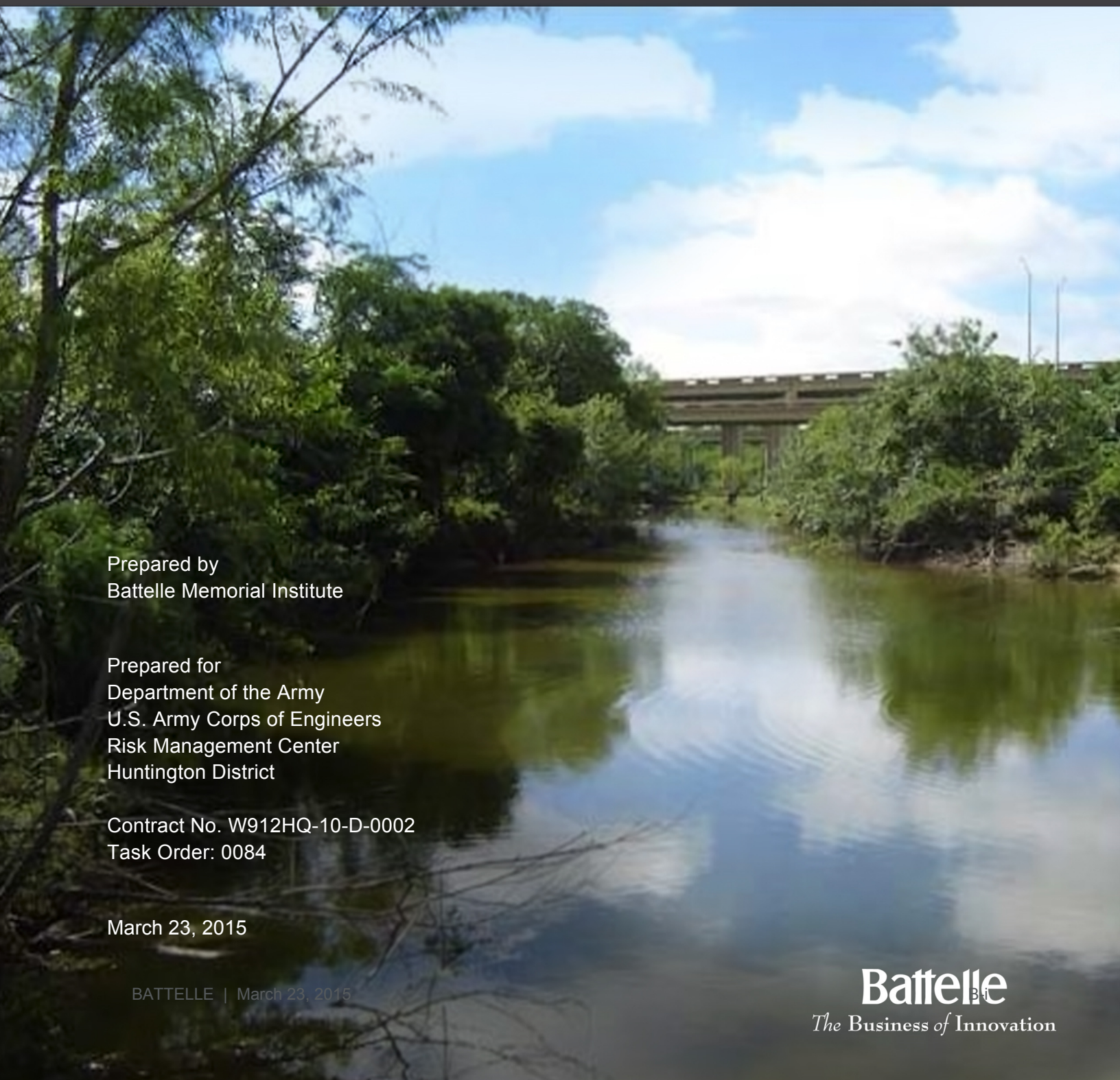
Final Independent External Peer Review Report Dam Safety Modification Report & Environmental Assessment for Zoar Levee & Diversion Dam, Zoar Village, Tuscarawas County, Ohio



Prepared by
Battelle Memorial Institute

Prepared for
Department of the Army
U.S. Army Corps of Engineers
Risk Management Center
Huntington District

