements of the project that should be clarified or revised.

Economics: The Panel notes that the Working Final EIS provides some economics uncertainty analysis that had not been included in previously reviewed documents (Phase 3). It is clear that USACE has tried to describe a distribution of the project benefits and costs; however, little documentation is provided upon

which the panel members could interpret how the benefits and costs were derived. For example, the main benefit USACE provides is increased profit to producers in the region; however, not enough detailed information is provided, even in the appendices, to understand how the economic analyses and projections have been calculated and whether profits increase or not and why. The Panel also notes that future crop yields and future without-project conditions for agriculture might not be taking into account climate change, changes in commodity prices, and changes in U.S. government policies. In addition, it appears that the economic analysis has not taken into account the value of changes in environmental amenities associated with impacts of the project itself.

Hydrogeomorphic (HGM) Model: The HGM model is the primary means by which wetland functions and impacts throughout the project area are calculated. Based on the information provided regarding the assumptions, data, and use of the HGM model to determine and compare wetland functions, the Panel is concerned that the modeling does not correctly represent the area and impacts. For instance, significant ecosystem functions and services are not being represented because of the functions chosen for use in the HGM model. For those functions chosen, the data collected are based on a very small percentage of the project area, collected during the driest time of the year, and only assess impacts on a subset of wildlife species, resulting in less than total impacts being accounted for in the habitat loss. In addition, impacts due to changes in wetland classifications and wetland function have not been correctly quantified and mitigated, resulting in underestimation of the impacts. Based on the information provided, it is not clear to the Panel whether the HGM approach is appropriate for assessing wetland functional loss and mitigation for this project.

Mitigation: The St. Johns Bayou and New Madrid Floodway Project relies on mitigation to compensate for significant impacts on the surrounding area and species due to project construction and operation. Currently the mitigation plan does not account for uncertainty. USACE has proposed an adaptive management approach to account for this uncertainty. However, the Panel believes that insufficient data are being used to develop the plan and therefore the adaptive management plan will not fully compensate for the impacts. Development of the current mitigation plan downplays the importance of ecosystems and uses methods, designs, and studies that are inadequate to determine the amount of mitigation that should be conducted. For instance, part of the shorebird model is used to develop the mitigation plan; however, the mitigation plan does not take into consideration reductions in habitat values due to relatively static water levels reducing the availability of food resources. Part of the mitigation plan is the development of new wetlands; however, the mitigation plan does not take into account the loss of habitat during the time that it will take the new wetland to become fully functioning. Impacts on fish spawning and rearing are based on a study that is limited in scope and average annual habitat units (AAHUs) have been overvalued during transition periods, again resulting in a potential for underestimating the amount of mitigation needed.

Many of the details regarding the environmental models are missing from the appendices. In the mitigation appendix, a reference to the main document is provided, however, the information is not in the main document.

Environmental Modeling: This project relies on a number of models to support the impact assessment. The Panel is not able to determine the adequacy and acceptability of some environmental models because sufficient detail is not provided regarding the methodology and results of modeling used to estimate project impacts and mitigation. For instance, the Panel could not determine whether use of the State of Missouri Stream Mitigation Method (MSMM) to evaluate impacts or mitigation related to ditch alterations is accurate because the methodology and specific application is not well-documented. In other

instances, such as the SPARROW model, 2014 data are released that, if used in place of the 2009 data, would result in a decrease in the significance of the environmental benefits of the authorized project. The current methods are insufficient for evaluating the full range of species in the ecosystems being affected such as reptiles, amphibians, and mussels.

4.2 Final Panel Comments

This section presents the full text of the Final Panel Comments prepared by the IEPR panel members.

Final Panel Comment 1

The adequacy and acceptability of the economic analyses and projections cannot be determined because sufficient information regarding agricultural economic modeling has not been provided.

Basis for Comment

A benefit-cost ratio that is larger than 1 is needed to support the selection of the recommended plan for the St. Johns/New Madrid proposed project. The benefit-cost ratio is estimated to be greater than 1 for the recommended plan, primarily because the economic benefits from the project associated with increases in profits to the agricultural activities in the region are claimed to exceed the project costs. However, the Panel finds it cannot assess the adequacy and acceptability of the economic analyses and projections without more information on the agricultural economic modeling that determines the benefits, which relate to expected future profits for the farmers there. Therefore, the Panel cannot confirm whether the benefit-cost ratio is greater than 1. The Working Final EIS does not include a complete description of the economic empirical model used in forecasting current and future yields and a complete explanation of how profits (total revenue less costs) are determined.

In Appendix B (no page numbers are provided) of the proposed St. Johns/New Madrid proposed project analysis, virtually all statements and conclusions, figures, and assumptions are presented without supporting documentation or explanation, as shown in the following examples:

- At the end of Appendix B (no page numbers are provided), there is a statement and letters that three agricultural economists approved the agricultural economics model in 2006, but details about the economic model that they reviewed at least nine years ago are lacking.
- Appendix B contains 30 tables of numbers, but little or no explanation is given beyond a title for each table. Little or no information is provided in the text as to how the numbers were generated. For example, no explanation is provided for how the ratio of dryland to irrigated farmland is calculated in Table B-1.
- After the Panel requested more information on the agricultural economic model, USACE provided new material in the form of a 22-page pdf document with the file name “Ag. Projections,” but gave no other information, or a document title. Similar to Appendix B of the Working Final EIS, this additional document also contains many tables and numbers, but provides no detailed explanations for the underlying structural economic models that produce the numbers. For example, there is mention of variable “X” in a model, but no definition of what “X” is. There is no mention of any adjustment for serial correlation, which is a very common problem in time series regression, which the Panel assumes is being conducted. Failure to adjust errors in the presence of serial correlation means that the t statistics are flawed.
- Text in Appendix B, coupled with the title of several tables, leads the Panel to assume that there is an empirical time series model that is being used to make the forecast on annual yield for different crops. However, specific details about the structure of the model and data that are important to understanding the model (see Acquaye, Alston, and Pardey, 2003) are missing. Specific details about the structure of the model and data are important to understanding any model of this nature (see Acquaye, Alston and Pardey 2005), including this one for the project. These are needed to

determine if it is an acceptable agricultural production model by standards in agricultural economics in the year 2015. A great deal has changed in the way yields are modeled now (Alston, Beddow, and Pardey, 2009b; Ball et al., 2013), even compared to 2006. The Panel at present is left unsure whether the empirical model is a time series regression, and if so, whether the errors are serially correlated, as they most often are. If they are, it is important to document the autoregressive or corrective structure used to correct for them.

- Several assumptions are made in Appendix B without adequate demonstration of positive benefit-cost ratios:
  (a) agricultural yields/production levels will increase over the life of the project (as indicated for irrigated corn in Table B-4),
  (b) changing weather patterns or climate change will have no impact on the economic analysis, and
  (c) prices and production costs are apparently held constant over the entire period at 2014 price levels.

- Using past data to make future predictions (i.e., forecasting) is fraught with difficulties, and it is well known that future predictions involve great potential errors. The errors get larger the farther into the future the projection is made. There is a debate in the agricultural economics literature that past increased productivity in agriculture may now be slowing down, thus it is unclear whether observed rates of productivity growth over the past 50 years are relevant in predicting what may happen in the future (Sanders et al., 2014; Acquaye et al., 2003; Alston et al., 2009a).

- Assumption (c) above is not entirely consistent with what is listed about production cost in Table B-4. Dividing crop production cost in the table by yield (also given in the table) in the different years in Table B-4 leads to slightly different numbers over time (for example, in year 2014 production cost is 449.27, divided by the agricultural output or yield is 2.49; in year 2059 the numbers are 511/272 = 1.87).

- Farm production costs affect profits; however, there is inadequate justification for why crop-related costs substantially differ in soybean and corn production, and whether this cost differential will remain the same if land is taken out of production of soybeans because of the project's influence on flood and other types of risk. In addition, assumptions about profits are not provided, and it is unclear whether consideration was given to acreage decisions under conditions of risk (Chavas and Holt, 1990). If prices rise or stay constant, this is only partly related to profits, as the other dimension is costs (i.e., profit = total revenue less cost, where the revenue side involves the price).

- Crop or flood insurance, as well as existing U.S. Federal subsidies, may play a role in production for farmers in the region, but there is no way to tell what assumptions about these were made in the modeling. There is apparently former use of, or dependence on, crop insurance in the project region (Olson and Morton, 2013). If so, some modeling of agricultural production under conditions of risk would predict that farmers who are insured would not change their behavior with reduced flooding risk.

- There are other costs associated with the project, but the economic analysis does not provide enough detail about purchase prices for lands used in mitigation, and does not give an adequate

description of the market, including availability of readily purchasable lands, or describe the adaptive management costs over the life of the project.

Significance – High

A positive benefit-cost ratio is largely dependent on the net agricultural benefits, which in turn depends on the underlying models of yield and profits that generate them. If there are important omissions or flaws in the model that is being used, then the St. Johns/New Madrid recommended plan's positive benefit-cost ratio may be over or under estimated.

Recommendations for Resolution

1. Discuss in detail the economic model underlying the agricultural benefits analysis, including all data used in the model.
2. Define all variables used in any empirical model and explain relevant equations that quantify relationships between them. Explain whether tests for serial correlation were conducted in the analysis and if so, what corrections were made.
3. Clarify the role of crop and flood insurance assumed in the agricultural economics model, and explain any assumptions about risk preferences.
4. Clarify and present details about all crop production costs.
5. Itemize all costs row by row (including mitigation and adaptive management) and all benefits for each year of the project, both in nominal and in present value terms.
6. Discuss in text the content of all tables that provide numbers with economic relevance.
7. Clarify assumptions about what generates profits for the agricultural sector, and describe the role of any farm subsidies in the determination of those profits over the long run.

Literature Cited:

Acquaye, A.K., J. Alston, and P.G. Pardey (2003). Post-war productivity patterns in U.S. agriculture: influences of aggregation procedures in a state-level analysis. American Journal of Agricultural Economics 85(1):59-80.

Alston, J.M., J.M. Beddow, and P.G. Pardey (2009a). Mendel vs. Malthus: research, productivity and food prices in the long run. Staff paper, Department of Applied Economics, University of Minnesota, St. Paul. Available online at: https://ideas.repec.org/p/ags/umaesp/53400.html

Alston, J.M., J.M. Beddow, and P.G. Pardey (2009b). Agricultural research, productivity, and food prices in the long run. Science 325:1209-1210.

Ball, E., D. Schmmelpfennig, and S.L. Wang. (2013). Is U.S. agricultural productivity growth slowing? Applied Economic Perspectives and Policy 35(3):435-450.

Chavas, J.P., and M.T. Holt (1990). Acreage decisions under risk: the case of corn and soybeans. American Journal of Agricultural Economics 72(3):529-538.

Olson, K.R., and L.W. Morton (2013). Restoration of 2011 flood-damaged Birds Point – New Madrid Floodway. Journal of Soil and Water Conservation 68(1):13A-18A.

Sanders, D.R., I.J. Altman, and N. Ferraro (2014). Technological advances in soybean yields: a disaggregated approach. Agribusiness 30(2):207-221.

Final Panel Comment 2

The methods used to determine the shorebird habitat value of the mitigation sites in Appendix R are inadequate because they do not consider reductions in habitat value due to relatively static water levels.

Basis for Comment

The model used in Appendix H to determine shorebird habitat value under existing conditions makes reasonable assumptions, applies acceptable methods supported by the literature, and is generally a significant improvement over the Phase 1 approaches to calculating shorebird habitat value in existing flooded and sparsely vegetated areas. However, the methods used to calculate the habitat value of the mitigation sites in Appendix R Part 1 (pp. 19-25) are not adequate. The existing site conditions include natural drawdowns following flooding, which serve to expose areas that were previously flooded and then gradually become available for shorebird foraging. Shorebirds forage intensively on newly exposed shallow areas (Colwell and Landrum, 1996; Colwell, 2010). The methods used to determine the habitat value of the mitigation sites in Appendix R are not appropriate because there is no reduction in habitat value for relatively static water levels, which greatly reduce the availability of invertebrate food sources relative to newly exposed areas following a gradual drawdown. Prey depletion has been shown to occur when shorebirds are concentrated at foraging sites (Schneider and Harrington, 1981; Weber and Haig, 1997). Reduced habitat value from prey depletion should be taken into account when calculating the area required to replace lost habitat value using sites managed to have relatively static water levels over periods of several weeks as proposed. The only adjustment made for habitat value at the mitigation sites in Appendix R is the discount factors associated with water depth from the shorebird model. With relatively static water levels, the same area will be exposed for longer periods, and prey depletion is likely to occur over time, resulting in loss of habitat value and reducing shorebird use of the area.

Although the mitigation plan mentions that water levels can be expected to rise and fall slightly with changes in precipitation during the migration season, these fluctuations are not likely to mimic natural drawdowns, which expose mudflats that have not been previously exposed. The life cycle of benthic invertebrates requires a period of flooding for growth, and they only become available to shorebirds as water levels fall (Colwell, 2010). Reflooding an area for a small period of time will not replace this cycle because it takes time for the invertebrate community to develop (Brown and Batzer, 2001). As shorebirds forage on newly exposed areas, they can deplete the prey items and reduce the quality of the habitat (Schneider and Harrington, 1986). Prey depletion is less likely to occur under natural drawdowns because newly exposed areas with new invertebrates become available (Hamer et al., 2006), and shorebirds concentrate on areas of newly exposed habitat (Colwell and Landrum, 1993). In general, shorebirds concentrate where food sources are abundant (Skagen and Oman, 1996), and their survival is affected by their ability to find adequate stopover habitat on migration (Skagen, 2008).

Shorebird abundance will drop at sites with low abundance of invertebrates, so when food is depleted at the mitigation sites numbers will decrease, and there is no way to compensate for this impact without additional data. It will be impossible to measure whether adequate shorebird habitat has been provided without additional pre- and post-project data, because there are no current data showing actual use of the project area by shorebirds, only the model showing the amount of newly exposed area. Similarly, there are no pre-project data on current abundance of invertebrate food sources. Without these data, it will not be

possible to determine mitigation adequacy as described in the Working Final EIS (p. 291). The proposed hydrology will not be adequate to determine function, so mitigation will likely be inadequate without additional data.

The data necessary to compare existing site conditions with mitigation sites are similar to the data needed to carry out the validation of the shorebird model, and could be collected at the same time. Validation was recommended by the St. Johns Panel in Phase 3, and was also recommended by the Shorebird Model Review Panel in their Final Planning Model Quality Assurance Review Report for the Model Review of the Assessment of Shorebird Habitat within the St. Johns-New Madrid Basins, Missouri (SJNM Shorebird Model) (Battelle, 2011), and validation is mentioned in the Working Final EIS (p. 296) as a proposed risk reduction method, and a plan is described in Appendix H Part 2. If designed appropriately, the validation process could also provide an assessment of current habitat quality that could be used to determine adequacy of mitigation.

Significance – Medium/High

The proposed mitigation sites are unlikely to replace lost shorebird habitat functions, and the proposed methods for measuring function are inadequate to quantify the lost habitat value.

Recommendations for Resolution

1. Measure the existing invertebrate density across a variety of representative sparsely vegetated habitats in the project area, including both shallowly flooded and recently exposed mudflat habitats. (Alternatively, directly measure shorebird use of these areas, and replace measures below with shorebird counts.)

2. Measure invertebrate abundance under the proposed management regimes, and then recalculate the value of the mitigation sites with a factor that compensates for their invertebrate abundance.

3. Increase the proposed mitigation area adequately to compensate for this loss in function, and include an additional amount to manage uncertainty associated with successfully creating and managing wetland habitats.

4. Include ongoing invertebrate abundance measurements of the mitigation sites as part of the adaptive management plan, and increase managed habitat area if needed.

Literature Cited:

Battelle (2011). Final Planning Model Quality Assurance Review Report for the Model Review of the Assessment of Shorebird Habitat within the St. Johns-New Madrid Basins, Missouri. Report Submitted to U.S. Army Corps of Engineers.

Brown, S., and D. Batzer (2001). Birds, Plants, and Macroinvertebrates as Indicators of Restoration Success in New York Marshes. In: Bioassessment and Management of North American Freshwater Wetlands, R.B. Rader, D. Batzer, and S.A. Wissinger, Eds. New York: John Wiley and Sons, Inc., pp. 237-248

Colwell, M.A., and S.L. Landrum (1993). Nonrandom shorebird distribution and fine-scale variation in prey abundance. The Condor 95(1):94-103.

Colwell, M.A. (2010). Foraging Ecology and Habitat Use. In: Shorebird Ecology and Management. Berkeley: University of California Press, pp. 131-157.

Hamer, G.L., E.J. Heske, J.D. Brawn, and P.W. Brown (2006). Migrant shorebird predation on benthic invertebrates along the Illinois River, Illinois. The Wilson Journal of Ornithology 118(2):152-163.

Schneider, D.C. and B.A. Harrington (1981). Timing of shorebird migration in relation to prey depletion. Auk 98:801–811.

Skagen, S.K., and H.D. Oman (1996). Dietary flexibility of shorebirds in the Western hemisphere. Canadian Field-Naturalist 110(3):419-444.

Skagen, S.K. (2006). Migration stopovers and the conservation of Arctic-breeding calidridine sandpipers. Auk 123(2):313-322.

Weber, L.M., and S. M. Haig. (1997). Shorebird-prey interactions in South Carolina coastal soft sediments. Canadian Journal of Zoology 75:245-252.

Final Panel Comment 3

Impacts on HGM wetland function as a result of changes to wetland classification caused by reducing hydrologic activity have not been correctly quantified and mitigated.

Basis for Comment

In the HGM, USACE makes the implicit assumption that no decline in function occurs when the wetland classification changes from, for example, low gradient riverine backwater (LGRB) to Flat due to reduced hydrologic activity (Appendix E, Part 4). As Klimas et al. (2011) state, “Subtle differences in terrain and water movement result in distinctly different functions being performed by wetlands that are in close proximity to or contiguous with one another.” Additionally, Klimas et al. p. 132 state “Rather, all connected wetlands are assumed to be fully functional with regard to the *VFREQ* variable unless there has been a change in flood frequency, and any such change, whether more or less frequent, will have adverse effects on the wetland communities and processes currently in place.” Appendix E, Part 4 (p. 2) states: “Because each variable is calibrated separately for each subclass, functional comparisons across subclasses cannot be made quantitatively, though they can be addressed qualitatively.”

By assuming that two wetlands provide similar functions because their average Functional Capacity Indices (FCIs) are equivalent, it appears that USACE is doing what they explicitly state above as being inappropriate. For example, 1,000 acres of LGRB with an FCI of 0.89 would produce 890 Functional Capacity Units (FCUs); if those 1,000 acres were converted to Flat with an average FCI of 0.89, the habitat would still count as 890 FCUs, requiring no mitigation.

However, as Klimas et al. (2011) state, changes in hydrology have tremendous impacts on wetland productivity (plant growth and production of resources for wildlife) and decreases in hydrologic activity decrease wetland productivity. Clearly, as documented in the USACE HGM manual, reducing hydrologic activity to a level that changes the wetland classification (e.g., LGRB to Flat) will have detrimental impacts to the function of those wetlands and those impacts need to be quantified and mitigated.