Contract No. W912HQ-10-D-0002
Task Order: 0084

March 23, 2015

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Executive Summary

Project Background and Purpose

The Zoar Dam Safety Modification Report & Environmental Assessment (DSMR/EA) is being prepared in accordance with Engineer Regulation (ER) 1110-2-1156 (USACE Safety of Dams – Policy and Procedures), Section 102(C) & (D) of National Environmental Policy Act of 1969 (NEPA) and its implementing regulations, 40 CFR 1500-1508 and ER 200-2-2 (Procedures for Implementing NEPA). Zoar Levee & Diversion Dam is part of the Muskingum River Basin System. The Muskingum River Basin is the site of Ohio's first multiple-purpose water management and land conservation river basin project. In response to the State of Ohio's Flood of 1913, which killed over 400 people and destroyed over 20,000 homes, the Muskingum Watershed Conservancy District (MWCD) was created on June 3, 1933. The MWCD has missions of flood control, water conservancy, erosion control, and other general uses of water within 8,000 square miles of drainage basin that ultimately enters the Ohio River at Marietta, Ohio.

An initial plan developed by MWCD to reduce flood risks in the basin called for 14 flood control reservoirs. In 1933, the Public Works Administration (PWA) awarded a grant of $22.09 million to the U.S. Army Corps of Engineers (USACE) to construct the proposed plan. In 1934, the Federal Government executed a contract with the MWCD to allow USACE to conduct investigations and draft a final plan. This official plan for the basin was approved by the MWCD on November 19, 1934. Construction of the project began in 1935, and the completed system was turned over to the MWCD in 1938. The Flood Control Act of 1939 returned the dams to the Federal government and flood control operations back to USACE. Today the USACE, Huntington District (District) manages these projects. Zoar Levee & Diversion Dam is an appurtenant structure to the Dover Dam and is located approximately 4 miles upstream of the dam on the Tuscarawas River. Dover Dam is a dry dam and retains pools only during events to attenuate downstream flooding in coordination with other Muskingum Basin projects. Zoar Levee provides flood damage reduction benefits to the Village of Zoar and provides protection from flooding when Dover Dam is retaining a pool above elevation (El.) 890 feet (a 3-year event). As such, the original crest elevation of the Zoar Levee was designed to correspond to the spillway elevation of Dover Dam of 916.0, with an additional 3 feet of freeboard for a resulting crest elevation of 919.0. The current crest elevation, following levee and interior drainage modification work in 1951, is 928.5.

Zoar Diversion Dam is located on Goose Run, about 1,000 feet upstream of Zoar Levee, and was built to work in conjunction with the levee. The Diversion Dam is a retention structure for runoff in the Goose Run watershed, which flows into a ponding area for the Zoar Levee pump station. A spillway, or diversion channel, connects the Diversion Dam impoundment to the Tuscarawas River, via Goose Run.

The Village of Zoar is located in east central Ohio, along the Tuscarawas River in Tuscarawas County, about 70 miles south of Cleveland, Ohio. Zoar Levee protects approximately 98 buildings or structures

from being inundated by flood waters being retained by Dover Dam. According to the 2010 census, the population of Zoar Village is estimated to be approximately 169 people.

The area protected by Zoar Levee & Diversion Dam has become the heart of a nationally significant historical site with unparalleled historical integrity that is symbiotically supported by an active, thriving municipal jurisdiction, as well as internal and external private and public interests. Between 2001 and July 2012, 114,226 people have visited Zoar Village, and the Zoar Community Association (ZCA) has earned a combined total of $523,000 in revenue from its stores, programs, and events. Between 1999 and 2011, ZCA reports that approximately $900,000 was granted to Zoar Village for the restoration of buildings and other interpretative improvements. In 2001, the Tuscarawas County Convention and Visitors Bureau estimated that Zoar Village's tourism contributed over $10.5 million to the local economy.

The Village of Zoar was established in 1817 by a group of German separatists called the Society of Separatists of Zoar. Although founded primarily as a religious community, the separatists introduced a communal system to pay their debts for land and guarantee their economic and social security.

The Village of Zoar is unique in the State of Ohio because it contains a significant collection of German folk architecture from a 19th century utopian community. Original documentation concerning the decision to construct the levee versus removing the town from Dover Dam's flowage easement indicates that USACE considered the historical significance of the community when it originally constructed the levee.

A 1949 design memorandum concerning the capacity of the Zoar pump station states that "…*protection of the village instead of evacuation was adopted because of its historical significance*…"

A 1950 memorandum concerning raising the crest of Zoar Levee stated: "*At the time Dover Dam was being planned, consideration was given to evacuating the population of 200 persons. However, since the village is of considerable historical importance and since two state-owned museums are located there, it was decided to protect the site by constructing earth levees rather than to evacuate the population*."

Further, a 2001 article from the National Park Service's magazine titled CRM stated: "…*in 1929, under pressure from the U.S. Army Corps of Engineers to move the town to higher ground to accommodate a nearby flood-control dam, the villagers began to recognize their heritage and restored the central garden and opened a museum. A levee was built instead*."

Much of Zoar was documented in 1936 by the Historic American Building Survey (HABS). In the 1960s, the Ohio General Assembly appropriated $300,000 to purchase buildings of historial significance in Zoar to preserve, restore, and interpret them. The Ohio History Connection (OHC), previously the Ohio Historical Society (OHS), now operates several buildings in the Village of Zoar. The OHC is also contracted by the State of Ohio to operate the State Historic Preservation Office. In 1967, ZCA was founded to ensure the preservation of the Village of Zoar and the surrounding areas and to assist in the maintenance of the economic vitality of the Zoar area. This community association hosts several festivals and events each year, and the village is a regional asset associated with tourism. The ZCA is now under contract to manage and runs tours of several of the buildings in Zoar for the OHC.

The Zoar State Memorial Historic District was placed on the National Register of Historic Places (NRHP) in 1969, and its boundary was increased in 1975. The community is listed under Criterion A for its association with the 19th century German separatist movement and under Criterion C for its outstanding

examples of nineteenth century architecture. As currently listed, its period of significance extends from 1817 to 1899. In 2013, OHC resubmitted a revised NRHP nomination to the National Park Service in the hopes of securing a National Historic Landmark (NHL) designation for Zoar Village. NHLs are nationally significant historic places designated by the Secretary of the Interior because they possess exceptional value or quality in illustrating or interpreting the heritage of the United State. The historic district measures 176.7 total acres, 54 acres of which are located within the protective limits of Zoar Levee at elevation 916.0. Approximately one-fifth of the historic District is above El. 916.0 feet.

Independent External Peer Review Process

Independent, objective peer review is regarded as a critical element in ensuring the reliability of scientific analysis. USACE is conducting an Independent External Peer Review (IEPR) of the Draft Dam Safety Modification Report (DSMR) & Environmental Assessment (EA) for Zoar Levee & Diversion Dam, Zoar Village, Tuscarawas County, Ohio (hereinafter: Zoar Levee 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 has experience in establishing and administering peer review panels for USACE and was engaged to coordinate the IEPR of the Zoar Levee & Diversion Dam. 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.

Based on the technical content of the Zoar Levee & Diversion Dam review documents and the overall scope of the project, Battelle identified potential candidates for the Panel in the following key technical areas: cultural resources/NEPA, plan formulation/economics, engineering geology, and geotechnical engineering. Battelle screened the candidates to identify those most closely meeting the selection criteria and evaluated them for COIs and availability. USACE was given the list of final candidates to confirm that they had no COIs, but Battelle made the final selection of the four-person Panel.

The Panel received an electronic version of the Zoar Levee & Diversion Dam review documents (6,460 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 site visit held prior to the start of the review to provide the Panel an opportunity to ask questions of USACE and clarify uncertainties. As part of this meeting, USACE led Battelle and the Panel on a visit of the Zoar Levee & Diversion Dam site and the Village of Zoar, including historic properties. 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 Zoar Levee 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, 15 Final Panel Comments were identified and documented. Of these, three were identified as having high significance, four were identified as having medium/high significance, five had a medium significance, two had medium/low significance, and one had low significance.

Battelle received public comments from USACE on the Zoar Levee & Diversion Dam and provided them to the IEPR panel members. The panel members were charged with determining if any information or concerns presented in the public comments raised any additional discipline-specific technical concerns with regard to the Zoar Levee & Diversion Dam review documents. After completing their review, the Panel confirmed that no new issues or concerns were identified other than those already covered in their Final Panel Comments.

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 Zoar Levee 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 review documents are well-organized and easy to follow. The documentation in the Draft DSMR/DEA and supporting appendices and background information provide considerable analysis and effectively summarize the planning and decision-making process and the risk assessment procedures for the project. The site visit/meeting conducted by USACE in Zoar Village was particularly detailed and USACE personnel answered the IEPR Panel's questions with detailed answers making the Panel's visit very valuable and provided a much clearer understanding of the project. The Panel did, however, identify elements of the project that require further analysis and evaluation and the sections of the Draft DSMR/DEA that should be clarified or revised.