Significance – Medium/High

Not accounting for wetland function loss due to wetlands changing classification leads to an underestimate of project impacts and mitigation needs.

Recommendation for Resolution

1. Develop an alternative approach to the HGM with other Federal agencies such as the U.S. Environmental Protection Agency (U.S. EPA) and U.S. Fish and Wildlife Service (USFWS) to estimate resource losses either quantitatively or qualitatively to account for losses in wetland function for wetlands that change classification due to the project and mitigate appropriately for those losses.

Literature Cited:

Klimas, C.V., E.O. Murray, J. Pagan, H. Langston, and T. Foti. 2011. A regional guidebook for applying the hydrogeomorphic approach to assessing functions of forested wetlands in the Delta Region of Arkansas, Lower Mississippi River Alluvial Valley. US Army Engineer Research and Development Center, Vicksburg, Mississippi. (certified revision of ERDC/EL TR-04-16).

Final Panel Comment 4

The design of a stable water management plan for mitigation of waterfowl resource impacts will lead to inadequate mitigation of waterfowl resources.

Basis for Comment

Dabbling ducks require water levels less than 15 inches deep to gain access to most foods found at the bottom of a wetland. The plan for mitigating waterfowl habitat loss calls for relatively static water levels (varying by plus or minus 1 foot) at floodgates throughout the winter and spring, with an unknown proportion of the wetlands at a depth unusable by dabbling ducks (i.e., greater than 15 inches). Stable water levels will provide usable resources only in areas around the periphery of the habitat, leading to inadequate mitigation of waterfowl resources.

Significance – Medium/High

The current management of habitat designed to mitigate waterfowl resource impacts will be inadequate to mitigate waterfowl resource losses.

Recommendation for Resolution

1. Mitigate waterfowl resources at a greater than 1:1 ratio or manage the hydrology on wetlands designed for waterfowl resources in a way that provides greater fluctuation in water levels.

Final Panel Comment 5

The potential for economic impacts from climate change in future years (e.g., 2069) has apparently not been considered in projecting future crop yields.

Basis for Comment

The economic projections appear to assume no impacts of climate change for future years as far into the future as the year 2069 and this may inappropriate. The Panel cannot tell for sure if projections include climate change impacts because insufficient detail about the forecasting model of agricultural yield has been provided. However, as Appendix B (no page numbers are provided) does not mention incorporating weather variables into any model of yield, it appears unlikely that any climate change impacts are being considered.

By roughly mid-century (2040) the low International Panel on Climate Change (IPCC) scenario has the Missouri region experiencing hotter temperatures (by about 2-3 degrees Fahrenheit) and the high IPCC scenario predicts 5 degree Fahrenheit increases in average temperature. To continue to maintain crop production yields or increase them under higher temperatures will require increased irrigation unless average precipitation also increases. Summers in the St. Johns/New Madrid proposed project area are predicted to be drier in the future, not wetter.

Economists have been estimating crop yield models with weather variables as factors for more than 20 years (Dixon et al., 1994). Mean yields are very likely to change under climate change scenarios and agricultural land values may change (Deschenes and Greenstone, 2007), and there is more variability in crop yields expected (Chen et al., 2004). New crop yield models strongly indicate that there are highly nonlinear effects of temperature (Schlenker and Roberts, 2009). Missouri region summers are predicted to be more than 5% drier, but winters are predicted to be wetter and cooler. These predictions should be factored into an agricultural production analysis. Despite uncertainty and a lack of precision regarding some of the specific impacts of climate change and global warming on agriculture, scientists appear to be agree that climate variability (including large fluctuations in temperature, precipitation, and storm events) will be much greater in the future.

If yields fall in much of the corn and soybean belt and other factors do not change, prices for these agricultural commodities could actually increase. However, profits (revenue less costs) may also fall if costs such as regional irrigation increase and commodity prices do not rise sufficiently to cover cost increases. Fisher et al. (2012) predicts that overall, the average U.S. farmer will be worse off in the future because of global warming, not better off, particularly in farming areas that already, or will in the future, require irrigation.

Significance – Medium/High

Profits in the agricultural sector in the region are what is driving the positive benefit-cost ratio, and profits could be much smaller under climate change scenarios, hence the benefit-cost ratio could change a great deal upon factoring in adverse impacts from global warming.

Recommendations for Resolution

1. Clarify whether agricultural yield models for future years are factoring in climate and/or weather

variables.

2. Clarify the current role of irrigation throughout the region, and how much dependence on irrigation water may increase with future increases in temperature.

3. Expand the uncertainty analysis to allow for very large differences in estimates of profit that may be due to adverse climate change impacts, presuming that the current model used does not factor in weather and climate impacts.

Literature Cited:

Chen, C., B.A. McCarl, and D.E. Schimmelpfennig (2004). Yield variability as influenced by climate: a statistical investigation. Climatic Change 66:239-61.

Deschenes, O., and M. Greenstone (2007). The economic impacts of climate change: evidence from agricultural output and random fluctuations in the weather. American Economic Review 97(1):354-85.

Dixon, Bruce L., et al. (1994). Estimating corn yield response models to predict impacts of climate change. Journal of Agrcultural. and Resource Economics 19(1):58-68.

Fisher, A. C., W.M. Hanemann, M.J. Roberts, and W. Schlenker (2012). The economic impacts of climate change: evidence from agricultural output and random fluctuations in weather: comment. The American Economic Review 102(7):3749-3760.

Schlenker, W., and M.J. Roberts (2009). Nonlinear temperature effects indicate severe damages to US crop yields under climate change. Proceedings of the National Academy of Sciences 106(37):15594-15598.

Final Panel Comment 6

The mitigation does not appear to be annualized and therefore does not account for the period of time required for functions of mitigation wetlands to fully develop.

Basis for Comment

For the purposes of this document, the Panel defines annualization of mitigation as accounting for the fact that a number of years are required for a newly developed wetland to function at the level of a mature wetland. Although the text (e.g., Appendix O, p.2; Appendix E, Part 4, throughout; Appendix R, p. 1) indicates in many areas that mitigation is annualized and cites an appendix (e.g., Appendix M Part 1) for details, none of the cited appendices provides details as to how the annualization was conducted. Furthermore, although the lack of detail in the description of mitigation makes it difficult to assess, it does not appear as though annualization of the mitigation occurred.

Mitigation needs to be annualized to account for the fact that newly established forested habitat would require 20 years to produce even limited functions, such as mast from trees, and will only become mature and produce maximum levels of mast near the end of the project period (Appendix F). Furthermore, although other wetlands types require less time than forested habitat, new established wetlands of other types will likely need 5 to 7 years and may never fully function (Moreno-Mateos et al., 2012). Not annualizing mitigation will result in an underestimate of total mitigation acreage.

Significance – Medium/High

Not annualizing wetland mitigation will lead to an underestimate of the mitigation requirements.

Recommendations for Resolution

1. Provide estimates of the number of years required post-establishment for mitigation wetlands to reach their maximum functioning and clearly document how they were used to estimate required mitigation.

2. Develop a mitigation ratio greater than 1:1 to account for the uncertainty in mitigation project success and lack of function that occurs between the time the wetlands are established and the time they reach their peak functional capacity.

Literature cited:

Moreno-Mateos D, Power ME, Comín FA, Yockteng R (2012) Structural and Functional Loss in Restored Wetland Ecosystems. PLoS Biol 10(1): e1001247.doi: 10.1371/journal.pbio.1001247

Final Panel Comment 7

Relying solely on the HGM Guidebook to select the six wetland functions used in the HGM model appears to have resulted in significant ecosystem functions and services not being included.

Basis for Comment

The USACE's HGM Regional Guidebook for a region of the Lower Mississippi River Basin (Klimas et al., 2011, given in Working Final EIS, Appendix E, Part 3) was used as the model for the HGM evaluation of this project. The HGM analysis for the St. Johns/New Madrid site is described in Working Final EIS Appendix E, Part 4. Wetlands in the study site were first grouped into regional subclasses: Low Gradient Riverine Backwater (LGRB), Low Gradient Riverine Overbank (LGRO), and Connected Depressions. The six wetland functions used in this EIS's HGM analysis are (quotes are from Klimas et al., 2011):

- **Detain Floodwater** ("the ability of wetlands to store, convey, and reduce the velocity of floodwater as it moves through a wetland"),
- **Detain Precipitation** ("the capacity of a wetland to prevent or slow runoff of rainfall to streams"),
- **Cycle Nutrients** ("the ability of the wetland to convert nutrients from inorganic forms to organic forms and back through a variety of biogeochemical processes such as photosynthesis and microbial decomposition"),
- **Export Organic Carbon** ("the capacity of the wetland to export dissolved and particulate organic carbon, which may be vitally important to downstream aquatic systems"),
- **Maintain Plant Communities** ("the capacity of a wetland to provide the environment necessary for characteristic plant community development and maintenance"; FCI includes six variables related to trees, soil, and hydrology), and
- **Provide Habitat for Fish and Wildlife** ("the ability of a wetland to support the fish and wildlife species that utilize wetlands during some part of their life cycles"; FCI includes 12 variables on physical structure of forested wetlands).

The FCIs for the St. Johns/New Madrid were estimated from the models in Klimas et al. (2011) and from data collected at 61 plots in 20 wetland assessment areas. The overall FCU was calculated for each subclass and each function by:

$$\text{FCI} \times (\text{wetland subclass area}) = \text{FCU}.$$

The Panel believes that relying on this agency-published guideline report (Klimas et al., 2011) and the use of these six wetland functions in the HGM analysis is flawed based on the following examples:

- It does not appear that carbon sequestration, a newly recognized yet vitally important ecosystem service, was included in the functions used. In fact, carbon sequestration means that the carbon is retained in the wetlands. This function is the opposite of carbon export in which the carbon leaves the wetland. The carbon export function is valued by some as the basis for the Mississippi River food chain. It is viewed by others as biological oxygen demand and pollution to the Mississippi River. When a wetland has high carbon export, it often has lower carbon sequestration.
- The function of "providing habitat for fish and wildlife" is too broad and based on mostly abiotic variables. Furthermore, some functions, e.g., detaining floodwater and providing habitat, overlap, yet in the analysis they are treated as independent functions and are added, thereby duplicating functions.

- Most of the FCIs, which are supposed to mean function, are almost entirely calculated from measures of structure in the forested wetlands.

To assess the usefulness of the HGM in "quantifying" a comparison of alternatives, the Panel reviewed the published literature and found only 14 peer-reviewed papers with "HGM" or related in their titles in the literature of the last 20 years. The most recent was Gebo and Brooks (2012); one of the earliest is Rheinhardt et al. (1997). Almost all of the papers were published in one journal—*Wetlands*. In a review paper of the HGM process entitled "HGM and wetland function assessment: six degrees of separation from the data?" (Cole, 2006) agrees with the Panel that function is not included in the structural indices used in the HGM process and furthermore concludes that the burden of proof on linking function to structure should be on the project advocate (e.g., USACE) and not on the regulatory community (in this case the U.S. EPA):

> *It is critical to begin to develop a research agenda that will address the relationships of structural indicators to actual function. How is soil organic matter related to nitrogen cycling? What is the relationship of percent cover of trees and shrubs to the storage of floodwater? Is there any way to assess ''characteristic hydrology'' through simple classification?...How does the presence of stressors on or near a site impact site hydrology or nutrient cycling or (for that matter) duck production? We cannot yet answer these basic questions except through our best professional judgment (BPJ). Yet we should be able to say to a permit applicant that a proposed mitigation site must have X % soil organic matter because that is what will be needed to replace the nitrogen cycling function in the impacted site.* ***The burden should be put upon the permittee to explain why that is or is not feasible, not upon the regulatory community to try and justify their best guess.***

Significance —Medium/High

The HGM analysis in this Working Final EIS is the "cross-road" calculation that attempts to take into account almost all of the main topics—wetlands, wildlife, fisheries, mitigation ratios, economics, cumulative impact, downstream impacts, etc.—yet it seems to be missing significant ecosystem functions, overlapping in others, and contradictory in others such that the method and especially the quantification of functions are inherently flawed.

Recommendations for Resolution

1. Assess the net loss of wetlands and the required mitigation with a simpler model that takes into account the ecosystem functions lost per each type of ecosystem lost, and that estimates the required mitigation using mitigation ratios that reflect the uncertainty of the mitigation, (e.g., high mitigation ratios for uncertain mitigations).

2. Begin an Agency-level evaluation of developing a much simpler and transparent methodology for estimating the loss of wetland function.

3. Begin a program of actually measuring function, e.g., net primary productivity, carbon accumulation, hydroperiods and flood pulses, nutrient retention, etc. in wetlands at this and future sites.

Literature Cited:

Cole, C.A. (2006). HGM and wetland function assessment: six degrees of separation from the data? Ecological Indicators 6:485-493.

Gebo, N.A., and R. P. Brooks (2012). Hydrogeomorphic (HGM) assessments of mitigation sites compared to natural reference wetlands in Pennsylvania. Wetlands 32: 321-333.

Klimas, C.V., E.O. Murray, J. Pagan, H. Langston, and T. Foti (2011). A regional guidebook for applying the hydrogeomorphic approach to assessing functions of forested wetlands in the Delta Region of Arkansas, Lower Mississippi River Alluvial Valley. U.S. Army Engineer Research and Development Center, Vicksburg, Mississippi (certified revision of ERDC/EL TR-04-16).

Rheinhardt, R. D., M. M. Brinson, and P. M. Farley (1997). Applying wetland reference data to functional assessment, mitigation, and restoration. Wetlands 17:195–215.

Final Panel Comment 8

The HGM model does not account for habitat losses to other wildlife that are not assessed in the other environmental models, therefore, the total loss of function associated with the project is not being evaluated.

Basis for Comment

The HGM model assumes no value to fish and wildlife in inundated previously converted wetlands or farmed wetlands, thus, not all fish and wildlife functions lost due to project impacts are being counted leading to an underestimate of project impacts and needed mitigation. This is primarily because the parameters used to describe fish and wildlife function in the HGM are those relevant to describing functions of forested habitat with little relevance to farmed or previously converted wetlands. While some of the losses to function for wildlife are accounted for in the terrestrial wildlife, waterfowl, shorebird, and fish models, losses of values to other wildlife, such as reptiles and amphibians, wading birds, and least terns remain unaccounted for in any of the models. For example, least terns, as well as wading birds other than blue herons, likely consume small fish and macro-invertebrates found in inundated, previously converted wetlands, farmed wetlands, and other remaining wetlands.

Significance – Medium/High

Not explicitly accounting for loss of resources to reptiles, amphibians, wading birds other than blue herons, and least terns leads to an underestimate of project impacts and required mitigation.

Recommendation for Resolution

1. Quantify the loss of wildlife functions associated with farmed and previously converted wetlands not accounted for with the waterfowl, shorebird, fish, and terrestrial wildlife models and mitigate these losses.

Final Panel Comment 9

It is not clear how the pre-project estimates and post-project predictions for assessing the Provide Habitat for Fish and Wildlife function in the HGM were derived and whether the parameters not directly associated with hydrology change from pre- to post-project can be predicted.

Basis for Comment

USACE assumes only a minor decline in FCIs for wetlands that remain in the same wetland class after the authorized project is completed. Although the lack of detail provided in any of the reference material (e.g., Appendices E, F, M, O, and R) makes it very difficult to determine how the HGM modeling was conducted, results in Appendix E, Part 4, based on the limited level of detailed text, appear to underestimate functional loss for the Cycle Nutrients, Export Organic Carbon, Maintain Plant Community, Provide Habitat for Fish and Wildlife Functions. For example, the model for assessing the Provide Habitat for Fish and Wildlife function in the HGM includes the following assessment variables, which are missing important details to explain how they are estimated:

- VFREQ = change in frequency of flooding. This variable can be predicted, but no value for this parameter was provided.
- VDUR = change in growing season flood duration. This variable can be predicted, but no value for this parameter was provided.
- VPOND = microdepressional ponding. This variable can be predicted, but no value for this parameter was provided.
- VTCOMP = tree composition. It is not clear how this variable can be predicted for post-project modeling.
- VSNAG = snag density. It is not clear how this variable can be predicted for post-project modeling because no details are provided.
- VSTRATA = number of vegetation layers. It is not clear how this variable can be predicted for post-project modeling because no details are provided.
- VTBA = tree basal area. It is not clear how this variable can be predicted for post-project modeling because no details are provided.
- VLOG = log density. It is not clear how this variable can be predicted for post-project modeling because no details are provided.
- VOHOR = O horizon thickness. It is not clear how this variable can be predicted for post-project modeling because no details are provided.
- VTRACT = wetland tract size. It is not clear how this variable can be predicted for post-project modeling because no details are provided.
- VCONNECT = habitat connections. It is not clear how this can be estimated for post-project

modeling because no details are provided.

- VCORE = core area. It is not clear how this can be predicted for post-project modeling because no details are provided.

There was no text indicating how USACE estimated how the changes in hydrology would affect these variables and no justification for the values used.

Significance – Medium/High

Without more detail as to how the parameter predictions were developed, it is not possible to determine if the parameter predictions are appropriate. Inappropriate predictions could lead to dramatically under- or overestimates of the required mitigation.

Recommendations for Resolution

1. Provide justification for post-project predictions for the above parameters.
2. At a minimum, a mean, standard deviation, and range of values for the above parameters should be provided for both the pre-project estimates and post-project predictions. The Panel recommends an appendix containing the actual field data sheets be provided for the pre-project analysis, with a detailed methodology as to how the data were collected.

Final Panel Comment 10

The data collected for the HGM FCIs appear to be inadequate because they are based on a very small percentage of the project area and were collected during the driest time of the year.

Basis for Comment

To reduce resources necessary for estimating a parameter or characteristic of a large population or area, random sampling is often used. The size of the sample influences both the precision and potential bias associated with the estimate derived from that sample. Determining the appropriate sample size typically requires an *a priori* objective of the desired level of variance associated with the sample estimate and a previously identified risk level for bias. Preliminary data is often used to determine how much variation occurs in the system and a statistical power analysis is conducted to determine the adequate sample size needed to minimize potential bias and achieve desired precision in the sample estimate. An alternative to collecting preliminary data and conducting a power analysis would be to use Klimas et al. (2011) recommend sample size:

> "If the WAA is relatively small (i.e., less than 2–3 acres, or about a hectare) and homogeneous with respect to the characteristics and processes that influence wetland function, then three or four 0.04-ha plots, with associated nested transects and subplots in representative locations, are probably adequate to characterize the WAA." (Klimas et al., 2011).

For the analysis on the project, the USACE used data from 61 plots (plot sizes are not provided) on 20 Wetland Assessment Areas (WAAs). If the Panel assumes three plots on each WAA, based on the HGM manual, then each WAA was approximately 1 ha in size. This means the USACE is basing its HGM modeling process on about 20 of the approximately 5,665 ha of wetlands in the project area or 0.35%. Klimas et al. recommend that approximately 2.6% of a 12 hectare WAA be sampled.

Additionally, data collection for the FCIs in the HGM was conducted in September, the driest time of the year in this region, thus monitors had a very limited ability to identify puddled areas or temporary wetlands.