Engineering Geology: Of primary concern to the Panel was that the geologic uncertainty, which results in uncertainty in other aspects of the project, is not sufficiently estimated or characterized. The design, construction, performance, and success of the selected Risk Management Plan/Preferred Action Alternative (RMP/PAA) will depend on the extent to which geologic conditions are known. USACE can address this uncertainty by conducting additional geologic investigations during the preconstruction engineering and design (PED) stage along the Internal Erosion Interception Trench (IEIT) alignment and in the ponding area, and characterize geologic conditions encountered during the IEIT excavation. Another Panel concern was that the proposed filter design for the Ponding Area does not appear to adequately protect against piping, considering the lack of geologic information in this area. USACE can address this issue by clarifying whether a filter fabric will be needed or, if filter fabric (geotextile) use is no longer appropriate, conducting additional subsurface investigations of the Ponding Area during the design phase to gain a better understanding of the geologic conditions, especially the horizontal and vertical variability of grain size distributions and the hydrologic conditions anticipated during construction. USACE can also assess whether the proposed 4-foot thick filter will be adequate to counter the anticipated uplift pressures associated with large storm events, including the probable maximum flood (PMF).

Geotechnical Engineering: Of primary concern to the Panel was that the effectiveness, completeness, and reliability of the IEIT concept for a dam or levee are untested. In response to the Panel's question on

the IEIT during the site visit, USACE responded that they had not previously used this procedure. Research conducted by the Panel also indicates the IEIT has not been used in the United States or anywhere else in the world to prevent backward erosion piping (BEP). To address this issue USACE can assess whether IEIT technology can be adequately quantified as a risk reduction measure since it is an unproven and untested technology; consider whether other action alternatives are more appropriate for risk reduction, such as extension of weighted filter blankets and use of relief wells, and would reduce risk to acceptable levels in a manner that is quantifiable; and conduct additional subsurface investigations during the PED phase to better characterize geologic conditions along the length of IEIT excavation and at deeper levels of glacial outwash. Another important concern to the Panel was that the risks associated with potential increased Dover Dam pool storage and pool elevation due to climate change have not been evaluated in sufficient detail and could affect the success of the project. To address this concern USACE can evaluate the pool elevation that may occur from climate change, evaluate the potential impacts flooding may have on piping or levee breach, and add a narrative to the Draft DSMR/DEA that more fully describes recent changes to Dover Dam and any risks associated with potential increased pool elevation, flooding risk in Zoar village, breach of Zoar levee, or impacts on pump inundation.

Plan Formulation: The Zoar Levee project adheres to sound planning principles and USACE regulations and policies. However, of primary concern to the Panel was that the preferred alternative has little redundancy given the estimated risks and uncertainty, especially for an alternative that has no record of effectiveness and reliability and that results in only partial risk reduction. USACE can address this issue by considering whether widening of the weighted filter berm, to be used in conjunction with IEIT, will provide additional redundancy and reduced risk; evaluating whether the weighted filter berm should be designed as a graded filter blanket or whether filter fabric may be used between in situ soils and the installed berm to provide additional redundancy and risk minimization from piping and boils; and assessing whether relief wells, found in Action Alternatives 3A and 4A, would provide more redundancy. Another important issue the Panel identified was that a comprehensive risk assessment appears to have been conducted on the Zoar Village levee system, but the methods used to characterize the analysis have not been documented in a manner consistent with ER 1105-2-100, Appendix E. For studies of existing levee systems, documenting compliance with ER 1105-2-100, Appendix E, is a policy and technical requirement. USACE can address this issue by explaining how the comprehensive levee risk analysis meets or exceeds the requirements of ER 1105-2-100, Appendix E, delineating levee reaches or river stations using appropriate economic, geotechnical, and hydrologic/hydraulic criteria, and assigning probable non-failure and failure elevations to the levees for each location in a manner compliant with ER 1105-2-100.

Economics: The Panel noted that while the Zoar Levee project is not formulated based on economic outputs, recreation benefits accruing to such a valuable resource could be significant, even if not used for project justification. USACE can address this by performing a unit day value (UDV) recreation benefit analysis and investigating whether other studies have been performed and whether they could be applicable to this study. The Panel also noted that Regional Economic Development (RED) outputs have not been analyzed, and could convey the message that all effects on regional employment and income in Zoar Village have been considered. To address this issue, USACE can perform an RED analysis of the selected RMP/PAA.