The small sample size used by the USACE to estimate the various FCIs for the HGM are too small to precisely estimate the FCIs for the region and the timing of the data collection (September) will lead to very biased estimates.

Significance – Medium/High

Increasing sample size may dramatically alter the estimates of wetland impacts, modifying the estimates of mitigation needs.

Recommendations for Resolution

1. Sample at least 4% of each wetland type because among wetland variation is likely greater than within wetland variation. Additionally, care should be taken to ensure that the sample is representative of all the wetlands in the project area by weighting sampling by distributing sampling throughout the entire project area and weighting sampling relative to the total acreage of each wetland class.

2. Conduct sampling during April or May when wetlands are most inundated.

Literature Cited:

Klimas, C.V., E.O. Murray, J. Pagan, H. Langston, and T. Foti (2011). A regional guidebook for applying the hydrogeomorphic approach to assessing functions of forested wetlands in the Delta Region of Arkansas, Lower Mississippi River Alluvial Valley. U.S. Army Engineer Research and Development Center, Vicksburg, Mississippi (certified revision of ERDC/EL TR-04-16).

Final Panel Comment 11

The mitigation plan is not based on sufficient data to ensure that the adaptive management plan can fully manage uncertainty.

Basis for Comment

During the Phase 3 IEPR, the Panel observed that it was unclear if the proposed mitigation plan would compensate for impacts on environmental resources because the models did not incorporate uncertainty. It was then recommended that one of two approaches be used to manage the risks associated with the uncertainty in both the environmental models used to measure current conditions and the amounts of mitigation required to replace lost functions. The Panel recommended either (1) using variance estimates around model parameters and outputs, or (2) increasing mitigation ratios to compensate for potential future risks of loss of function. Appendix S addresses the Phase 3 IEPR recommendation (p. 5-7), and states that variance estimates are not practical and that mitigation ratios will not be increased. It suggests instead that adaptive management will be used to ensure full mitigation for lost function.

Without some estimate of the variability around modeled levels of wildlife and ecosystem function, however, there is no way to know how much function is at risk of being lost. Measurements of existing functions and values are likely to be imprecise, particularly when using qualitative measures. As Smith et al. (2014) pointed out in an applied study of adaptive management, “it is important to incorporate uncertainty into the decision framing and evaluate the effect of reducing that uncertainty on achieving the desired outcomes.” Many aspects of the mitigation plan, including fish habitat, waterfowl habitat, wetland ecosystem function, and shorebird habitat, use models with unknown precision to estimate current function. Without a measure of uncertainty around these estimates, it is impossible to know how accurate they are. This creates uncertainty in determining whether impacts have been fully mitigated.

USACE states (Appendix S, p. 6) that uncertainty is equally likely to result in over- mitigation and under-mitigation of function. The literature on evaluation of mitigation suggests that considerable uncertainty results from potential failure of mitigation sites, and the successful creation and management of mitigation sites is uncertain. It is common for mitigation sites to underperform compared to planned levels of function (Brown and Veneman, 2001; Kihslinger, 2008; Hill et al., 2013). A summary of published measured regulatory success rates (in Hill et al., 2013) documented a range of 18 to 69%, with an average of 48%. The lack of certainty about both current levels of functions and the likelihood of successful replacement is a significant risk with the implementation of mitigation plans.

USACE proposes to use adaptive management to manage uncertainty. Adaptive management can be an effective tool when the data required to measure levels of function are available, but requires quantitative data to guide adjustments in mitigation strategies. It is unclear how USACE will adaptively manage the uncertainty around measures of existing function or levels of function achieved in mitigation sites, since there are limited data proposed to be collected on direct measures of function, only the point estimates of the models for existing conditions and indicators of success for mitigation sites like replacement of hydrology.

It is common practice in wetland mitigation to increase acreage of mitigation sites to accommodate this risk. For example, Maryland uses ratios from 1:1 to 4.5:1 depending on the relative values of the types of wetland being impacted and replaced (see the link below), and a similar approach should be used here.

According to Mitsch and Gosselink (2015),

> "Considerable controversy exists, for example, in the United States, on the question as to whether wetland loss can be mitigated successfully or if it is essentially impossible (NRC, 2001). Robb (2002) reviewed several years' efforts on mitigating wetland loss in Indiana and suggested, based on failure rates of various wetland types, that there should be these mitigation ratios: 7.6:1 for wet meadows, 3.5:1 for forested wetlands, 1.2:1 for freshwater marshes, and 1:1 for open-water systems."

Wetland mitigation projects have frequently been shown to have a high likelihood of not replacing lost functions, and increased mitigation ratios are widely recommended to help address this risk.

Significance – Medium/High

Uncertainty about current levels of function and success rates of mitigation could lead to significant under-mitigation if current functions are underestimated, or if mitigation plans do not replace lost functions.

Recommendation for Resolution

1. Increase proposed mitigation levels for wildlife and ecosystem function to provide a buffer against both underestimation of current function, and failure of mitigation sites to achieve full planned function.

Literature Cited:

Brown, S., and P. Veneman (2001). Effectiveness of compensatory wetland mitigation in Massachusetts, USA. Wetlands 21(4):508-518.

Hill, T., E. Kulz, B. Munoz, and J.R. Dorney (2013). Compensatory stream and wetland mitigation in North Carolina: an evaluation of regulatory success. Environmental Management 51(5):1077-1091.

Kihslinger, R.L. (2008). Success of wetland mitigation projects. National Wetlands Newsletter 30(2):14-16.

Mitsch, W.J., and J.G. Gosselink (2015). Wetlands, 5th ed. John Wiley & Sons, New York. 472 pp.

Mitigation ratios from Maryland (examples): http://www.mde.state.md.us/programs/Water/WetlandsandWaterways/Regulations/Pages/programs/waterprograms/wetlands_waterways/regulations/mitigation.asp

National Research Council (2001). Compensating for Wetland Losses under the Clean Water Act. National Academy Press, Washington, DC. 158 pp.

Robb, J.T. (2002). Assessing wetland compensatory mitigation sites to aid in establishing mitigation ratios. Wetlands 22:435-440.

Smith, D.R., C.P. McGowan, J.P. Daily, J.D. Nichols, J.A. Sweka, and J.E. Lyons (2013). Evaluating a multispecies adaptive management framework: must uncertainty impede effective decision-making? Journal of Applied Ecology 50(6):1431-1440.

Final Panel Comment 12

Cumulative impacts on shorebird habitat are not adequately considered because it is assumed that wildlife can relocate if habitat is lost.

Basis for Comment

Cumulative impacts on shorebird habitat are not adequately considered in Appendix R. USACE suggests in Appendix R (pp. 23-24) that shorebirds can move elsewhere in response to project impacts, and uses this argument to justify why mitigation will not be proposed for losses in shorebird habitat resulting from mitigation measures proposed to offset other wildlife habitat losses.

The ongoing losses of wildlife habitat from project impacts across the landscape are the reason that environmental impact analyses are required to include consideration of cumulative impacts. It is apparent that habitat losses are likely contributing to declines in shorebird populations, and that the lack of appropriate habitats is a major driving force in ongoing declines (Brown et al., 2001; Skagen, 2006).

It is not sufficient to say that shorebirds or other wildlife can go elsewhere after habitat is lost. This is why the lack of mitigation for loss of shorebird habitat when sparsely vegetated areas are reforested to account for other project impacts continues to be of concern to the Panel. Mitigation is intended to compensate for all unavoidable significant impacts, and cumulative losses are an important part of the project impacts.

The Panel continues to maintain that mitigation plans should ensure pre-project wildlife and ecosystem functions are replaced by post-project mitigation, with a plan in place to measure function and provide assurance it will be achieved.

Significance – Medium/High

If post-project habitat values are not equal to or greater than pre-project habitat values, and the project adds to the cumulative loss of wetland habitats, it will result in a net loss of function, and avoiding this situation should be the goal of the mitigation plan both as a whole and with respect to specific groups of wildlife. This issue applies not just to shorebird habitat, but also to the overall mitigation plan approach.

Recommendations for Resolution

1. Ensure that the mitigation plan replaces all wildlife habitat and ecosystem function losses resulting from the project, and does not require wildlife to relocate to other areas.

2. Measure achieved functions to ensure they adequately replace lost functions, and increase mitigation through the adaptive management process as needed.

Literature Cited:

Brown, S., C. Hickey, B. Harrington, and R. Gill, eds. (2001). The U.S. Shorebird Conservation Plan, 2nd Edition. Manomet Center for Conservation Sciences, Manomet, Massachusetts. 62 pp.

Skagen, S.K. (2006). Migration stopovers and the conservation of Arctic-breeding calidridine sandpipers. Auk 123(2):313-322.

Final Panel Comment 13

Fish spawning and rearing impacts and associated mitigation may be underestimated due to the limited scope of the fish passage study conducted for the St. Johns Bayou Basin and New Madrid Floodway.

Basis for Comment

As presented in the Working Final EIS, this study demonstrated fish passage by 13 of 14 species (93%) and 29 of 85 tagged individuals (34%) through the St. Johns' gate structure, which was open for 34% of the time from tagging (14 April) to the end of the spawning season (30 June). All species and all individuals passed into and out of the open New Madrid Floodway. Species passage (93%) and gate-adjusted individual passage (66%) was averaged, creating a fish passage coefficient (0.73) that was used to adjust AAHUs.

As conducted this study is limited in its decision-making application for assessing impacts and mitigation due to the limited data obtained. This study does not evaluate:

- Multiple years and timeframes/species outside of the April to June spawning rearing periods. A study conducted over multiple years will provide estimates of annual variation and 95% confidence limits for the fish passage coefficient. Fish passage estimates prior to and during the early spawning and rearing timeframe are needed to provide a more complete understanding of fish access restrictions for the St. Johns Bayou Basin and New Madrid Floodway.
- The influence gate operation has on fish passage due to annual river stage variation and project alternatives. Gate operation timing will vary annually due to annual river stage variation and project alternatives will create different fish access restrictions that have not been assessed.
- The relation between river stage and passage. This relation is important because the assumption that adequate passage can take place during proposed operational gate openings is not independent of the river stage, as demonstrated in the fish passage study.
- There is no supporting evidence that adjusting AAHUs compensates for reduced fish passage or that averaging species and individual passage generates an appropriate adjustment factor.

Significance – Medium/High

A more comprehensive understanding of fish passage impacts on fish spawning and rearing is needed to determine if mitigation is possible and to improve mitigation planning and evaluation.

Recommendations for Resolution

1. Conduct multi-year studies that include all spawning and rearing seasons to assess passage reduction and its effect on recruitment within the New Madrid Floodway.
2. Simulate fish passage reduction based on proposed gate operations and river stage.
3. Provide detailed mitigation plans and adaptive management alternatives that can be implemented if fish passage reduction is found to influence fish recruitment.

Final Panel Comment 14

The impacts on and mitigation planning for fish spawning and rearing habitat have not been adequately quantified due to AAHUs being overvalued during the transition periods.

Basis for Comment

Quantifying the impacts on fish spawning and rearing habitat and achievable mitigation is critical. The impact on fish spawning and rearing habitat was measured by subtracting future with-project average annual habitat units (AAHUs) from future without-project average AAHUs. Increasing HSI value by changing habitat type will increase habitat units (HUs) and is a mitigation strategy. In addition, habitat transition time to achieve full habitat suitability index (HSI) value is important to consider in AAHU calculations and has been included in the Working Final EIS. However, since cumulative HUs use an average HSI value during transition time and cumulative HUs are averaged over 50 years, mitigation will not offset impacts during a significant portion of the 50-year project period. This delay in ecosystem function as fish spawning and rearing habitat (HSI value) and impact on achievable mitigation has not been assessed or discussed in the Working Final EIS.

Significance – Medium/High

Since gate and pumping operations are not to be initiated prior to mitigation, HSI transition times will significantly extend initiation of gate and pumping operations because mitigation will not be achieved during the transition.

Recommendations for Resolution

1. Increase mitigated AAHUs by using the upper 95% confidence limits rather than the averages, and increase the ratio of mitigation AAHUs to impact.

2. Develop a cumulative HU equation that is not based on the average HSI value over the transition period to quantify mitigation, but overcompensates HUs and mathematically shortens the transition period.

3. Design research and monitoring studies that evaluate fish spawning and rearing habitat use and success to determine appropriate transition time and HSI value increase through the transition periods.

Final Panel Comment 15

The dates and the water levels used in the various scenarios of the waterfowl analysis (Appendix F) are not consistent with those in the recommended plan.

Basis for Comment

According to recommended plan in the Working Final EIS (p. xv and elsewhere) the water levels will be managed between 15 November and 28 February for wintering waterfowl and 1 March to 15 April for spring waterfowl, whereas according to Appendix F (p. 8) Duck use Days for February and March will be combined. Given the difference in the dates and time periods, it is not clear how USACE can estimate the appropriate impact and mitigation needs.

Significance – Medium

Modifying the waterfowl model so it is aligned with the dates in the Working Final EIS may substantially modify the mitigation estimates.

Recommendations for Resolution

1. Fix the discrepancy between the dates in the Working Final EIS and Appendix F so they are consistent.

2. Rerun the waterfowl model so the dates and water levels align appropriately with those of the Working Final EIS.

Final Panel Comment 16

The overall assessment of the flood pulse and statements throughout the Working Final EIS suggesting that there is little to no value associated with river connectivity or flood pulse for environmental resources in the floodways are not well supported.

Basis for Comment

While the Working Final EIS recognizes the importance of flood pulsing on floodplain ecosystem function by citing Junk et al. (1989) (and only that reference) 13 times, the Panel believes that change in flood pulsing, even though the floodplain is already heavily impacted, could be one of the most important changes that this project would have for fish, wildlife, and wetlands. Although river connectivity and floodplain habitat have been highly altered in the New Madrid Floodway, the flood pulse is still ecologically functioning and is important to the Mississippi River floodplain ecosystem (Phelps et al., 2015). The HGM model, used for comparing the impact of the alternatives on wetlands, differentiates between flooding inputs from adjacent landscapes and precipitation inputs directly to the wetland, but appears to be incapable of quantifying the importance of these flood pulses to the ecological health of the forested wetlands. In addition, the EnviroFish model was not used to estimate historic fish rearing and spawning habitat Average Annual Habitat Units (AAHUs) because of changes to the flood pulse. The text provides assumptions about Average Daily Flooded Acres (Working Final EIS page 172), without a clear understanding of how this was calculated since the flood pulse is not the same as during the period of record.

Furthermore, there is little mention of potential nutrient capture of riparian wetlands from a naturally flooding river (except in the title of Appendix B, Part 1) despite the significant amount of literature on floodplain nutrient retention by backwater floodplain wetlands when they are connected to rivers (e.g., Fink and Mitsch, 2007; Mitsch et al., 2008). Appendix I emphasizes the export of nutrients and sediments for the alternatives, but water quality improvement by floodplain wetlands, including bottomland hardwood forests, is not based on their export but more on net retention of nutrients from natural flood pulsing.

Significance – Medium

Recognition and research/monitoring of the ecological importance of the existing altered flood pulse and the ecological benefits associated with the rare use of the Birds Point New Madrid Floodway (Phelps et al., 2015) would provide a more realistic overview of the St. Johns Basin and New Madrid Floodway.

Recommendation for Resolution

1. Establish a research and monitoring program to estimate quantitatively the floodwater and nutrient retention (or export) of the Big Oak Tree State Park reflooding. It could be a demonstration project to illustrate if more such “openings” of the levee system to the floodplains of the Mississippi River might lead to some improvement of river water quality if done on a larger scale elsewhere.

2. Change the text in the Working Final EIS that diminishes the ecological importance of existing flood pulses and associated ecological benefits to the floodplain river ecosystem.

Literature Cited:

Fink, D.F., and W.J. Mitsch (2007). Hydrology and biogeochemistry in a created river diversion oxbow wetland. Ecological Engineering 30:93-102.

Junk, W.J., P.B. Bayley, and R.E. Sparks (1989). The flood pulse concept in river-floodplain systems. In: Proceedings of the International Large River Symposium, D. P. Dodge, ed. Special Issue of the Journal of Canadian Fisheries and Aquatic Sciences 106:11-127.

Mitsch, W.J., L. Zhang, D.F. Fink, M.E. Hernandez, A.E. Altor, C.L. Tuttle, and A.M. Nahlik (2008). Ecological engineering of floodplains. Ecohydrology & Hydrobiology 8:139-147.

Phelps, Q.E. et al., 2015. Temporary connectivity: the relative benefits of large river floodplain inundation in the lower Mississippi River. Restoration Ecology 23: 53–56.

Final Panel Comment 17

The current methods used are insufficient for evaluating the full range of species in the ecosystems being affected because the HSI and other models do not adequately address reptiles, amphibians, terns, and mussels.

Basis for Comment

The Working Final EIS includes detailed modeling and analysis of fisheries, shorebirds, and waterfowl, but inadequate analysis of other terrestrial and aquatic wildlife, such as reptiles, amphibians, least terns, and mussels.

HSI models for some aquatic and terrestrial species were used to quantify riparian ditch bank, bottomland hardwood forest, and scrub shrub habitat. The Working Final EIS (section 4.8.2.5, page 156) states that "no additional, readily available HSI models exist that are capable of capturing the effects of hydrologic changes to herpetological resources," but that the bird and mammal species used in these models "also represent amphibians and reptiles normally associated with" these habitats. Nonetheless, this approach does not adequately account for the intricacies of the dynamic wetland habitat in the project areas and the variety of species that occupy it.

Of specific concern is the change from shallow wetlands habitats that migrate across the landscape during flood recession to permanent, static wetlands. Salamanders, frogs, and other species may use vernal pools and other ephemeral habitats preferentially over static wetlands. This effect is not well captured by the HSI models used.

Also of concern are the stream habitats that contained significant mussel populations in the project area, though not in recent surveys. This recent loss is attributed to "channel maintenance" and is not further addressed. The Working Final EIS does not include an HSI model or otherwise quantify the remaining or potential mussel habitat that could accrue from different alternatives.

Significance – Medium

Additional analysis of the non-modeled terrestrial and aquatic species associated with ephemeral wetland habitats would improve the assessment of potential consequences.

Recommendations for Resolution

1. Analyze the habitat requirements of non-models species such as reptiles, amphibians, least terns, and mussels.
2. Match these requirements with the HSI habitats (riparian ditch bank, bottomland hardwood forest, and scrub shrub habitat) and other stream and ephemeral wetland habitats associated with floodwater recession (e.g., vernal pools).
3. Evaluate the potential environmental impacts on these species from changes in these habitats.

Final Panel Comment 18

The assumption that the future without-project conditions for agriculture will be stable may not be realistic, given that the agriculture commodity prices in recent years have been greatly influenced by productivity growth and by U.S. government ethanol policy.

Basis for Comment

There are many concerns related to projections of the future for the region, even without the project taking place. The without-project conditions for agriculture are assumed stable going forward into the future. However, agricultural commodity prices in past years have been greatly influenced by productivity growth and also by U.S. government ethanol policy (Roberts and Schlenker, 2010), which could change greatly in the near future, especially if U.S. ethanol policy changes. In a peer-reviewed publication in the leading journal in the economics profession, Roberts and Schlenker (2013) document that the U.S. government ethanol policy increased food prices about 30% in recent years. However, under any given political administration, the current production targets for corn-based fuel could change, along with tax incentives or other subsidies that help achieve them.

Productivity growth for certain commodities has kept agricultural commodity prices low, but it may be slowing now (Ball et al. 2013; James et al. 2009; Alston et al. 2009).

The probability distributions used in the risk simulations are all assumed to be normal and crop prices and yields are only allowed to vary by 15% and 10%, respectively. Production costs are only allowed to vary by 5% (Appendix B – the appendix has no page numbers). Some agricultural commodity prices varied by more than 200% between 2005 and 2008 alone and output (yield) has varied by much more than 10% in the past 10 years.

Fertilizer prices have been much more volatile since 2004, reaching record high levels in 2009 (Huang, 2009). Even using smoothed five-year normalized indexes, more volatility can be expected as fertilizer and several other inputs are linked to energy prices (e.g., nitrogen fertilizers and their prices are critically dependent on natural gas prices). Much evidence exists that agricultural yield distributions are highly skewed and likely not to follow the normal distribution (see Hennessy 2009; Ramirez et al. 2003). No scenarios are run to reflect possible impacts of climate change on agricultural output, costs, and profits in future years. These climate change impacts could specifically be on regional agricultural input costs, such as irrigation, basic flood frequency and variability, and prices of commodities.

Significance – Medium

The description of the future without project conditions should be an accurate prediction of the future that considers the influences of productivity growth, U.S. government ethanol policy, as well as climate change.

Recommendations for Resolution

1. Consider future projections for yield changes associated with climate change (see above references and discussion).

2. Consider more thorough risk and uncertainty modeling with broader ranges in all key variables,

such as costs.

3. Allow for a wider range of possibilities for uncertainty related to future agricultural prices.

Literature Cited:

Alston, J.M., J.M. Beddow, and P.G. Pardev (2009a). Mendel vs. Malthus: research, productivity and food prices in the long run." Staff paper. Department of Applied Economics, University of Minnesota, St. Paul. Available online at https://ideas.repec.org/p/ags/umaesp/53400.html

Ball, E., D. Schimmelpfennig, and S. Wang (2013). Is U.S. agricultural productivity growth slowing? Applied Economics Perspective and Policy 35(3):435-450.

Hennessy, David A. (2009). Crop yield skewness under law of the minimum technology. American J. of Agricultural Economics 91 (1): 197-208.

Huang, Wen-Yuan (2009). Factors Contributing to the Recent Increase in U.S. Fertilizer Prices, 2002-2008. U.S.D.A. Report (AR-33).

James, J.S., J.M. Alston, P.G. Pardey, and M.A. Andersen. (2009). Structural changes in U.S. agricultural production and productivity. Choices: The Magazine of Food, Farm, and Resource Issues. Available online at:
http://www.choicesmagazine.org/magazine/article.php?article=94

Ramirez, Octavio A., S. Misra, and J. Field. (2003). Crop-yield distributions revisited. American J. of Agricultural Economics 85 (1): 108-120.

Roberts, M.J., and W. Schlenker (2013). Identifying supply and demand elasticities of agricultural commodities: Implications for the US ethanol mandate. American Economic Review 103(6):2265-2295.

Roberts, M.J., and W. Schlenker (2010). Identifying supply and demand elasticities of agricultural commodities: implications for the US ethanol mandate (No. w15921). National Bureau of Economic Research

Final Panel Comment 19

Values for environmental amenities from the project have not been used in the economic analysis.

Basis for Comment

Environmental damages and net changes from the proposed St. Johns/New Madrid project likely remain because proposed mitigation will not offset them. The recommended plan for the proposed project will likely result in lost ecosystem services and damaged environmental amenities because of this. The costs of the environmental damages have not been calculated, however, estimates for physical amounts of specific lost ecosystem services per acre are available in the literature (for example, there are estimates for tons of carbon sequestration [see Villa and Mitsch, 2015, and Estrada et al., 2015]; and there are estimates for the amount of reduced nutrient loading because of a reduction in agricultural acreage [Tables 4.67 and 4.68 in the Working Final EIS]). These physical losses per acre could be used in conjunction with estimates of economic value for the services to calculate costs or benefits (in the case of nutrient load reduction) for these environmental changes.

Environmental values are a more general concept than ecosystem values (for an entire ecosystem, such as a wetland), or ecosystem service values (values for specific services). Calculations of ecosystem service values come from value added to market products (e.g. pharmaceuticals) or trading prices in markets (e.g., in Europe there is an active trading market in carbon (a recent trading price was €6.88/ton of carbon). Leggett and Bockstael (2000) and Palmquist et al. (1997) use changes in market prices of houses to provide values for lost ecosystem services.

Estimates of value also come from survey data, usually in the form of maximum willingness to pay for changes environmental amenities. Hite et al. (2002) and van Houtven et al. (2014) specifically address eutrophication and nutrient loading. There are also estimates for the value of carbon sequestration, per ton or other unit, available (Brainard et al., 2005). For entire acreage changes, recently estimated value estimates include values per acre for wetlands. For example, Heimlich et al. (1998) list 33 wetlands studies with values per acre as high as about $22,000, though there is huge variability in the study estimates of value per acre. Woodward and Wui (2001) conducted a meta analysis of values of wetlands to determine the key factors in a study that lead to variability in the values.

Estimates of environmental and ecosystem values area available in the literature and include many appropriate values for specific services that resources or ecosystem components in the St. Johns/New Madrid region provide (Atkinson et al. 2012). A database of economic values for ecosystem services from 320 publications and 300 case studies are stored in the Ecosystem Services Value Database (http://www.fsd.nl/esp/80763/5/0/50 and Costanza et al., 2014); this database is a source of information on specific values for ecosystem services.

Using the method known as “benefit transfer,” which has some limitations (Johnston and Rosenberger, 2010), values from one study area or context can be transferred for use in the region where the project may have impacts.

Significance – Medium

Failure to calculate environmental damages (costs) and monetary benefits results in possible bias in the economic analysis. The bias is small if estimated net environmental impacts from the proposed St.

Johns/New Madrid project are small.

Recommendations for Resolution

1. Examine the potential ecosystem services lost due to the project if mitigation fails, including losses in amenities like types of total wetland acreage, losses in carbon sequestered from existing lands, and nutrient load reductions. Match these services with values for specific services in Recommendation 2.

2. Examine and present the literature that contains appropriate per unit estimates of market and non-market (environmental or ecosystem service) value that can be applied to categories of environmental damage from the project. See http://www.fsd.nl/esp/80763/5/0/50 as one possible source of values. Conduct a benefits transfer exercise.

3. Provide a back-up analysis of environmental damages based on non-market values in the event that mitigation fails. For example, if wetlands are lost because mitigation does not fully compensate for lost acreage, a per hectare or per acre value for wetlands can be multiplied by the estimate of the total acreage that is lost.

4. Conduct a sensitivity analysis using high, medium, and low value estimates relating to environmental damages. This likely needs to be done because there is a range of estimated values for similar or identical environmental goods to be found in the literature.

Literature Cited:

Atkinson, G., I. Bateman, and S. Mourato (2012). Recent advances in the valuation of ecosystem services and biodiversity. Oxford Review of Economic Policy 28(1):23-47.

Brainard, J., I.J. Bateman, and A.A. Lovett (2005). The social value of carbon sequestered in Great Britain's woodlands. Centre for Social and Economic Research on the Global Environment (CSERGE) Working Paper EDM, No. 05-03.

Costanza, R., R. de Groot, P. Sutton, S. van der Ploeg, S. Anderson, I. Kubiszewski, S. Farber, and R. K. Turner (2014). Changes in the global value of ecosystem services. Global Environmental Change 26:152-158.

Estrada, G.C.D., MLG Soares, V. Fernandez, and PMM De Almeida (2015). The economic evaluation of carbon storage and sequestration as mangrove ecosystem service: a case study from Southeastern Brazil. International Journal of Biodiversity Science, Ecosystem Service Management (forthcoming as accepted peer-reviewed journal article).

Heimlich, R.E., K. Wiebe, R. Claassen, D. Gadsby, and R. House (1998). Wetlands and agriculture: private interests and public benefits. Resource Economics Division, Economic Research Service, U.S.D.A. Agricultural Economics Report 765-10. 99 pp.

Hite, D., D. Hudson, and W. Intarapapong (2002). Willingness to pay for water quality improvements: the case of precision application technology. Journal of Agricultural and Res. Economics 27(2):433-449.

Johnston, R.J., and R.S. Rosenberger (2010). Methods, trends, and controversies in contemporary benefit transfer. Journal of Economic Surveys 24:479-510.

Leggett, C.G., and N.E. Bockstael (2000). Evidence of the effects of water quality on residential land prices. Journal of Environmental Economics and Management 39(2):121-144.

Palmquist, R.B., F.M. Roka, and T. Vukina (1997). Hog operations, environmental effects, and residential property values. Land Economics 73(1):114-124.

Van Houtven, G., C. Mansfield, D.J. Phaneuf, R. von Haefen, B. Milstead, M.A. Kenney, et al. (2014). Combining expert elicitation and stated preference methods to value ecosystem services from improved lake water quality. Ecological Economics 99:40-52.

Villa, J.A., and W.J. Mitsch (2015). Carbon sequestration in different wetland plant communities in Southwest Florida. International Journal of Biodiversity Science, Ecosystem Service Management (forthcoming as an accepted peer-reviewed journal article)

Woodward, R.T., and Y. Wui (2001). The economic value of wetland services: a meta analysis. Ecological Economics 37:257-270.

Final Panel Comment 20

The reduction in use of moist soil management techniques may reduce the wildlife habitat value of the mitigation sites.

Basis for Comment

USACE states in the Working Final EIS Appendix R:

> Moist soil units are a common management technique utilized throughout the region and especially in the project area (*i.e.,* Ten Mile Pond Conservation Area). Moist soil units can be managed for both shorebirds and waterfowl. **However, during the IEPR review, the panel indicated that the cost of management of moist soil units could be problematic for this project. Therefore, a decision was made not to pursue new moist soil management but instead rely on less intensive management techniques.** However, the moist soil management units that exist in the Ten Mile Pond Conservation Area were quantified. New moist soil units can still be utilized if a future determination warrants the use during the development of tract specific plans. (bolding applied, Working Final EIS Appendix R, p. 19)

The Phase 3 IEPR Final Panel Comments did not include a specific comment on the cost of management of moist soil units, but did raise the issue of the cost of adaptive management, and the source of funds to support it (Phase 3 IEPR, FPC 12). USACE concurred with the comment, and indicated that "specific costs and details associated with adaptive management would be presented in the Draft EIS" (Working Final EIS Volume 3 Part 4 – Phase 3 Final Comment Response Record, p. 36). The costs associated with moist soil management were not clearly specified in the Draft EIS, leading the Panel to question whether there was sufficient funding available to conduct adaptive management on mitigation sites including proposed moist soil management areas.

The Panel did not suggest lower levels of management, and achieving a high level of function in mitigation sites without intensive management typical of moist soil management units may be difficult. Based on the information provided in Appendix R, it is not clear if the decision to reduce the moist soil management units was made on the basis of cost alone, and it is also not clear whether the necessary mitigation value can be achieved without intensive management typical of moist soil management units or whether funding is adequate to carry out intensive management.

Furthermore, the management of Ten Mile Pond Conservation Area is assumed to be adequate to provide compensatory shorebird habitat value, but no details are provided about how it will be managed. Development and detailed expert review of management plans and proposed management techniques will be critical to determine the habitat value likely to be provided by the mitigation sites. Using intensive management will likely be necessary to achieve the levels of function needed at mitigation sites to compensate for lost wildlife habitat functions.

Significance – Medium

Without clearly defined management plans and clear enumeration of associated costs and sources of funding it is difficult to determine whether mitigation will be successful.

Recommendations for Resolution

1. Specify the management plan for the Ten Mile Pond Conservation Area, and how much habitat value will be provided.
2. Apply intensive management techniques such as those typically used for moist soil management units at mitigation sites, and measure resulting shorebird and other wildlife habitat value.

Final Panel Comment 21

The adequacy and acceptability of some environmental models cannot be determined because sufficient detail is not provided regarding the methodology and results of modeling used to estimate project impacts and mitigations.

Basis for Comment

The detail of the methodology and results of Appendices E, F, M, O, and R is inadequate to appropriately assess the applicability of the models or model results. Several examples of the inadequate detail are presented below.

- Appendix R, part 1: FCIs for newly planted Bottom Land Hardwoods (BLH) (0.599) are estimated to be higher than the FCI (0.47) of existing mature BLH. It is not clear to the Panel how the FCIs for mitigation were derived. This appears to make little sense considering the newly planted BLH will only be mature near the very end of the project time period. With no detail as to how the FCIs were estimated, there is no way to understand why the mitigation FCIs would be higher.

- Appendix R, page 11: “Additional details regarding mitigation can be found in Sections 5 and 7 of the draft EIS”. It is the opinion of the Panel that these details should be provided in the appendices.

- Appendix E 1: Natural Resource Conservation Service (NRCS) concludes that less than 1,000 acres of farmed wetlands occur in the New Madrid basin. Yet by simply estimating the amount of crop fields inundated by floodwaters for 15 consecutive days during the growing season, the Panel found that it would exceed 8,000 acres in most years. Without more detail about the methodology and results of the NRCS analysis, there is no way to validate the approach.

Similar examples of lack of detail can be found in all five of the above appendices.

Significance – Medium/Low

Sufficient details are needed to fully understand the methodology and results of the modeling.

Recommendations for Resolution

1. Provide adequate detail for the reader to duplicate the modeling process in each of the environmental models, including both methodology and results.

2. Provide all information needed for modeling in the appendix for that specific model instead of citing a different appendix for additional information.

Final Panel Comment 22

The adequacy and acceptability of the State of Missouri Stream Mitigation Method (MSMM) to evaluate impacts or mitigation related to ditch alterations cannot be determined because the methodology and specific application are not well documented.

Basis for Comment

The MSMM is one of several ecological models described and used in the Working Final EIS to quantify existing conditions, impacts, and mitigation. As stated in the Working Final EIS, the MSMM was developed for natural streams, is not a certified model, and was designed to evaluate linear stream impacts based on credits quantified through a scoring criteria. However, the MSMM methodology and worksheets are not adequately explained in detail or referenced in the Working Final EIS. In addition, it is unclear how proposed long-term monitoring and adaptive management techniques outlined in the Working Final EIS relate to mitigation credit needed using MSMM. As a result, it is unclear if impacts are quantified appropriately or if the mitigation plan compensates for lost ecosystem function.

Significance – Medium/Low

The use of different techniques to assess impact credits relative to long-term monitoring and adaptive management creates uncertainty of the MSMMs application.

Recommendations for Resolution

1. Provide more detailed information on the MSMM methodology used and model results in the body of the Working Final EIS.

2. Provide a written summary of worksheet calculations in Appendix P Part 1 and 2.

3. Use the proposed long-term monitoring and adaptive management techniques outlined in Sections 7.2.6 (Resident Fish), 7.2.7 (Water Quality), 7.2.8 (Aquatic Macroinvertebrates), and 7.2.9 (Mussels) to create baseline ditch conditions, evaluate impacts and mitigation, and assess the validity of the MSMM for lost ecosystem function.

Final Panel Comment 23

Residual flood risks associated with extreme flood events are not addressed in detail in the Working Final EIS.

Basis for Comment

Both the St. Johns Bayou improvements and New Madrid Floodway levee closure have significant residual flood risks. The St. John Bayou channel improvements can reduce losses for the full range of flood magnitudes though some residual damages will still occur for floods exceeding channel and pumping plant capacities. Changes in pump operating rules may affect residual flood risk. The levee closure could conceivably cause increased flooding in the New Madrid Floodway from rain falling behind the levees coincident with low flow in the Mississippi River. Analysis of coincident flooding from rain falling on the Mud Ditch watershed versus the large Mississippi River watershed above New Madrid is complex. The levee closure can also cause increased flooding within the floodway during the infrequent (so far 1937 and 2011) extreme event of the upstream levee being breached to activate the floodway during an extreme flood on the Mississippi River.

Appendix C, Parts 1 and 3, describe tests with a physical model of the Mississippi River system that were performed in 1989 to analyze the water surface profiles for the river and floodway for the standard project flood for both with versus without the 1,500-foot levee closure. Increases in water surface elevations of the Mississippi River along the frontline levee and the New Madrid floodway along the setback levee are cited in Appendix C.

The stage and area frequency analyses of Appendix C, Parts 1 and 2, are based on continuous sequences of daily water surface elevations in the sump areas behind the levees for the period 1943-2009 synthesized using hydrologic and hydraulic simulation models assuming flat (no hydraulic gradient) water pool surfaces. Stage and area frequency information presented in the Working Final EIS for annual exceedance frequencies of 2.0 percent or greater is used for various analyses. However, the types of analyses of extreme flood events commonly performed with the USACE Hydrologic Engineering Center Hydrologic Modeling System and River Analysis System, such as delineations of the 1.0 percent annual exceedance frequency and less frequent floodplains common in urban flood studies, are not presented. The range of flooding conditions covered was presumably designed to support the environmental and economic analyses and motivated by the agricultural predominance of flood damages and the frequent flooding that occurs.

However, more detailed consideration in the Working Final EIS of human safety and other aspects of extreme flood events may be worthwhile along with a clearer articulation of project flood control capabilities. Residual flood risks are relevant in the design of the levee and channel improvements, pumping plant, pump operating rules, and appurtenant flood control improvements. Residual flood risk is affected by levee heights, channel capacities, pump capacities, and pump operating rules. Also, public officials and floodplain occupants should be made clearly aware that they must continue to deal with residual flood risk through floodplain management and other measures even after project implementation.

More detailed analyses of flood control capacities and residual flood risk would likely have negligible effect on the comparative evaluation of alternative plans. Refinements in estimates of the differences in residual flood risks between plans likely will not affect the optimum choice of plan. However, residual risks are

important in both design of the proposed flood control structures and future nonstructural floodplain management activities of local officials and floodplain occupants.

Significance – Medium/Low

Residual risk is important in the planning and design of the flood risk mitigation project though further more detailed analyses would have little or no effect on the comparative evaluation of alternative plans and the final recommendation.

Recommendations for Resolution

1. Revise the Working Final EIS to more clearly and in more detail describe flood control capabilities, including probabilities of exceeding flow and storage capacities, of the project components and human welfare and safety and other issues related to residual flood risks associated with extreme flood events.

2. Alternatively, if further more detailed hydrologic, hydraulic, and other analyses of residual flood risk have been or will be documented in other reports, reference these reports in the Working Final EIS and briefly summarize relevant findings.

Final Panel Comment 24

The carbon sequestration benefits discussion references a non-peer-reviewed report despite a significant volume of peer-reviewed literature on this subject.