Cultural Resources/NEPA: The Panel found the cultural resources background, the history of Zoar, and the probability model sections were very detailed, well-written, and will serve as a benefit in the determination of eligibility for any undocumented cultural resources that may be encountered during field

investigations. The baseline study on terrestrial and aquatic habitats was also done well. One cultural resource concern the Panel noted was the Draft DSMR/DEA defines the Programmatic Agreement as a document that will account for all impacts on all social, economic, and recreational resources, but this exceeds the scope and intent of the agreement as established in 36 CFR 800.14 and ER 1105-2-100. USACE can address this issue by rewording text in the Draft DSMR/DEA that discusses social, economic, and recreational resources in tandem with cultural resources to note that the relationship is symbiotic only for those social, economic, and recreational resources that support or are linked with the town's heritage tourism industry, which relies on preserved integrity of its historic properties/district.

Table ES-1. Overview of 15 Final Panel Comments Identified by the Zoar Levee IEPR Panel

No.	Final Panel Comment
Significance – High	
1	Geologic uncertainty, which results in uncertainty in other aspects of the project, is not sufficiently estimated or characterized.
2	The preferred alternative has little redundancy given the estimated risks and uncertainty.
3	The effectiveness, completeness, and reliability of the IEIT concept for a dam or levee are untested.
Significance – Medium/High	
4	A comprehensive risk assessment appears to have been conducted on the Zoar Village levee system, but the methods used to characterize the analysis have not been documented in a manner consistent with ER 1105-2-100, Appendix E.
5	Potential pool storage elevations for Dover Dam related to climate change and recent dam modifications, which could impact impoundment and levee performance, are not fully described in the Draft DSMR/DEA.
6	The proposed filter design for the Ponding Area does not appear to adequately protect against piping, considering the lack of geologic information in this area.
7	The limited width of the weighted filter berm in the Ball Field Reach, to be used in conjunction with the IEIT, does not provide resiliency and redundancy to assist in controlling migration of fines from piping.
Significance – Medium	
8	Piezometer data are inconsistent and incomplete, and many piezometers are often inaccessible or nonfunctional during large-flood events, creating data gaps.
9	Pump station performance during low-frequency floods, including PMF, has not been fully characterized.
10	Considering the extensive seepage and piping observed in the Rock Knoll area during the flood events of 2005 and 2008, the emergency seepage blanket may not be adequate to minimize future piping problems.

Table ES-1. Overview of 15 Final Panel Comments Identified by the Zoar Levee IEPR Panel (continued)

No.	Final Panel Comment
11	The possible migration of sand and silt size particles from the glacial outwash that comprises the levee foundation, which could result in foundation adjustment and detrimental settlement of the levee, has not been evaluated.
12	Pipes or channels beneath the levee may lead to unknown risk of a levee collapse and breach.
Significance – Medium/Low	
13	Potential recreation benefits have not been estimated in sufficient detail to reinforce its importance to the area.
14	Regional Economic Development outputs have not been analyzed, and could convey the message that all effects on regional employment and income in Zoar Village have been considered.
Significance – Low	
15	The Draft DSMR/DEA defines the Programmatic Agreement as a document that will account for all impacts on all social, economic, and recreational resources, but this exceeds the scope and intent of the agreement as established in 36 CFR 800.14 and ER 1105-2-100.

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LIST OF ACRONYMS

ATR	Agency Technical Review
BEP	Backward Erosion Piping
COI	Conflict of Interest
Cu	Coefficient of Uniformity
CVM	Contingent Valuation Method
CVS	Contingent Valuation Survey
DrChecks	Design Review and Checking System
DSMR	Dam Safety Modification Report
DSMS	Dam Safety Modification Study
EA	Environmental Assessment
EC	Engineer Circular
El.	Elevation
ER	Engineer Regulation
ERDC	Engineer Research and Development Center
IEIT	Internal Erosion Interception Trench
IEPR	Independent External Peer Review
MWCD	Muskingum Watershed Conservancy District
NED	National Economic Development
NEPA	National Environmental Policy Act
NHL	National Historic Landmark
NRHP	National Register of Historic Places
OHC	Ohio History Connection
OHS	Ohio Historical Society
OEO	Outside Eligible Organization
OMB	Office of Management and Budget
PA	Programmatic Agreement
PAA	Preferred Action Alternative
PDT	Project Delivery Team
PED	Preconstruction Engineering and Design
PFM	Potential Failure Mode
PMF	Probable Maximum Flood

PWA	Public Works Administration
RED	Regional Economic Development
RMC	Risk Management Center
RMP	Risk Management Plan
SM	silty sand
SP	poorly graded sand
TCM	Travel Cost Method
TRLL	Tolerable Risk Limit Line
UDV	Unit Day Value
USACE	United States Army Corps of Engineers
USFWS	United States Fish and Wildlife Services
WPA	Works Progress Administration
WRDA	Water Resources Development Act
ZCA	Zoar Community Association