Basis for Comment

The section in the Working Final EIS, Nutrient Capture and Carbon Sequestration Benefits (pp. 51-53), cites an old non-peer-reviewed report (Shabman and Zepp, 2000) as the main source of information on carbon credit despite a significant amount of current, peer-reviewed literature on the subject of carbon sequestration in riparian and forested wetlands (e.g., Anderson and Mitsch, 2006; Craft et al., 2008; Zehetner et al., 2009; Bernal and Mitsch, 2012, 2013). Furthermore, the Shabman and Zepp report appears to only count carbon accumulated temporarily in trees and does not count the more substantial and sustainable carbon accumulated in floodplain and wetland soils that most new references include.

The Panel understands that this new "ecosystem service" of natural ecosystems would not have been addressed in pre-2005 versions of this EIS; however there is sufficient peer-reviewed literature to support a discussion relative to this project.

Significance – Low

Carbon sequestration by ecosystems, particularly wetlands, is becoming a more important ecosystem service of wetlands every year and its discussion in the EIS should be based on the latest peer-reviewed analyses.

Recommendations for Resolution

1. Include a more comprehensive analysis of the soil carbon that is currently sequestered by the wetlands on this site and how the various alternatives may change that carbon sequestration.

2. Undertake a more in-depth analysis of carbon sequestration in future floodplain and wetland projects.

Literature Cited:

Anderson, C.J., and W.J. Mitsch (2006). Sediment, carbon, and nutrient accumulation at two 10-year-old created riverine marshes. Wetlands 26:779-792.

Bernal, B., and W.J. Mitsch (2012). Comparing carbon sequestration in temperate freshwater wetland communities. Global Change Biology 18:1636-1647.

Bernal, B., and W.J. Mitsch (2013). Carbon sequestration in two created riverine wetlands in the Midwestern United States. Journal of Environmental Quality 42:1236-1244.

Craft, C.B., C. Washburn, and A. Parker (2008). Latitudinal trends in organic carbon accumulation in temperate freshwater peatlands. In: Wastewater Treatment, Plant Dynamics and Management in Constructed and Natural Wetlands, J. Vymazal, ed. Springer, New York, pp. 23–31.

Shabman, L., and L. Zepp (2000). An Approach for Evaluating Nonstructural Alternatives with Application to the Yazoo River (Mississippi) Backwater Area. Report prepared in cooperation with U.S. EPA, Grant #X 984355-98.

Zehetner, F., G.J. Lair, and M.H. Gerzabek (2009). Rapid carbon accretion and organic matter pool stabilization in riverine floodplain soils. Global Biogeochemical Cycles, 23(4), GB4004. Available online at: http://onlinelibrary.wiley.com/doi/10.1029/2009GB003481/epdf

Final Panel Comment 25

The SPARROW model results (2009) relied upon in the nutrient export analyses have been superseded by more recent results (2014) that decrease the significance of the environmental benefits of the authorized project.

Basis for Comment

In Appendix I of the Working Final EIS, reductions in nutrient exports from the project area to the Mississippi River are analyzed in relation to nutrient loads in Robertson et al. (2009). This paper used national-scale SPAtially Referenced Regression on Watershed Attributes (SPARROW) models based on geospatial datasets for 1992 to estimate nutrient yields and loads from Mississippi-Atchafalaya River Basin (MARB) watersheds to the Gulf of Mexico. These results have been superseded by Robertson et al. (2014), which used SPARROW models constructed specifically for the MARB based on geospatial datasets for 2002.

Delivered nutrient loads in Robertson et al. (2014) for HUC8 basin 8020201, which includes St. Johns Bayou-New Madrid Floodway, are substantially lower than those in Robertson et al. (2009). Estimated annual delivered yields for total phosphorus (TP) decreased from 400 to 95 kg TP/km^2 and those for total nitrogen (TN) decreased from 3,024 to 1,878 kg TN/km^2. In addition, Robertson et al. (2009) rank this basin as the number two nutrient exporter (on an areal basis) in the MARB, whereas Robertson et al. (2014) rank it as number 26 for nitrogen and number 101 for phosphorus, out of 822 total watersheds.

Nutrient export from the project area to the Mississippi River is estimated using the models in Appendix I. Relative to delivered nutrient loads in Robertson et al. (2009), in terms of yield per unit area, nutrient export from the authorized project is 17-25% of the SPARROW rate for TP and 17-50% for TN. Relative to delivered nutrient loads in Robertson et al. (2014), nutrient export from the authorized project is 72-108% of the SPARROW rate for TP and 27-82% for TN. Relative to the revised, updated results in Robertson et al. (2014), estimated nutrient exports show substantially less retention or trapping under inundated conditions than is stated in the Working Final EIS and Appendix I. Consequently, based on the updated results, the claim that reductions in nutrient export from the project area could show significant environmental benefits is overstated.

The benefit of using the revised, updated results in Robertson et al. (2014) is a more accurate assessment of the magnitudes of estimated nutrient exports from the authorized project, relative to current conditions.

Significance – Low

Use of revised, updated results for nutrient yields and watershed rankings in the MARB will increase the accuracy of the analysis in the Working Final EIS, but will not affect the overall conclusions of the water quality component of the project.

Recommendation for Resolution

1. Revise all sections of the Working Final EIS and Appendix I that rely upon nutrient yields and watershed rankings from Robertson et al. (2009), and update them with those from Robertson et al. (2014).

Literature Cited:

Robertson, D.M., G.E. Schwarz, D.A. Saad, and R.B. Alexander (2009). Incorporating uncertainty into the ranking of SPARROW model nutrient yields from Mississippi／Atchafalaya River Basin watersheds. Journal of the American Water Resources Association (JAWRA) 45(2):534-549.

Robertson, D.M., D.A. Saad, and G.E. Schwarz (2014). Spatial variability in nutrient transport by HUC8, state, and subbasin based on Mississippi/Atchafalaya River Basin SPARROW models. Journal of the American Water Resources Association (JAWRA) 50(4): 988-1009.

Final Panel Comment 26

The beneficial impacts of nitrogen loading reductions to the Mississippi River over the 50-year life of the project are greatly overstated in terms of their significance to hypoxia in the Gulf of Mexico.

Basis for Comment

Section 4.12.2.2 of the Working Final EIS states that the recommended plan would remove 12,183.92 tons of nitrogen from the project area over the course of the (50-year) project life due to compensatory mitigation for fish and wildlife impacts (Tables 4.67 and 4.68). In this section, and also in Section 4.12.3 and the Summary, this nitrogen loading reduction is characterized as resulting in tremendous gains, possibly leading to a reduction or a delay in growth of the hypoxic zone in the Gulf of Mexico.

The long-term annual average nitrogen load delivered to the Gulf of Mexico, relative to a base year of 2002, is 1,351,000 metric tons (Robertson et al., 2014). A nitrogen load reduction of 12,183.92 metric tons over the 50-year life of the project corresponds to an annual reduction of 0.018% in the total annual delivered nitrogen load to the Gulf of Mexico. Although this nitrogen loading reduction would be directionally beneficial, its magnitude is insignificant and should not be expected to result in any measurable reduction or a delay in growth of the hypoxic zone in the Gulf of Mexico.

Significance – Low

Placing the nitrogen loading reductions over the 50-year life of the project within the context of the long-term annual average nitrogen load delivered to the Gulf of Mexico would provide a more realistic assessment of potential beneficial impacts, but will not affect the overall conclusions of the water quality component of the project.

Recommendation for Resolution

1. Revise the sections of the Working Final EIS that discuss nitrogen loading reductions over the 50-year life of the project to include the relationship of these reductions to the long-term annual average nitrogen load delivered to the Gulf of Mexico.

Literature Cited:

Robertson, D.M., D.A. Saad, and G.E. Schwarz (2014). Spatial variability in nutrient transport by HUC8, state, and subbasin based on Mississippi/Atchafalaya River Basin SPARROW models. Journal of the American Water Resources Association (JAWRA) 50(4):988-1009.

5. REFERENCES

Acquaye, A.K., J. Alston, and P.G. Pardey (2003). Post-war productivity patterns in U.S. agriculture: influences of aggregation procedures in a state-level analysis. American Journal of Agricultural Economics 85(1):59-80.

Alston, J.M., J.M. Beddow, and P.G. Pardey (2009a). Mendel vs. Malthus: research, productivity and food prices in the long run. Staff paper, Department of Applied Economics, University of Minnesota, St. Paul. Available online at: https://ideas.repec.org/p/ags/umaesp/53400.html

Alston, J.M., J.M. Beddow, and P.G. Pardey (2009b). Agricultural research, productivity, and food prices in the long run. Science 325:1209-1210.

Anderson, C.J., and W.J. Mitsch (2006). Sediment, carbon, and nutrient accumulation at two 10-year-old created riverine marshes. Wetlands 26:779-792.

Atkinson, G., I. Bateman, and S. Mourato (2012). Recent advances in the valuation of ecosystem services and biodiversity. Oxford Review of Economic Policy 28(1):23-47.

Ball, E., D. Schimmelpfennig, and S. Wang (2013). Is U.S. agricultural productivity growth slowing? Applied Economics Perspective and Policy 35(3):435-450.

Battelle (2011). Final Planning Model Quality Assurance Review Report for the Model Review of the Assessment of Shorebird Habitat within the St. Johns-New Madrid Basins, Missouri. Report Submitted to U.S. Army Corps of Engineers.

Bernal, B., and W.J. Mitsch (2012). Comparing carbon sequestration in temperate freshwater wetland communities. Global Change Biology 18:1636-1647.

Bernal, B., and W.J. Mitsch (2013). Carbon sequestration in two created riverine wetlands in the Midwestern United States. Journal of Environmental Quality 42:1236-1244.

Brainard, J., I.J. Bateman, and A.A. Lovett (2005). The social value of carbon sequestered in Great Britain's woodlands. Centre for Social and Economic Research on the Global Environment (CSERGE) Working Paper EDM, No. 05-03.

Brown, S., and D. Batzer (2001). Birds, Plants, and Macroinvertebrates as Indicators of Restoration Success in New York Marshes. In: Bioassessment and Management of North American Freshwater Wetlands, R.B. Rader, D. Batzer, and S.A. Wissinger, Eds. New York: John Wiley and Sons, Inc., pp. 237-248

Brown, S., C. Hickey, B. Harrington, and R. Gill, eds. (2001). The U.S. Shorebird Conservation Plan, 2nd Edition. Manomet Center for Conservation Sciences, Manomet, Massachusetts. 62 pp.

Brown, S., and P. Veneman (2001). Effectiveness of compensatory wetland mitigation in Massachusetts, USA. Wetlands 21(4):508-518.

Chavas, J.P., and M.T. Holt (1990). Acreage decisions under risk: the case of corn and soybeans. American Journal of Agricultural Economics 72(3):529-538.

Chen, C., B.A. McCarl, and D.E. Schimmelpfennig (2004). Yield variability as influenced by climate: a statistical investigation. Climatic Change 66:239-61.

Cole, C.A. (2006). HGM and wetland function assessment: six degrees of separation from the data? Ecological Indicators 6:485-493.

Colwell, M.A., and S.L. Landrum (1993). Nonrandom shorebird distribution and fine-scale variation in prey abundance. The Condor 95(1):94-103.

Colwell, M.A. (2010). Foraging Ecology and Habitat Use. In: Shorebird Ecology and Management. Berkeley: University of California Press, pp. 131-157.

Costanza, R., R. de Groot, P. Sutton, S. van der Ploeg, S. Anderson, I. Kubiszewski, S. Farber, and R. K. Turner (2014). Changes in the global value of ecosystem services. Global Environmental Change 26:152-158.

Craft, C.B., C. Washburn, and A. Parker (2008). Latitudinal trends in organic carbon accumulation in temperate freshwater peatlands. In: Wastewater Treatment, Plant Dynamics and Management in Constructed and Natural Wetlands, J. Vymazal, ed. Springer, New York, pp. 23–31.

Deschenes, O., and M. Greenstone (2007). The economic impacts of climate change: evidence from agricultural output and random fluctuations in the weather. American Economic Review 97(1):354-85.

Dixon, Bruce L., et al. (1994). Estimating corn yield response models to predict impacts of climate change. Journal of Agrcultural. and Resource Economics 19(1):58-68.

Estrada, G.C.D., MLG Soares, V. Fernandez, and PMM De Almeida (2015). The economic evaluation of carbon storage and sequestration as mangrove ecosystem service: a case study from Southeastern Brazil. International Journal of Biodiversity Science, Ecosystem Service Management (forthcoming as accepted peer-reviewed journal article).

Fink, D.F., and W.J. Mitsch (2007). Hydrology and biogeochemistry in a created river diversion oxbow wetland. Ecological Engineering 30:93-102.

Fisher, A. C., W.M. Hanemann, M.J. Roberts, and W. Schlenker (2012). The economic impacts of climate change: evidence from agricultural output and random fluctuations in weather: comment. The American Economic Review 102(7):3749-3760.

Gebo, N.A., and R. P. Brooks (2012). Hydrogeomorphic (HGM) assessments of mitigation sites compared to natural reference wetlands in Pennsylvania. Wetlands 32: 321-333.

Hamer, G.L., E.J. Heske, J.D. Brawn, and P.W. Brown (2006). Migrant shorebird predation on benthic invertebrates along the Illinois River, Illinois. The Wilson Journal of Ornithology 118(2):152-163.

Heimlich, R.E., K. Wiebe, R. Claassen, D. Gadsby, and R. House (1998). Wetlands and agriculture: private interests and public benefits. Resource Economics Division, Economic Research Service, U.S.D.A. Agricultural Economics Report 765-10. 99 pp.

Hennessy, David A. (2009). Crop yield skewness under law of the minimum technology. American J. of Agricultural Economics 91 (1): 197-208.

Hill, T., E. Kulz, B. Munoz, and J.R. Dorney (2013). Compensatory stream and wetland mitigation in North Carolina: an evaluation of regulatory success. Environmental Management 51(5):1077-1091.

Hite, D., D. Hudson, and W. Intarapapong (2002). Willingness to pay for water quality improvements: the case of precision application technology. Journal of Agricultural and Res. Economics 27(2):433-449.

Huang, Wen-Yuan (2009). Factors Contributing to the Recent Increase in U.S. Fertilizer Prices, 2002-2008. U.S.D.A. Report (AR-33).

James, J.S., J.M. Alston, P.G. Pardey, and M.A. Andersen. (2009). Structural changes in U.S. agricultural production and productivity. Choices: The Magazine of Food, Farm, and Resource Issues. Available online at:
http://www.choicesmagazine.org/magazine/article.php?article=94

Johnston, R.J., and R.S. Rosenberger (2010). Methods, trends, and controversies in contemporary benefit transfer. Journal of Economic Surveys 24:479-510.

Junk, W.J., P.B. Bayley, and R.E. Sparks (1989). The flood pulse concept in river-floodplain systems. In: Proceedings of the International Large River Symposium, D. P. Dodge, ed. Special Issue of the Journal of Canadian Fisheries and Aquatic Sciences 106:11-127.

Kihslinger, R.L. (2008). Success of wetland mitigation projects. National Wetlands Newsletter 30(2):14-16.

Klimas, C.V., E.O. Murray, J. Pagan, H. Langston, and T. Foti (2011). A regional guidebook for applying the hydrogeomorphic approach to assessing functions of forested wetlands in the Delta Region of Arkansas, Lower Mississippi River Alluvial Valley. U.S. Army Engineer Research and Development Center, Vicksburg, Mississippi (certified revision of ERDC/EL TR-04-16).

Leggett, C.G., and N.E. Bockstael (2000). Evidence of the effects of water quality on residential land prices. Journal of Environmental Economics and Management 39(2):121-144.

Mitigation ratios from Maryland (examples):
http://www.mde.state.md.us/programs/Water/WetlandsandWaterways/Regulations/Pages/programs/waterprograms/wetlands_waterways/regulations/mitigation.asp

Mitsch, W.J., L. Zhang, D.F. Fink, M.E. Hernandez, A.E. Altor, C.L. Tuttle, and A.M. Nahlik (2008). Ecological engineering of floodplains. Ecohydrology & Hydrobiology 8:139-147.

Mitsch, W.J., and J.G. Gosselink (2015). Wetlands, 5th ed. John Wiley & Sons, New York. 472 pp.

Moreno-Mateos D, Power ME, Comín FA, Yockteng R (2012) Structural and Functional Loss in Restored Wetland Ecosystems. PLoS Biol 10(1): e1001247.doi: 10.1371/journal.pbio.1001247

National Research Council (2001). Compensating for Wetland Losses under the Clean Water Act. National Academy Press, Washington, DC. 158 pp.

Olson, K.R., and L.W. Morton (2013). Restoration of 2011 flood-damaged Birds Point – New Madrid Floodway. Journal of Soil and Water Conservation 68(1):13A-18A.

OMB (2004). Final Information Quality Bulletin for Peer Review. Executive Office of the President, Office of Management and Budget, Washington, D.C. Memorandum M-05-03. December 16.

Palmquist, R.B., F.M. Roka, and T. Vukina (1997). Hog operations, environmental effects, and residential property values. Land Economics 73(1):114-124.

Phelps, Q.E. et al., 2015. Temporary connectivity: the relative benefits of large river floodplain inundation in the lower Mississippi River. Restoration Ecology 23: 53–56.

Ramirez, Octavio A., S. Misra, and J. Field. (2003). Crop-yield distributions revisited. American J. of Agricultural Economics 85 (1): 108-120.

Rheinhardt, R. D., M. M. Brinson, and P. M. Farley (1997). Applying wetland reference data to functional assessment, mitigation, and restoration. Wetlands 17:195–215.

Robb, J.T. (2002). Assessing wetland compensatory mitigation sites to aid in establishing mitigation ratios. Wetlands 22:435-440.

Roberts, M.J., and W. Schlenker (2010). Identifying supply and demand elasticities of agricultural commodities: implications for the US ethanol mandate (No. w15921). National Bureau of Economic Research

Roberts, M.J., and W. Schlenker (2013). Identifying supply and demand elasticities of agricultural commodities: Implications for the US ethanol mandate. American Economic Review 103(6):2265-2295.

Robertson, D.M., G.E. Schwarz, D.A. Saad, and R.B. Alexander (2009). Incorporating uncertainty into the ranking of SPARROW model nutrient yields from Mississippi／Atchafalaya River Basin watersheds. Journal of the American Water Resources Association (JAWRA) 45(2):534-549.

Robertson, D.M., D.A. Saad, and G.E. Schwarz (2014). Spatial variability in nutrient transport by HUC8, state, and subbasin based on Mississippi/Atchafalaya River Basin SPARROW models. Journal of the American Water Resources Association (JAWRA) 50(4): 988-1009.

Sanders, D.R., I.J. Altman, and N. Ferraro (2014). Technological advances in soybean yields: a disaggregated approach. Agribusiness 30(2):207-221.

Schlenker, W., and M.J. Roberts (2009). Nonlinear temperature effects indicate severe damages to US crop yields under climate change. Proceedings of the National Academy of Sciences 106(37):15594-15598.

Schneider, D.C. and B.A. Harrington (1981). Timing of shorebird migration in relation to prey depletion. Auk 98:801–811.

Shabman, L., and L. Zepp (2000). An Approach for Evaluating Nonstructural Alternatives with Application to the Yazoo River (Mississippi) Backwater Area. Report prepared in cooperation with U.S. EPA, Grant #X 984355-98.

Skagen, S.K., and H.D. Oman (1996). Dietary flexibility of shorebirds in the Western hemisphere. Canadian Field-Naturalist 110(3):419-444.

Skagen, S.K. (2006). Migration stopovers and the conservation of Arctic-breeding calidridine sandpipers. Auk 123(2):313-322.

Smith, D.R., C.P. McGowan, J.P. Daily, J.D. Nichols, J.A. Sweka, and J.E. Lyons (2013). Evaluating a multispecies adaptive management framework: must uncertainty impede effective decision-making? Journal of Applied Ecology 50(6):1431-1440.

The National Academies (2003). Policy on Committee Composition and Balance and Conflicts of Interest for Committees Used in the Development of Reports. The National Academies (National Academy of Science, National Academy of Engineering, Institute of Medicine, National Research Council). May 12.

USACE (2012). Water Resources Policies and Authorities: Civil Works Review. Department of the Army, U.S. Army Corps of Engineers, Washington, D.C. Engineer Circular (EC) 1165-2-214. December 15.

Van Houtven, G., C. Mansfield, D.J. Phaneuf, R. von Haefen, B. Milstead, M.A. Kenney, et al. (2014). Combining expert elicitation and stated preference methods to value ecosystem services from improved lake water quality. Ecological Economics 99:40-52.

Villa, J.A., and W.J. Mitsch (2015). Carbon sequestration in different wetland plant communities in Southwest Florida. International Journal of Biodiversity Science, Ecosystem Service Management (forthcoming as an accepted peer-reviewed journal article)

Weber, L.M., and S. M. Haig. (1997). Shorebird-prey interactions in South Carolina coastal soft sediments. Canadian Journal of Zoology 75:245-252.

Woodward, R.T., and Y. Wui (2001). The economic value of wetland services: a meta analysis. Ecological Economics 37:257-270.

Zehetner, F., G.J. Lair, and M.H. Gerzabek (2009). Rapid carbon accretion and organic matter pool stabilization in riverine floodplain soils. Global Biogeochemical Cycles, 23(4), GB4004. Available online at: http://onlinelibrary.wiley.com/doi/10.1029/2009GB003481/epdf

This page is intentionally left blank.

APPENDIX A

IEPR Process for the St. Johns Phase 4 Project

This page is intentionally left blank.

A.1 Planning and Conduct of the Independent External Peer Review (IEPR)

Table A-1 presents the schedule followed in executing the St. Johns Bayou and New Madrid Floodway Project, Missouri, Working Final Environmental Impact Statement (EIS) Independent External Peer Review (hereinafter: St. Johns Phase 4 IEPR). Due dates for milestones and deliverables are based on the receipt of charge questions from USACE on December 8, 2014. The review documents were provided by the U.S. Army Corps of Engineers (USACE) between November 14, 2014 and November 19, 2014. Note that the work items listed under Task B6 occur after the submission of this report. Battelle will enter the 26 Final Panel Comments developed by the Panel into USACE's Design Review and Checking System (DrChecks), a Web-based software system for documenting and sharing comments on reports and design documents, so that USACE can review and respond to them. USACE will provide responses (Evaluator Responses) to the Final Panel Comments, and the Panel will respond (BackCheck Responses) to the Evaluator Responses. All USACE and Panel responses will be documented by Battelle. Battelle will provide USACE and the Panel a pdf printout of all DrChecks entries, through comment closeout, as a final deliverable and record of the IEPR results.

Table A-1. St. Johns Phase 4 Complete IEPR Schedule

Task	Action	Due Date
B1[a]	Award/Effective Date	9/29/2011
	Review documents available	11/14-19/2014
	Battelle submits addendum to the final Work Plan[b]	12/10/2014
	USACE provides comments on draft Work Plan	12/16/2014
	Battelle submits final Work Plan[b]	12/18/2014
B2	Battelle completes subcontracts for panel members	11/13/2014
B3	Battelle convenes kick-off meeting with USACE	11/17/2014
	Battelle sends review documents to panel members	12/8/2014
	Battelle convenes kick-off meeting with panel members	11/13-14/2014
	Battelle convenes mid-review teleconference for panel members to ask clarifying questions of USACE[c]; State agencies permitted to present to panel members (10 minute presentations for each agency)	1/8/2015
B4	Panel members complete their individual reviews	1/16/2015
	Battelle provides panel members with talking points for Panel Review Teleconference	1/23/2015
	Battelle convenes Panel Review Teleconference	1/26/2015
	Battelle provides Final Panel Comment templates and instructions to panel members	1/26/2015

Table A-1. St. Johns Phase 4 Complete IEPR Schedule (continued)

Task	Action	Due Date
B4	Panel members provide draft Final Panel Comments to Battelle	2/3/2015
	Battelle provides feedback to panel members on draft Final Panel Comments; panel members revise Final Panel Comments	2/3-12/2015
	Panel finalizes Final Panel Comments	2/12/2015
B5	Battelle provides Final IEPR Report to panel members for review	2/17/2015
	Panel members provide comments on Final IEPR Report	2/19/2015
	Battelle submits Final IEPR Report to USACE[b]	2/23/2015
B6[d]	Battelle inputs Final Panel Comments to DrChecks and provides Final Panel Comment response template to USACE	2/24/2015
	Battelle convenes teleconference with USACE to review the Post-Final Panel Comment Response Process	2/24/2015
	Battelle convenes teleconference with Panel to review the Post-Final Panel Comment Response Process	2/25/2015
	Project Delivery Team (PDT) provides draft Evaluator Responses to Planning Center of Expertise (PCX)	3/2/2015
	PCX reviews draft Evaluator Responses and works with PDT regarding clarifications	3/5/2015
	PCX provides Battelle with reviewed draft Evaluator Responses	3/6/2015
	Battelle provides the panel members the draft PDT Evaluator Responses	3/9/2015
	Panel members provide Battelle with draft BackCheck Responses	3/11/2015
	Battelle convenes teleconference with panel members to discuss draft BackCheck Responses	3/12/2015
	Battelle convenes Comment-Response Teleconference with panel members and USACE	3/13/2015
	USACE inputs final PDT Evaluator Responses to DrChecks	3/16/2015
	Battelle provides final PDT Evaluator Responses to panel members	3/17/2015
	Panel members provide Battelle with final BackCheck Responses	3/19/2015
	Battelle inputs the Panel's final BackCheck Responses in DrChecks	3/23/2015
	Battelle submits pdf printout of DrChecks project file[b]	3/24/2015
	Contract End/Delivery Date	6/30/2015

[a] Task numbers are numbered "B" consistent with the September 2011 USACE PWS for conducting both Phases 3 (A tasks) and 4 (B tasks) IEPRs.
[b] Deliverable
[c] The original scope of work included a kickoff meeting, but did not include a mid-review teleconference. Because the Panel had participated in three previous IEPRs on the project Battelle substituted the mid-review teleconference for the kickoff meeting.
[d] Task B6 occurs after the submission of this report

At the beginning of the Period of Performance for the St. John's Phase 4 IEPR, Battelle held a kick-off meeting with USACE to review the preliminary/suggested schedule, and discuss the IEPR process. Revisions to the schedule were submitted as part of the final Work Plan. In addition, USACE provided 32 charge questions, which were included in the addendum to the final Work Plan. The final charge also included general guidance for the Panel on the conduct of the peer review (provided in Appendix C of this final report).

Prior to beginning their review and within one day of their subcontracts being finalized, all members of the Panel attended a kick-off meeting via a teleconference planned and facilitated by Battelle in order to review the IEPR process, the schedule, communication procedures, and other pertinent information for the Panel. The IEPR Panel received an electronic version of the final charge, as well as the St. Johns Phase 4 review documents and reference materials listed below. The documents and files in bold font were provided for review; the other documents were provided for reference or supplemental information only.

Volume I

- **Working Final EIS (386 pages)**
- **Appendix A – Figures (43 pages)**
- **Appendix B Part 1 – Economics of Alternatives (59 pages)**
- **Appendix B Part 2 – Economic Cost Estimates (16 pages)**
- **Appendix C – H&H text (26 pages)**
- **Appendix C – H&H figures (143 pages)**
- Appendix C Part 2 – Historical Rainfall Analysis
- Appendix C Part 3 – Model Test
- Appendix D Part 1 – Project History
- Appendix D Part 2 – Historic Conditions
- Appendix E Part 1 – NRCS Farmed Wetlands
- **Appendix E Part 2 - Wetland Goods and Services (8 pages)**
- **Appendix E – Wetlands 404(b)(1) (26 pages)**
- **Appendix E – HGM Assessment (58 pages)**
- Appendix E – HGM Version 2
- **Appendix F Part 1- Waterfowl Impacts (28 pages)**
- Appendix F Part 2 – Waterfowl Appendices
- **Appendix G Part 1 – Fisheries (52 pages)**
- **Appendix G Part 2 – USACE Response to USFWS Fish Access (8 pages)**
- **Appendix H Part 1 – Shorebirds (51 pages)**
- **Appendix H Part 2 – Shorebird Model Validation (16 pages)**
- **Appendix I – Water Quality text (54 pages)**
- **Appendix I – Water Quality program code (49 pages)**
- **Appendix J – Biological Assessment (33 pages)**

- Appendix K – HTRW
- Appendix K – HTRW reference
- Appendix L – Post Flood Report
- **Appendix M Part 1 – WRP (11 pages)**
- **Appendix M Part 2 – WETSORT (51 pages)**
- Appendix M Part 3 – GIS Elevations
- **Appendix M Part 4 – DEM Assessment (10 pages)**
- Appendix M Part 5 – Farmland Impact Conversion Rating Form AD-1006 (10-83)
- **Appendix N – Mussels (96 pages)**
- **Appendix O – Terrestrial Wildlife (53 pages)**
- Appendix P Part 1 – MO Stream Mitigation Method
- **Appendix P Part 2 – Adverse Stream Impacts (5 pages)**
- **Appendix P Part 3 – In Stream Work and Riparian Buffer Creation (4 pages)**
- **Appendix Q Part 1 – USFWS CAR (92 pages)**
- Appendix Q Part 2 – Previous USFWS Coordination
- **Appendix R Part 1 – Mitigation Technical Appendix (48 pages)**
- **Appendix R Part 2 – Mitigation ICA (14 pages)**
- **Appendix S – Risk and Uncertainty (51 pages)**

Volume II

- Volume II Part 1 – Public Scoping
- Volume II Part 2 – Socioeconomic References
- **Volume II Part 3 – Summary Table of Comments (Excel spreadsheet)**
- Volume II Part 3 – Response to DEIS Comments (Comment Letters)
- **Volume II Part 4 – Response to Advance Copy DEIS Comments (132 pages)**

Volume III

- Volume III Part 1 – Court Decision
- Volume III Part 2 – Phase 1 IEPR
- Volume III Part 3 – Phase 2 IEPR Addendum
- Volume III Part 4 – Phase 3 Final Comment Response Record
- Volume III Part 6.1 – Model Review EnviroFish
- Volume III Part 6.2 – Model Review Waterfowl
- Volume III Part 6.3 – Model Review HGM
- Volume III Part 6.4 – Model Review Shorebirds

References

- USACE guidance *Civil Works Review* (EC 1165-2-214; 15 December 2012)

- Office of Management and Budget's *Final Information Quality Bulletin for Peer Review* (December 16, 2004).

A kickoff meeting with USACE, the panel members, and Battelle was not held prior to the review because the Panel had participated in three previous IEPRs on the project. In substitution for this meeting, a mid-review teleconference was held on January 8, 2015 with USACE, the Panel, and Battelle so that USACE could answer any questions the Panel had concerning either the review documents or the project. At the beginning of this call USACE provided a brief summary of the status of the project prior to answering clarifying questions from the panel. Prior to this teleconference, Battelle submitted 47 panel member questions to USACE. USACE provided responses to 42 of the 47 questions within three working days of the teleconference. Additional economic information was provided on January 27, 2015. Five questions related to water quality were answered prior to submission of the Final Report. All clarifying questions posed by the Panel received a response by USACE.

Following the mid-review teleconference, another teleconference was held on January 8, 2015 with USACE, the Panel, Battelle, and representatives from the SJNM Interagency Team. Representatives from the U.S. Environmental Protection Agency, the U.S. Fish and Wildlife Service, the Missouri Department of Natural Resources, and the Missouri Department of Conservation were each allotted 10 minutes to present to the panel members on scientific and technical matters associated with the reasonableness and adequacy of engineering, environmental, and economic data, assumptions, methodologies, modeling, analysis, interpretations of analysis, and conclusions based on analysis as presented in the Working Final EIS.

In addition, at the request of the panel members, USACE provided the following document: Heitmeyer (2010). A Manual for Calculating Duck-Use-Days to Determine Habitat Resource Values and Waterfowl Population Energetic Requirements in the Mississippi Alluvial Valley. This document was provided to Battelle and then sent to the Panel as additional information only and was not part of the official review.

A.2 Review of Individual Comments

The Panel was instructed to address the charge questions/discussion points within a charge question response table provided by Battelle. At the end of the review period, the Panel produced individual comments in response to the charge questions/discussion points. Battelle reviewed the comments to identify recurring themes, areas of potential conflict, and other impressions. At the end of the review, Battelle summarized the individual comments in a preliminary list of 34 overall comments and discussion points. Each panel member's individual comments were shared with the full Panel in a merged individual comments table.

A.3 IEPR Panel Teleconference

Battelle facilitated a 5-hour teleconference with the Panel so that the panel members could exchange technical information. The main goal of the teleconference was to identify which issues should be carried forward as Final Panel Comments in the Final IEPR Report and decide which panel member would serve as the lead author for the development of each Final Panel Comment. This information exchange ensured that the Final IEPR Report would accurately represent the Panel's assessment of the project, including any conflicting opinions. The Panel engaged in a thorough discussion of the overall positive and negative comments, added any missing issues of significant importance to the findings, and merged any related individual comments. At the conclusion of the teleconference, Battelle reviewed each Final Panel

Comment with the Panel, including the associated level of significance, and confirmed the lead author for each comment.

The Panel also discussed responses to charge question 1, where there appeared to be disagreement among panel members. The conflicting comments were resolved based on the professional judgment of the Panel, and all sets of comments were determined not to be conflicting and to be a non-significant issue.

At the end of these discussions, the Panel identified 26 comments and discussion points that should be brought forward as Final Panel Comments.

A.4 Preparation of Final Panel Comments

Following the teleconference, Battelle prepared a summary memorandum for the Panel documenting each Final Panel Comment (organized by level of significance). The memorandum provided the following detailed guidance on the approach and format to be used to develop the Final Panel Comments for the St. Johns Phase 4 IEPR:

- Lead Responsibility: For each Final Panel Comment, one Panel member was identified as the lead author responsible for coordinating the development of the Final Panel Comment and submitting it to Battelle. Battelle modified lead assignments at the direction of the Panel. To assist each lead in the development of the Final Panel Comments, Battelle distributed the merged individual comments table, a summary detailing each draft final comment statement, an example Final Panel Comment following the four-part structure described below, and templates for the preparation of each Final Panel Comment.

- Directive to the Lead: Each lead was encouraged to communicate directly with the other panel member as needed and to contribute to a particular Final Panel Comment. If a significant comment was identified that was not covered by one of the original Final Panel Comments, the appropriate lead was instructed to draft a new Final Panel Comment.

- Format for Final Panel Comments: Each Final Panel Comment was presented as part of a four-part structure:

    1. Comment Statement (succinct summary statement of concern)

    2. Basis for Comment (details regarding the concern)

    3. Significance (high, medium/high, medium, medium/low, and low; see description below)

    4. Recommendation(s) for Resolution (see description below).

- Criteria for Significance: The following were used as criteria for assigning a significance level to each Final Panel Comment:

    1. **High:** Describes a fundamental issue with the project that affects the current recommendation or justification of the project, and which will affect its future success, if the project moves forward without the issue being addressed. Comments rated as high indicate

that the Panel determined that the current methods, models, and/or analyses contain a "showstopper" issue.

2. **Medium/High:** Describes a potential fundamental issue with the project, which has not been evaluated at a level appropriate to this stage in the Planning process. Comments rated as medium/high indicate that the Panel analyzed or assessed the methods, models, and/or analyses available at this stage in the Planning process and has determined that if the issue is not addressed, it could lead to a "showstopper" issue.

3. **Medium:** Describes an issue with the project, which does not align with the currently assessed level of risk assigned at this stage in the Planning process. Comments rated as medium indicate that, based on the information provided, the Panel identified an issue that would raise the risk level if the issue is not appropriately addressed.

4. **Medium/Low:** Affects the completeness of the report at this time in describing the project, but will not affect the recommendation or justification of the project. Comments rated as medium/low indicate that the Panel does not currently have sufficient information to analyze or assess the methods, models, or analyses.

5. **Low:** Affects the understanding or accuracy of the project as described in the report, but will not affect the recommendation or justification of the project. Comments rated as low indicate that the Panel identified information that was mislabeled or incorrect or that certain data or report section(s) were not clearly described or presented.

- Guidelines for Developing Recommendations: The recommendation section was to include specific actions that USACE should consider to resolve the Final Panel Comment (e.g., suggestions on how and where to incorporate data into the analysis, how and where to address insufficiencies, areas where additional documentation is needed).

Battelle reviewed and edited the Final Panel Comments for clarity, consistency with the comment statement, and adherence to guidance on the Panel's overall charge, which included ensuring that there were no comments regarding either the appropriateness of the selected alternative or USACE policy. During the Final Panel Comment development process, the Panel determined that two of the Final Panel Comments could be dropped; however, two additional new Final Panel Comments were developed; therefore, the total Final Panel Comment count remained 26. At the end of this process, 26 Final Panel Comments were prepared and assembled. There was no direct communication between the Panel and USACE during the preparation of the Final Panel Comments. The Final Panel Comments are presented in the main report.

A.5 Conduct of the Public Comment Review

Battelle received from USACE a summary Excel spreadsheet of the public comments on the St. Johns Draft EIS, along with a document containing 1,960 pages of comments. These documents, along with questions from the St. Johns New Madras Interagency Team, were provided to the IEPR panel members as supplemental information. No Final Panel Comments were generated as a result of the public comment review.

This page is intentionally left blank.

APPENDIX B

Identification and Selection of IEPR Panel Members
for the St. Johns Phase 4 Project

This page is intentionally left blank.

B.1 Panel Identification

The St. Johns Bayou and New Madrid Floodway Project, Missouri, Working Final Environmental Impact Statement (EIS) (Phase 4) Independent External Peer Review (hereinafter: St. Johns Phase 4 IEPR) is a continuation of the contract under which the Phase 3 review was also conducted. The contract's Performance Work Statement requested that, when possible, the panel members who participated during the Phase 1 and 2 IEPR efforts be used to "ensure the continuity, validity, and expert opinion remains intact for the IEPR Phases 3 and 4." Prior to the Phase 3 review, Battelle contacted the original Phase 1 and 2 panel members, evaluated them for conflicts of interest (COIs) and availability, and informed USACE that the panel members from Phases 1 and 2 would be used for Phases 3 and 4. The Panel provided expertise in the following key technical areas: water quality, fish biology, hydrologic and hydraulic engineering, economics, NEPA, waterfowl biology, shorebird biology, and wetland ecology.