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1. INTRODUCTION

The Zoar Dam Safety Modification Report & Environmental Assessment (DSMR/EA) is being prepared in accordance with Engineer Regulation (ER) 1110-2-1156 (USACE Safety of Dams – Policy and Procedures), Section 102(C) & (D) of National Environmental Policy Act of 1969 (NEPA) and its implementing regulations, 40 CFR 1500-1508 and ER 200-2-2 (Procedures for Implementing NEPA). Zoar Levee & Diversion Dam is part of the Muskingum River Basin System. The Muskingum River Basin is the site of Ohio's first multiple-purpose water management and land conservation river basin project. In response to the State of Ohio's Flood of 1913, which killed over 400 people and destroyed over 20,000 homes, the Muskingum Watershed Conservancy District (MWCD) was created on June 3, 1933. The MWCD has missions of flood control, water conservancy, erosion control, and other general uses of water within 8,000 square miles of drainage basin that ultimately enters the Ohio River at Marietta, Ohio.

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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 Independent External Peer Review (IEPR) of the Dam Safety Modification Report & Environmental Assessment for Zoar Levee & Diversion Dam, Zoar Village, Tuscarawas County, Ohio (hereinafter Zoar Levee IEPR) in accordance with procedures described in the Department of the Army, 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 cultural resources/NEPA, plan formulation, economics, engineering geology, and geotechnical engineering contained in the Zoar Levee IEPR 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 January 27, 2015. Appendix D presents the COI Questionnaire that Battelle completed and submitted to the Institute for Water Resources (IWR) prior to the award of the Zoar Levee & Diversion Dam IEPR.

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. For the purpose of this IEPR, USACE has been directed by Congress to evaluate USACE dams for safety assurance. IEPR provides an independent assessment of the cultural resources/NEPA, plan formulation, economics, engineering geology, and geotechnical engineering analyses of the project study. In particular, the IEPR addresses the technical soundness of the project study's assumptions, methods, models, 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 Zoar Levee & Diversion Dam 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 Zoar Levee IEPR. Due dates for milestones and deliverables are based on the award/effective date of January 12, 2015. Note that the work items listed under Task E occur after the submission of this report. Battelle anticipates submitting the pdf printout of the USACE's Design Review and Checking System (DrChecks) project file

(the final deliverable) on April 13, 2015. The actual date for contract end will depend on the date that all activities for this IEPR are conducted.

Table 1. Major Milestones and Deliverables of the Zoar Levee IEPR

Task	Action	Due Date
A	Award/Effective Date	1/12//2015
	Review documents available	1/13/2015
	Public comments available	2/17/2015
B	Battelle submits list of selected panel members	1/19/2015
	USACE confirms the panel members have no COI	1/21/2015
C	Battelle convenes kick-off meeting with USACE	1/16/2015
	Battelle convenes on-site meeting with USACE and panel members to view project-specific locations	2/10/2015
D	Panel members complete their individual reviews	2/26/2015
	Battelle sends public comment to panel members to review	2/27/2015
	Panel confirms no additional Final Panel Comment is necessary with regard to the public comments	3/6/2015
	Panel members provide draft Final Panel Comments to Battelle	3/12/2015
	Battelle submits Final IEPR Report to USACE	3/23/2015
E[a]	Battelle convenes Comment-Response Teleconference with panel members and USACE	4/7/2015
	Battelle submits pdf printout of DrChecks project file to USACE	4/13/2015
	Contract End/Delivery Date	6/12/2015

[a] *Task E occurs after the submission of this report.*

Battelle identified, screened, and selected four panel members to participate in the IEPR based on their expertise in the following disciplines: cultural resources/NEPA, plan formulation/economics, engineering geology, and geotechnical engineering. The Panel reviewed the Zoar Levee review documents and produced 15 Final Panel Comments in response to 30 charge questions, including those charge questions provided by USACE for the review, Battelle's two charge questions that sought summary information, and one charge question on the public comments. 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 are provided.

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 Zoar Levee IEPR review documents. Based on the Panel's review, the review documents are well-organized and easy to follow. The documentation in the Draft DSMR/DEA and supporting appendices and background information provide considerable analysis and effectively summarize the planning and decision-making process and the risk assessment procedures for the project. The site visit/meeting conducted by USACE in Zoar Village was particularly detailed and USACE personnel answered the IEPR Panel's questions with detailed answers making the Panel's visit very valuable and provided a much clearer understanding of the project. The Panel did, however, identify elements of the project that require further analysis and evaluation and the sections of the Draft DSMR/DEA that should be clarified or revised. The following summarizes the Panel's findings.