Prior to the conduct of the Phase 3 review, the candidates were rescreened for the following potential exclusion criteria or COIs.[1] These COI questions serve as a means of disclosure and to better characterize a candidate's employment history and background. Providing a positive response to a COI screening question did not automatically preclude a candidate from serving on the Panel. For example, participation in previous USACE technical peer review committees and other technical review panel experience was included as a COI screening question. A positive response to this question could be considered a benefit.

- Involvement by you or your firm[2] in any part of the St. John's Bayou and New Madrid Floodway Environmental Impact Statement process, including:
  - Final Environmental Impact Statement entitled: Mississippi Rivers and Tributaries, Mississippi River Levees and Channel Improvement (1976)
  - Final EIS entitled: St. John's Bayou/New Madrid Floodway Project Final EIS (1982)
  - Draft Supplemental EIS (1999)
  - Final Supplemental EIS (2000)
  - Revised Supplemental EIS (2002)
  - Second Revised Supplemental EIS (2006).

[1] Battelle evaluated whether scientists in universities and consulting firms that are receiving USACE-funding have sufficient independence from USACE to be appropriate peer reviewers. See OMB (2004, p. 18), "….when a scientist is awarded a government research grant through an investigator-initiated, peer-reviewed competition, there generally should be no question as to that scientist's ability to offer independent scientific advice to the agency on other projects. This contrasts, for example, to a situation in which a scientist has a consulting or contractual arrangement with the agency or office sponsoring a peer review. Likewise, when the agency and a researcher work together (e.g., through a cooperative agreement) to design or implement a study, there is less independence from the agency. Furthermore, if a scientist has repeatedly served as a reviewer for the same agency, some may question whether that scientist is sufficiently independent from the agency to be employed as a peer reviewer on agency-sponsored projects."

[2] Includes any joint ventures in which a panel member's firm is involved and if the firm serves as a prime or as a subcontractor to a prime.

- Any involvement by you or your firm[2] in the conceptual or actual design, construction, or operation and maintenance of the St. Johns Bayou and New Madrid Floodway, Missouri Project or related projects.
- Involvement as an expert, or provided testimony for, the civil action (04-1575) Environmental Defense, et al. v. U.S. Army Corps of Engineers, et al.
- Involvement as an expert, or provided testimony for, Water Quality Certification for the St. Johns Bayou and New Madrid Floodway Project (06-0421) Missouri Coalition for the Environment, et al. v. Missouri Department of Natural Resources et al.
- Current employment by USACE.
- Current or previous employee or affiliation with members of the interagency mitigation team or the local sponsor, including the U.S. Environmental Protection Agency (U.S. EPA), U.S. Fish and Wildlife Service (USFWS), Missouri Department of Natural Resources (MDNR), Missouri Department of Conservation (MDC), and the St. Johns Levee and Drainage District.
- Current or previous employment or affiliation with Environmental Defense, National Wildlife Federation, or Missouri Coalition for the Environment (for pay or pro bono).
- Current personal involvement with other USACE projects, including whether involvement was to author any manuals or guidance documents for USACE. If yes, provide titles of documents or description of project, dates, and location (USACE district, division, Headquarters, ERDC, etc.), and position/role. Please highlight and discuss in greater detail any projects that are specifically with the Memphis District.
- Current firm[2] involvement with other USACE projects, specifically those projects/contracts that are with the Memphis District. If yes, provide title/description, dates, and location (USACE district, division, Headquarters, ERDC, etc.), and position/role.
- Previous employment by USACE as a direct employee or contractor (either as an individual or through your firm[2]) within the last 10 years, notably if those projects/contracts are with the Memphis District. If yes, provide title/description, dates employed, and place of employment (district, division, Headquarters, ERDC, etc.), and position/role.
- Previous experience conducting technical peer reviews. If yes, please highlight and discuss any technical reviews concerning water resource development projects involving levees, channel modifications, and pumping stations, and include the client/agency and duration of review (approximate dates).
- A significant portion (i.e., greater than 50%) of personal or firm[2] revenues within the last 3 years came from USACE contracts.
- Any publicly documented statement made advocating for or against the Mississippi River and Tributaries Project, including subject project.
- Any publicly documented statement (including, for example, advocating for or discouraging against) related to the St. Johns Bayou project.
- Past, current, or future interests or involvements (financial or otherwise) by you, your spouse, or children related to the St. Johns Bayou project or future benefits from the project.
- Any other perceived COI not listed, such as:
    - Repeatedly served as USACE technical reviewer
    - Paid or unpaid participation in litigation related to the work of USACE

- Prior repeated service as a technical advisor to, or expert witness for, Environmental Defense, National Wildlife Federation, and the Missouri Coalition for the Environment.
- Any other perceived COI not listed.

B.2 Panel Selection

Two of the eight final reviewers are affiliated with a consulting company; one is an independent consultant, and the remaining five are affiliated with universities. Battelle established subcontracts with the panel members when they indicated their willingness to participate and confirmed the absence of COIs through a signed COI form. USACE was given the list of candidate panel members, which was the same panel as engaged for Phases 1, 2, and 3.

Table B-1 gives an overview of the credentials of the final eight members of the Panel and their qualifications in relation to the technical evaluation criteria. More detailed biographical information regarding each panel member and his area of technical expertise is presented in Section B.3.

Table B-1. St. Johns Phase 4 IEPR Panel: Technical Criteria and Areas of Expertise

Technical Criterion	Mitsch	Eichholz	Jackson	Brown	Bierman	Wurbs	Shaw	Southerland
Wetland Ecologist								
Nationally recognized expert (e.g., authored books, invited speaker at national conferences/meetings, professional society memberships)	X							
Experience performing wetland delineations	X							
Experience developing wetland mitigation plans	X							
Experience restoring wetlands/floodplains within the floodplain of large river systems	X							
Number of peer-reviewed publications related to wetlands	X							
Ph.D. – Environmental engineering	X							
Waterfowl Biologist								
Nationally recognized expert (e.g., authored books, invited speaker at national conferences/meetings, professional society memberships)		X						
Experience studying waterfowl biology of large river systems		X						
Familiarity with caloric models for determining waterfowl usage of various land uses within floodplains of large river systems		X						
Number of peer-reviewed publications related to waterfowl		X						
Ph.D. – Wildlife/waterfowl ecology		X						
Fishery Biologist								
Nationally recognized expert (e.g., authored books, invited speaker at national conferences/meetings, professional society memberships)			X					
Experience studying fisheries biology of large river systems			X					
Familiarity with issues relating to fish passage through culverts or similar structures			X					
Number of peer-reviewed publications related to studying fishes of large river systems			X					
Ph.D. – Fisheries management			X					

Table B-1. St. Johns Phase 4 IEPR Panel: Technical Criteria and Areas of Expertise (continued)

Technical Criterion	Mitsch	Eichholz	Jackson	Brown	Bierman	Wurbs	Shaw	Southerland
Shorebird Biologist								
Nationally recognized expert (e.g., authored books, invited speaker at national conferences/meetings, professional society memberships)				X				
Experience studying shorebird ecology				X				
Number of peer-reviewed publications related to studying shorebird ecology				X				
Ph.D. – Natural resources				X				
Water Quality Expert								
Nationally recognized expert (e.g., authored books, invited speaker at national conferences/meetings, professional society memberships)					X			
Experience studying water quality within large river systems					X			
Experience studying Gulf of Mexico Hypoxia					X			
Number of peer-reviewed publications related to studying water quality within large river systems					X			
Ph.D. – Environmental engineering					X			
Hydrologic and Hydraulic Engineer								
Extensive experience in hydrology and hydraulics (minimum of 10 years requested)						X		
Experience in hydraulic engineering with an emphasis on large public works projects on large river systems (registered professional engineer)						X		
Extensive background in hydraulic theory and practice (professor from academia)						X		
Familiarity with standard USACE hydrologic and hydraulic computer models						X		
Registered professional engineer						X		
Ph.D. – Civil engineering/water resources						X		
Economist								
Experience in agricultural-economics							X	
Experience in water resource economic evaluation or review							X	

Table B-1. St. Johns Phase 4 IEPR Panel: Technical Criteria and Areas of Expertise (continued)

Technical Criterion	Mitsch	Eichholz	Jackson	Brown	Bierman	Wurbs	Shaw	Southerland
Ph.D. (field of study) – Economics							X	
NEPA Expert								
Experience in evaluating and conducting controversial water resource development Environmental Impact Statements (minimum of 10 years requested)								X
Familiarity with research and theories relating to adaptive management of wetlands mitigation								X
Ph.D. – Biology/ecology								X

B.3 Panel Member Qualifications

William Mitsch, Ph.D., PWS

Role: Wetland ecology
Affiliation: Florida Gulf Coast University

Dr. Mitsch is a Professional Wetland Scientist (PWS) and a Certified Senior Ecologist with 42 years of diverse experience in wetland ecology. His areas of expertise span wetland ecosystems, ecological engineering, and ecosystem restoration, with particular interest in performing wetland delineations, mitigation plans, and restoring wetlands/floodplains within large rivers systems. Dr. Mitsch, who holds a Ph.D. in environmental engineering sciences (systems ecology) from the University of Florida, is currently Distinguished Professor of Environment and Natural Resources, Professor of Evolution, Ecology, and Organismal Biology, and Professor of Civil and Environmental Engineering at Florida Gulf Coast University. He was also Director of the Wilma H. Schiermeier Olentangy River Wetland Research Park at The Ohio State University in Columbus, Ohio. In addition, he is a nationally recognized water quality expert with 30 years of experience studying large river system water quality and 16 years of experience studying hypoxia in the Gulf of Mexico.

Dr. Mitsch served on the National Technical Review Committee and the Post-Hurricane Katrina Review Committee for the restoration of the Louisiana coastal area. He has served on several National Research Council Committees, where he has provided expertise related to river basins and coastal systems, wetland mitigation, and wetland characterization. He also has presented oral and written testimony to Congress on wetlands. Dr. Mitsch has provided consulting services related to water quality and wetland monitoring, modeling, restoration, conservation, mitigation, delineation, and creation to numerous agencies and companies.

Michael Eichholz, Ph.D.

Role: Waterfowl biology
Affiliation: Southern Illinois University Carbondale

Dr. Eichholz has a Ph.D. in wildlife/waterfowl ecology from the University of Alaska- Fairbanks. He is a nationally recognized expert in waterfowl biology and has 15 years of experience in waterfowl biology of large river systems and caloric modeling for determining waterfowl use of various land uses within floodplains of large river systems. He is currently an Associate Professor of zoology at Southern Illinois University Carbondale, and holds a position as a Waterfowl/Wetland Ecologist at the University's Cooperative Wildlife Research Laboratory. His research interests include investigating the influence of resource availability during the spring on productivity and population dynamics of waterfowl and the influence of waterfowl density on reproductive and survival rates. In addition, Dr. Eichholz has conducted research on macroinvertebrate response to floodplain wetland habitat rehabilitation and the impact on migrating waterfowl.

John Jackson, Ph.D.

Role: Fisheries biology
Affiliation: Arkansas Tech University

Dr. Jackson, an Associate Professor of Fisheries Science and Director of the Fisheries and Wildlife Science Program at Arkansas Tech University, holds a Ph.D. in fisheries management from Mississippi State University. He teaches a variety of biology and ecology courses, including population dynamics, quantitative fisheries science, principles of ecology, and biostatistics. Dr. Jackson is a nationally recognized expert in fisheries biology and has 18 years of experience in studying fisheries biology of large river systems. He also has several years of experience dealing with issues of floodplain connectivity and fish use of floodplains. He has authored numerous technical reports relating to fish biology in streams and rivers, including a report for USACE characterizing floodplain fish assemblages in a large river system. In addition, Dr. Jackson has researched the relationship between fish and environmental variables in large river-floodplain ecosystems, microhabitat partitioning by multiple fish species, urban fisheries management, and has conducted evaluations of supplemental fish stocking strategies.

Stephen Brown, Ph.D.

Role: Shorebird ecology
Affiliation: Independent Consultant

Dr. Brown is the Director of Shorebird Science at the Manomet Center for Conservation Sciences in Manomet, Massachusetts. He has a Ph.D. in natural resources from Cornell University. Dr. Brown is a recognized national expert on shorebird biology/ecology with 19 years of experience in shorebird ecology. He has authored numerous publications on topics related to shorebird abundance, distribution, and population trends. His current role at the Manomet Center involves designing, funding, and managing a research program on shorebird ecology and conservation. He previously held the position of U.S. Shorebird Conservation Plan Coordinator at the Manomet Center, which involved developing a national conservation plan for all U.S. shorebird species among all 50 states, Federal agencies, non-governmental organizations, and academic institutions, including research priorities, population trend monitoring program, habitat management recommendations, and public education and outreach.

Victor J. Bierman Jr., Ph.D., BCEEM

Role: Water quality
Affiliation: LimnoTech

Dr. Bierman is a Senior Scientist with LimnoTech in Oak Ridge, North Carolina, and holds a Ph.D. in environmental engineering from the University of Notre Dame. He has 42 years of experience in the development and application of water quality models, leading to his publication of more than 100 technical papers and reports. He is a former U.S. EPA National Expert in Environmental Exposure Assessment and a former Associate Professor in the Department of Civil Engineering at the University of Notre Dame. He is a Board Certified Environmental Engineering Member (BCEEM) of the American Academy of Environmental Engineers and Scientists. Dr. Bierman has 25 years of experience studying water quality in large river systems and 22 years of experience studying hypoxia in the Gulf of Mexico. Projects of note include the Gulf of Mexico Hypoxia Assessment completed for the White House Committee on Environment and Natural Resources, in which Dr. Bierman developed a water quality model to assess hypoxia responses to reductions in nutrient loadings from the Mississippi River Basin. He also conducted transport and fate modeling studies for sediments contaminated with polychlorinated biphenyls (PCBs) to investigate the impacts of continued No Action and various remedial scenarios in the Upper Hudson River.

As a Senior Scientist for LimnoTech, Dr. Bierman conducts research and development on projects for Federal, state, and regional government clients. He also provides scientific peer review, litigation support, and expert testimony on a variety of environmental issues. Dr. Bierman is a leading expert in the assessment and solution of problems related to nutrients, nuisance algal blooms, nitrogen fixation, hypoxia, exotic species, and ecosystem processes. He has conducted studies in watersheds, lakes, rivers, estuaries, and coastal marine systems. Dr. Bierman is also a leading expert in toxic chemical transport, fate, partitioning, and bioaccumulation. He has conducted assessment studies in major river systems, estuaries, and the Great Lakes, and remedial investigations at U.S. EPA Superfund sites.

Ralph Wurbs, Ph.D., P.E.

Role: Hydrologic and hydraulic engineering
Affiliation: Texas A&M University

Dr. Wurbs is a Registered Professional Engineer in Texas and a Diplomate of the American Academy of Water Resources Engineers. He has a Ph.D. in civil engineering-water resources from Colorado State University. Dr. Wurbs has 44 years of experience in hydrology and hydraulics, including experience in hydraulic engineering working on large public works projects on large river systems. He has experience in hydraulic theory and practice and is familiar with standard USACE hydrologic and hydraulic computer models. He has authored numerous technical reports involving simulation studies, water availability monitoring, flood control, river/reservoir system modeling, water resource planning and management, and other topics related to hydrology and/or hydraulics, including several reports for USACE.

Dr. Wurbs has held positions as Professor, Associate Professor, and Assistant Professor since 1980 in the Civil Engineering Department at Texas A&M University. He was also the Associate Director for Engineering at the Texas Water Resources Institute for five years. Dr. Wurbs has been the principal investigator for university research contracts and grants funded by numerous agencies, including USACE.

W. Douglass Shaw, Ph.D.

Role: Water resource economic evaluation
Affiliation: Texas A&M University

Dr. Shaw is a tenured Full Professor in the Department of Agricultural Economics, and a Research Fellow at the Hazard Reduction and Recovery Center at Texas A&M University for more than 10 years. He has a Ph.D. in economics from the University of Colorado. Dr. Shaw has more than 34 years of experience in general water resource economic evaluation or review and five years of experience in studying water quality issues within large river systems. He regularly teaches environmental and natural resource economics at both the undergraduate and Ph.D. levels at Texas A&M University and was a member of the University's interdisciplinary program in Hydrologic Science and Policy from 2004 to 2013. He also developed and taught new coursework for the Hydrologic Science Program at University of Nevada-Reno in water resource economics. Dr. Shaw is the author of "Water Resource Economics and Policy: an Introduction" published by Edward Elgar Press, and is the former associate editor for the journal *Water Resources Research*. He has published many peer-reviewed articles on water quality topics such as drinking water and arsenic, and dissolved oxygen, turbidity, and the role of these water quality measures in explaining recreational fishing demand. He also recently published an article on the advantages and disadvantages of habitat equivalency analysis over traditional benefit-cost analysis approaches.

Dr. Shaw recently served as a reviewer to evaluate the economics (i.e., benefits and costs) of programs, relocation plans, and potential facilities to enhance safety and improve coastal response to future hurricanes. He also evaluated the risk and uncertainty analysis for the programs and projects, and similarly, was recently a reviewer of the U.S. EPA's safe drinking water risk model. His research specialties are environmental and water resource economics, with emphasis on valuing environmental amenities in the presence of risk, as well as valuing and modeling changes in health risks associated with contamination of resources and human health effects.

Mark T. Southerland, Ph.D.

Role: NEPA
Affiliation: Versar, Inc.

Dr. Southerland is a Principal Ecologist and NEPA Director with Versar, Inc. in Columbia, Maryland. He is also Chair of the Maryland Water Monitoring Council and a member of the Howard County Environmental Sustainability Board. His current position with Versar, Inc. involves directing major programs in the monitoring, assessment, and restoration of freshwater and terrestrial ecosystems. He is a Certified Senior Ecologist and Project Management Professional. He holds a Ph.D. in biology (ecology) from the University of North Carolina-Chapel Hill. Dr. Southerland has 10 years of experience each performing wetland delineations, developing wetland mitigation plans, and restoring wetlands/floodplains within the floodplains of large river systems. In addition, he has 24 years of experience in evaluating and conducting controversial water resource development Environmental Impact Statements and 14 years of familiarity/experience with research and theories relating to adaptive management of wetlands mitigation. His areas of expertise include NEPA guidance and compliance. He is considered a national expert on NEPA analysis, representing the Council on Environmental Quality throughout the United States. Since 1993, Dr. Southerland has been involved in USACE reconnaissance and feasibility studies for environmental restoration of the Susquehanna River, Delaware River, Anacostia River, and Barnegat Bay watersheds.

This page is intentionally left blank.

APPENDIX C

Final Charge to the IEPR Submitted
to USACE on December 18, 2014
for the St. Johns Phase 4 Project

This page is intentionally left blank.