Engineering Geology: Of primary concern to the Panel was that the geologic uncertainty, which results in uncertainty in other aspects of the project, is not sufficiently estimated or characterized. The design, construction, performance, and success of the selected Risk Management Plan/Preferred Action Alternative (RMP/PAA) will depend on the extent to which geologic conditions are known. USACE can address this uncertainty by conducting additional geologic investigations during the preconstruction engineering and design (PED) stage along the Internal Erosion Interception Trench (IEIT) alignment and in the ponding area, and characterize geologic conditions encountered during the IEIT excavation. Another Panel concern was that the proposed filter design for the Ponding Area does not appear to adequately protect against piping, considering the lack of geologic information in this area. USACE can address this issue by clarifying whether a filter fabric will be needed or, if filter fabric (geotextile) use is no longer appropriate, conducting additional subsurface investigations of the Ponding Area during the design phase to gain a better understanding of the geologic conditions, especially the horizontal and vertical variability of grain size distributions and the hydrologic conditions anticipated during construction. USACE can also assess whether the proposed 4-foot thick filter will be adequate to counter the anticipated uplift pressures associated with large storm events, including the probable maximum flood (PMF).

Geotechnical Engineering: Of primary concern to the Panel was that the effectiveness, completeness, and reliability of the IEIT concept for a dam or levee are untested. In response to the Panel's question on the IEIT during the site visit, USACE responded that they had not previously used this procedure. Research conducted by the Panel also indicates the IEIT has not been used in the United States or anywhere else in the world to prevent backward erosion piping (BEP). To address this issue USACE can assess whether IEIT technology risk can be adequately quantified as a risk reduction measure since it is an unproven and untested technology; consider whether other action alternatives are more appropriate for risk reduction, such as extension of weighted filter blankets and use of relief wells, and would reduce risk to acceptable levels in a manner that is quantifiable; and conduct additional subsurface investigations during the PED phase to better characterize geologic conditions along the length of IEIT excavation and at deeper levels of glacial outwash. Another important concern to the Panel was that the risks associated with potential increased Dover Dam pool storage and pool elevation due to climate change have not been evaluated in sufficient detail and could affect the success of the project. To address this concern USACE can evaluate the pool elevation that may occur from climate change, evaluate the potential impacts flooding may have on piping or levee breach, and add a narrative to the Draft DSMR/DEA that more fully describes recent changes to Dover Dam and any risks associated with potential increased pool elevation, flooding risk in Zoar village, breach of Zoar levee, or impacts on pump inundation.

Plan Formulation: The Zoar Levee project adheres to sound planning principles and USACE regulations and policies. However, of primary concern to the Panel was that the preferred alternative has little redundancy given the estimated risks and uncertainty, especially for an alternative that has no record of effectiveness and reliability and that results in only partial risk reduction. USACE can address this issue by considering whether widening of the weighted filter berm, to be used in conjunction with IEIT, will provide additional redundancy and reduced risk; evaluating whether the weighted filter berm should be designed as a graded filter blanket or whether filter fabric may be used between in situ soils and the installed berm to provide additional redundancy and risk minimization from piping and boils; and assessing whether relief wells, found in Action Alternatives 3A and 4A, would provide more redundancy. Another important issue the Panel identified was that a comprehensive risk assessment appears to have been conducted on the Zoar Village levee system, but the methods used to characterize the analysis have not been documented in a manner consistent with ER 1105-2-100, Appendix E. For studies of existing levee systems, documenting compliance with ER 1105-2-100, Appendix E, is a policy and technical requirement. USACE can address this issue by explaining how the comprehensive levee risk analysis meets or exceeds the requirements of ER 1105-2-100, Appendix E, delineating levee reaches or river stations using appropriate economic, geotechnical, and hydrologic/hydraulic criteria, and assigning probable non-failure and failure elevations to the levees for each location in a manner compliant with ER 1105-2-100.

Economics: The Panel noted that while the Zoar Levee project is not formulated based on economic outputs, recreation benefits accruing to such a valuable resource could be significant, even if not used for project justification. USACE can address this by performing a unit day value (UDV) recreation benefit analysis and investigating whether other studies have been performed and whether they could be applicable to this study. The Panel also noted that Regional Economic Development (RED) outputs have not been analyzed, and could convey the message that all effects on regional employment and income in Zoar Village have been considered. To address this issue, USACE can perform an RED analysis of the selected RMP/PAA.