CHARGE QUESTIONS AND GUIDANCE TO THE PANEL MEMBERS FOR THE IEPR OF THE ST. JOHNS BAYOU AND NEW MADRID FLOODWAY PROJECT, MISSOURI, WORKING FINAL EIS (PHASE 4)

BACKGROUND

The St. Johns Bayou and New Madrid Floodway Project, Missouri, is an authorized project with a portion of it already constructed. Due to environmentally based litigation, the U.S. District Court for the District of Columbia halted construction and ordered constructed work restored to pre-construction conditions. In response to this litigation, a current environmental impact statement (EIS) is being prepared to address the requirements of the National Environmental Policy Act (NEPA). The purpose of this Independent External Peer Review (IEPR) is to ensure that the scope of the current EIS is complete and scientifically accurate.

The St. Johns Bayou Basin and New Madrid Floodway Project area is located in Mississippi and New Madrid counties in southeastern Missouri along the right descending bank of the Mississippi River floodplain. The project area encompasses portions of two drainage basins separated by the Mississippi River and Tributaries Project's Birds Point-New Madrid Setback Levee.

The EIS will focus on Flood Risk Management (FRM) within the St. Johns Bayou Basin and the New Madrid Floodway. Agriculture is the primary economic resource within the project area. According to recent data, the 2-year backwater flood occurrence in the New Madrid Floodway inundates 33,391 acres, of which approximately 25,000 acres are agricultural lands. At high Mississippi River stages, the St. Johns Bayou Basin control gates are closed to prevent backwater flooding. However, closing the gates prevents interior drainage and leads to impounded interior. The 2-year flood event under these circumstances inundates approximately 11,900 acres, 7,110 of which are agricultural lands.

OBJECTIVES

The objective of this work is to conduct an IEPR of the St. Johns Bayou and New Madrid Floodway project – Phase 4 (hereinafter: St. Johns Bayou Phase 4 IEPR) in accordance with the Department of the Army, U.S. Army Corps of Engineers (USACE), Water Resources Policies and Authorities' *Civil Works Review* (Engineer Circular [EC] 1165-2-214, dated December 15, 2012), and the Office of Management and Budget's *Final Information Quality Bulletin for Peer Review* (December 16, 2004).

Peer review is one of the important procedures used to ensure that the quality of published information meets the standards of the scientific and technical community. Peer review typically evaluates the clarity of hypotheses, validity of the research design, quality of data collection procedures, robustness of the methods employed, appropriateness of the methods for the hypotheses being tested, extent to which the conclusions follow from the analysis, and strengths and limitations of the overall product.

The purpose of the IEPR is to assess the "adequacy and acceptability of the economic, engineering, and environmental methods, models, and analyses used" (EC 1165-2-214; p. D-4) for the St. Johns Bayou Phase 4 documents. The IEPR will be limited to technical review and will not involve policy review. The IEPR will be conducted by subject matter experts (i.e., IEPR panel members) with extensive experience in wetland ecology, waterfowl biology, fishery biology, shorebird ecology, water quality, hydraulic and

hydrologic engineering, economics, and NEPA issues relevant to the project. They will also have experience applying their subject matter expertise to flood risk management.

The Panel will be “charged” with responding to specific technical questions as well as providing a broad technical evaluation of the overall project. Per EC 1165-2-214, Appendix D, review panels should identify, explain, and comment upon assumptions that underlie all the analyses, as well as evaluate the soundness of models, surveys, investigations, and methods. Review panels should be able to evaluate whether the interpretations of analysis and the conclusions based on analysis are reasonable. Reviews should focus on assumptions, data, methods, and models. The panel members may offer their opinions as to whether there are sufficient analyses upon which to base a recommendation.

DOCUMENTS TO BE PROVIDED

The following is a list of documents, supporting information, and reference materials that will be provided for review by the designated discipline(s):

Table 2. Documents to Be Reviewed

Original List of Phase 4 Review Documents		Document Review by Panel Member Discipline							
Review Document Title	Pages*	Water Quality	Fisheries	Hydrologic and Hydraulic	Economics	NEPA	Wildlife	Shorebird	Wetland
Volume I									
Working Final EIS	386	386	386	386	386	386	386	386	386
Appendix A - Figures	43	43	43	43	43	43	43	43	43
Appendix B Part 1– Economics of Alternatives	59	59	59	59	59	59	59	59	59
Appendix B Part 2 – Economic Cost Estimates	16				16				
Appendix C - H&H text	26	26	26	26	26	26	26	26	26
Appendix C - H&H figures	143	143	143	143	143	143	143	143	143
Appendix C Part 2 – Historical Rainfall Analysis	R								
Appendix C Part 3 – Model Test	R								
Appendix D Part 1 - Project History	R								
Appendix D Part 2 – Historic Conditions	R								
Appendix E Part 1 – NRCS Farmed Wetlands	R								
Appendix E Part 2 - Wetland Goods and Services	8						8	8	8
Appendix E - Wetlands 404(b)(1)	26	26	26			26	26	26	26
Appendix E – HGM Assessment	58	58	58			58	58	58	58
Appendix E – HGM Version 2	R								
Appendix F Part 1- Waterfowl Impacts	28		28			28	28	28	
Appendix F Part 2 – Waterfowl Appendices	R								
Appendix G Part 1 - Fisheries	52		52	52		52	52	52	
Appendix G Part 2 – USACE Response to USFWS Fish Access	8		8						
Appendix H Part 1 - Shorebirds	51		51			51	51	51	

Table 2. Documents to Be Reviewed (continued)

Original List of Phase 4 Review Documents		Document Review by Panel Member Discipline							
Review Document Title	Pages*	Water Quality	Fisheries	Hydrologic and Hydraulic	Economics	NEPA	Wildlife	Shorebird	Wetland
Appendix H Part 2 – Shorebird Model Validation	16							16	
Appendix I - Water Qual text	54	54		54		54			54
Appendix I - Water Qual program code	49	49		49					
Appendix J - Biological Assessment	33					33			33
Appendix K - HTRW	R								
Appendix K - HTRW reference	R								
Appendix L - Post Flood Report	R								
Appendix M Part 1- WRP	11	--	11	--	--	11	11	11	11
Appendix M Part 2 - WETSORT	51	--	51	--	--	--	51	51	51
Appendix M Part 3 – GIS Elevations	R								
Appendix M Part 4 - DEM Assessment	10						10	10	
Appendix M Part 5 - Farmland Impact Conversion Rating Form AD-1006 (10-83)	R								
Appendix N – Mussels	96		96				96		
Appendix O – Terrestrial Wildlife	53						53		
Appendix P Part 1 – MO Stream Mitigation Method	R								
Appendix P Part 2 – Adverse Stream Impacts	5		5			5	5		5
Appendix P Part 3 – In Stream Work and Riparian Buffer Creation	4		4			4	4		4
Appendix Q Part 1– USFWS CAR	92		92			92	92	92	92
Appendix Q Part 2 – Previous USFWS Coordination	R								
Appendix R Part 1 – Mitigation Technical Appendix	48	48	48	48		48	48	48	48
Appendix R Part 2 – Mitigation ICA	14	14	14	14	14	14	14	14	14
Appendix S – Risk and Uncertainty	51	51	51	51	51	51	51	51	51

Table 2. Documents to Be Reviewed (continued)

Original List of Phase 4 Review Documents		Document Review by Panel Member Discipline							
Review Document Title	Pages*	Water Quality	Fisheries	Hydrologic and Hydraulic	Economics	NEPA	Wildlife	Shorebird	Wetland
Volume II									
Volume II Part 1 - Public Scoping[1]	R								
Volume II Part 2 - Socioeconomic References	R								
Volume II Part 3 – Summary Table of Comments	Spread-sheet	Spreadsheet will be reviewed by all Panel Members							
Volume II Part 3 - Response to DEIS Comments (Comment Letters)	R								
Volume II Part 4 - Response to Advance Copy DEIS Comments	132	132	132	132	132	132	132	132	132
Volume III*	R								
Volume III Part 1 – Court Decision	R								
Volume III Part 2 – Phase 1 IEPR	R								
Volume III Part 3 – Phase 2 IEPR Addendum	R								
Volume III Part 4 – Phase 3 Final Comment Response Record	R								
Volume III Part 6.1 – Model Review EnviroFish	R								
Volume III Part 6.2 – Model Review Waterfowl	R								
Volume III Part 6.3 – Model Review HGM	R								
Volume III Part 6.4 – Model Review Shorebirds	R								

* R – Documents provided for Reference (R) only.

Documents for Reference

- USACE guidance *Civil Works Review,* (EC 1165-2-214, December 15, 2012)
- Office of Management and Budget's *Final Information Quality Bulletin for Peer Review* (December 16, 2004)

SCHEDULE

This schedule is based on the receipt of the final charge questions on December 8, 2014. Note that dates presented in the schedule below could change due to panel member and USACE availability.

Task	Action	Due Date
Conduct Peer Review	Battelle sends review documents to panel members	12/8/2014
	Battelle convenes kick-off meeting with panel members	11/13-14/2014
	Battelle convenes kick-off meeting with USACE and panel members	NA[#]
	Battelle convenes mid-review teleconference for panel members to ask clarifying questions of USACE	1/8/2015
	Panel members complete their individual reviews	1/16/2015
Prepare Final Panel Comments and Final IEPR Report	Battelle provides panel members with talking points for Panel Review Teleconference	1/23/2015
	Battelle convenes Panel Review Teleconference	1/26/2015
	Battelle provides Final Panel Comment templates and instructions to panel members	1/27/2015
	Panel members provide draft Final Panel Comments to Battelle	2/3/2015
	Battelle provides feedback to panel members on draft Final Panel Comments; panel members revise Final Panel Comments	2/3/2015-2/12/2015
	Battelle finalizes Final Panel Comments	2/12/2015
	Battelle provides Final IEPR Report to panel members for review	2/17/2015
	Panel members provide comments on Final IEPR Report	2/19/2015
	***Battelle submits Final IEPR Report to USACE**	**2/23/2015**
Comment/ Response Process	Battelle inputs Final Panel Comments to the Design Review and Checking System (DrChecks) and provides Final Panel Comment response template to USACE	2/24/2015
	Battelle convenes teleconference with USACE to review the Post-Final Panel Comment Response Process	2/24/2015
	Battelle convenes teleconference with Panel to review the Post-Final Panel Comment Response Process	2/25/2015
	Project Delivery Team (PDT) provides draft Evaluator Responses to Planning Center of Expertise (PCX)	3/2/2015
	PCX reviews draft Evaluator Responses and works with PDT regarding clarifications	3/5/2015
	PCX provides Battelle with reviewed draft Evaluator Responses	3/6/2015
	Battelle provides the panel members the draft PDT Evaluator Responses	3/9/2015
	Panel members provide Battelle with draft BackCheck Responses	3/11/2015
	Battelle convenes teleconference with panel members to discuss draft BackCheck Responses	3/12/2015
	Battelle convenes Comment-Response Teleconference with panel members and USACE	3/13/2015

Task	Action	Due Date
	USACE inputs final PDT Evaluator Responses to DrChecks	3/16/2015
	Battelle provides PDT Evaluator Responses to panel members	3/17/2015
	Panel members provide Battelle with final BackCheck Responses	3/19/2015
	Battelle inputs the panel members' final BackCheck Responses to DrChecks	3/23/2015
	*Battelle submits pdf printout of DrChecks project file	3/24/2015

* Deliverables

The original scope of work included a kickoff meeting, but did not include a mid-review teleconference. Given that this is a second review of the same project for this panel, Battelle is substituting the Mid-Review Teleconference for the kickoff meeting.

CHARGE FOR PEER REVIEW

Members of this IEPR Panel are asked to determine whether the technical approach and scientific rationale presented in the St. Johns Bayou Phase 4 documents are credible and whether the conclusions are valid. The Panel is asked to determine whether the technical work is adequate, competently performed, and properly documented; satisfies established quality requirements; and yields scientifically credible conclusions. The Panel is being asked to provide feedback on the economic, engineering, environmental resources, and plan formulation. The panel members are not being asked whether they would have conducted the work in a similar manner.

Specific questions for the Panel (by report section or appendix) are included in the general charge guidance, which is provided below.

General Charge Guidance

Please answer the scientific and technical questions listed below and conduct a broad overview of the St. Johns Bayou Phase 4 documents. Please focus your review on the review materials assigned to your discipline/area of expertise and technical knowledge. Even though there are some sections with no questions associated with them, that does not mean that you cannot comment on them. Please feel free to make any relevant and appropriate comment on any of the sections and appendices you were asked to review. In addition, please note the following guidance. Note that the Panel will be asked to provide an overall statement related to 2 and 3 below per USACE guidance (EC 1165-2-214; Appendix D).

1. Your response to the charge questions should not be limited to a “yes” or “no.” Please provide complete answers to fully explain your response.

2. Assess the adequacy and acceptability of the economic and environmental assumptions and projections, project evaluation data, and any biological opinions of the project study.

3. Assess the adequacy and acceptability of the economic analyses, environmental analyses, engineering analyses, formulation of alternative plans, methods for integrating risk and uncertainty, and models used in evaluating economic or environmental impacts of the proposed project.

4. If appropriate, offer opinions as to whether there are sufficient analyses upon which to base a recommendation.

5. Identify, explain, and comment upon assumptions that underlie all the analyses, as well as evaluate the soundness of models, surveys, investigations, and methods.

6. Evaluate whether the interpretations of analysis and the conclusions based on analysis are reasonable.

7. Please focus the review on assumptions, data, methods, and models.

Please **do not** make recommendations on whether a particular alternative should be implemented, or whether you would have conducted the work in a similar manner. Also please **do not** comment on or make recommendations on policy issues and decision making. Comments should be provided based on your professional judgment, **not** the legality of the document.

1. If desired, panel members can contact one another. However, panel members **should not** contact anyone who is or was involved in the project, prepared the subject documents, or was part of the USACE Agency Technical Review (ATR).

2. Please contact the Battelle Project Manager (Lynn McLeod, mcleod@battelle.org) or Program Manager (Karen Johnson-Young (johnson-youngk@battelle.org) for requests or additional information.

3. In case of media contact, notify the Battelle Program Manager, Karen Johnson-Young (johnson-youngk@battelle.org) immediately.

4. Your name will appear as one of the panel members in the peer review. Your comments will be included in the Final IEPR Report, but will remain anonymous.

Please submit your comments in electronic form to Lynn McLeod, **mcleod@battelle.org**, no later than January 16, 2015, 10 pm ET.

Independent External Peer Review

of the

St. Johns Bayou and New Madrid Floodway Project, Missouri, Draft and Final Environmental Impact Statement

Charge Questions and Relevant Sections as Supplied by USACE

The following Charge to Reviewers outlines the objectives of the Independent External Peer Review (IEPR) for the subject study and the specific advice sought from the IEPR Panel.

> The objective of the IEPR is to obtain an independent evaluation of whether the interpretations of analysis and conclusions based on analysis are reasonable for the subject study. The IEPR Panel is requested to offer a broad evaluation of the overall study decision document in addition to addressing the specific technical and scientific questions included in the charge. The Panel has the flexibility to bring important issues to the attention of decision makers, including positive feedback, issues outside those specific areas outlined in the charge, or issues raised during prior phases of the IEPR (if still applicable).
>
> The Panel review is to focus on scientific and technical matters, leaving policy determinations for USACE and the Army. The Panel should not make recommendations on whether a particular alternative should be implemented or present findings that become “directives” in that they call for modifications or additional studies or suggest new conclusions and recommendations. In such circumstances, the Panel may have assumed the role of advisors as well as reviewers, thus introducing bias and potential conflict in their ability to provide objective review.

Broad Evaluation Charge Questions

1. Are the need for and intent of the decision document clearly described?
2. Does the decision document adequately address the stated need and intent?

Given the need for and intent of the decision document, assess the adequacy and acceptability of the following:

3. Project evaluation data used in the study analyses,
4. Economic, environmental, and engineering assumptions that underlie the study analyses,
5. Economic, environmental, and engineering methodologies, analyses, and projections,
6. Models used in the evaluation of existing and future without-project conditions and of economic or environmental impacts of alternatives,
7. Methods for integrating risk and uncertainty,
8. Formulation of alternative plans and the range of alternative plans considered,

9. Quality and quantity of the surveys, investigations, and engineering sufficient for conceptual design of alternative plans, and
10. Overall assessment of significant environmental impacts and any biological analyses.

Further,

11. Evaluate whether the interpretations of analysis and the conclusions based on analysis are reasonable, and
12. Assess the considered and tentatively selected alternatives from the perspective of systems, including systemic aspects being considered from a temporal perspective, including the potential effects of climate change.

For the tentatively selected plan, assess whether

13. The models used to assess life safety hazards are appropriate?
14. The assumptions made for the life safety hazards are appropriate?
15. The quality and quantity of the surveys, investigations, and engineering are sufficient for a concept design considering the life safety hazards and to support the models and assumptions made for determining the hazards?
16. The analysis adequately address the uncertainty and residual risk given the consequences associated with the potential for loss of life for this type of project?
17. From a public safety perspective, the proposed alternative is reasonably appropriate or are there other alternatives that should be considered?

Specific Technical and Scientific Charge Questions

18. Assess the adequacy and acceptability of the environmental analyses related to changes in riverine hydrologic connectivity in both the impact analysis and mitigation planning, including effects on fish, wildlife and wetlands. Consider temporal effects and effects of changes in natural variability on fish, wildlife and wetlands.
19. Are the costs associated with projects impacts and project mitigation adequately considered in the cost benefit analysis? Are cost associated operation and maintenance, monitoring and adaptive management considered?
20. Evaluate whether the interpretations of analysis and conclusions regarding extent to which proposed mitigation will offset significant impacts to wetlands, fish and wildlife are reasonable.
21. Assess the adequacy and acceptability of the evaluation (extent and magnitude) of direct, indirect and cumulative environmental impact of the considered and tentatively selected alternatives on significant wetlands, streams, fish and wildlife including potential impacts associated with potential changes in jurisdictional wetland status.
22. Assess the adequacy and acceptability of the nutrient export analyses and water quality analyses.
23. Assess the adequacy and acceptability of the Adaptive Management Plan.

24. Assess the technical adequacy and acceptability of the screening of potential alternatives and the screening criteria.
25. Assess the adequacy and acceptability of the economic and environmental modeling and output for distinguishing among the proposed alternatives.
26. Does the mitigation plan include sufficient details about implementation, monitoring, operation and maintenance to reasonably support conclusions regarding outputs of mitigation activities?
27. Do the environmental impact evaluations provide sufficient detail on methods and data to reasonably support the conclusions?
28. Were surveys and analyses related to fish passage sufficient for decision-making?
29. Assess the adequacy and acceptability of the analyses of effects of project alternatives and mitigation alternatives on fish spawning and rearing, shorebirds, waterfowl and wetlands. Do these analyses reasonably support conclusions regarding project impacts and mitigation outputs?
30. Assess the adequacy and acceptability of the environmental analyses related to changes in hydrology in both the impact analysis and mitigation planning, including effects on fish, wildlife, streams and wetlands.
31. Assess the adequacy and acceptability of analyses related to changes in flooding to adjacent and downstream communities.
32. Assess the adequacy and acceptability of methods used to identify the project footprint for areas associated with anticipated economic and environmental impacts and benefits.

Battelle
The Business *of* Innovation