Cultural Resources/NEPA: The Panel found the cultural resources background, the history of Zoar, and the probability model sections were very detailed, well-written and will serve as a benefit in the determination of eligibility for any undocumented cultural resources that may be encountered during field investigations. The baseline study on terrestrial and aquatic habitats was also done well. One cultural resource concern the Panel noted was the Draft DSMR/DEA defines the Programmatic Agreement as a document that will account for all impacts on all social, economic, and recreational resources, but this exceeds the scope and intent of the agreement as established in 36 CFR 800.14 and ER 1105-2-100. USACE can address this issue by rewording text in the Draft DSMR/DEA that discusses social, economic, and recreational resources in tandem with cultural resources to note that the relationship is symbiotic only for those social, economic, and recreational resources that support or are linked with the town's heritage tourism industry, which relies on preserved integrity of its historic properties/district.

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

Geologic uncertainty, which results in uncertainty in other aspects of the project, is not sufficiently estimated or characterized.

Basis for Comment

The Draft Dam Safety Modification Report and Draft Environmental Assessment (Draft DSMR/DEA) acknowledge that there is a significant amount of uncertainty regarding geologic conditions below the levee, the seepage area on the Village side of the Ball Field Section, the ponding area adjacent to the Rock Knoll area, and at other locations across the project. The Draft DSMR/DEA states (p. I, p. 8-1): "While there is uncertainty concerning the nature of the geology which affects the certainty of estimates of breach probabilities, two potential failure modes (PFMs) (PFM 1A-2 & PFM 1A-4) at Zoar Levee are forecasted..." Geologic uncertainty contributes to the uncertainty associated with the potential modes of failure. Figure 3-6 (p. 3-10) shows that the uncertainty in the probability of occurrence of PFMs 1A-2 (Ball Field Reach) and 1A-4 (Rock Knoll area), the critical risk drivers with respect to levee breach, is more than one to two orders of magnitude.

Given such a high level of uncertainty, it is difficult to predict if the probability of occurrence of a particular mode of failure, even after implementation of the selected Risk Management Plan (RMP), would be above or below the USACE tolerable risk limit line (TRLL). The DSMR/DEA (p. 3-51) supports this argument by stating:

> "In summary, existing and future risks indicate that Zoar Levee presents an annual probability of inundation from breaching or pump inundation that is greater than the USACE TRLL of 1 in 10,000 chances every year. The Zoar Diversion Dam also has incremental inundation probabilities, but these are estimated to be well below the USACE TRLL. These estimates of probabilities do have significant uncertainties associated with the nature of the geology."

Appendix A, Volume 1 states (p. 8-69):

> "As discussed previously, there was significant uncertainty regarding the estimate for PFM 1A-4. Specifically, the team recognized that there was little known about the materials at the bottom of the Pump Station Pond (seepage exit point). The mechanism by which this material would heave and displace (allowing eroded particles to move through this material and deposit on the surface) is not well understood." It is important to reduce this uncertainty by conducting additional geologic investigations during the design phase.

Geologic uncertainty also affects the evaluation and design of risk management alternatives. Appendix B states (p. B-3): "The team also addressed uncertainty in each of alternative designs. Specifically, there is still significant uncertainty regarding the PDT's understanding of foundation conditions."

The selected RMP/Preferred Action Alternative (PAA) involves installation of an Internal Erosion Interception Trench (IEIT) from stations 1+50 to 24+50 and an inverted weighted filter berm in the ponding area to reduce the risks associated with PFMs 1A-2 and 1A-4, respectively (site visit briefing – slide 137). The design and construction of both of these remediation actions depend on the geologic conditions along the IEIT alignment and in the ponding area, which, at this stage, have not been adequately characterized. While the review documents recognize geologic uncertainty and the Panel fully understands some geologic uncertainty will always remain because of the complexity of geologic conditions at the project site, additional efforts are required to estimate and characterize geologic uncertainty regarding variations in grain size distributions, thickness and continuity of alluvium and fine sand layers, and ground water conditions, especially during the design phase of the project.

Significance – High

Additional estimation and characterization of geologic uncertainty will reduce uncertainty and provide

Final Panel Comment 1

improved information about geologic conditions. The design, construction, performance, and success of the selected RMP/PAA will depend on the extent to which geologic conditions are known.

Recommendation for Resolution

1. Conduct additional geologic investigations during the preconstruction engineering and design (PED) stage along the IEIT alignment and in the ponding area, with particular attention to variations in grain size distributions, thickness and continuity of alluvium and fine sand layers, and ground water conditions.
2. Characterize geologic conditions, as stated under Recommendation 1, encountered during IEIT excavation.

Final Panel Comment 2

The preferred alternative has little redundancy given the estimated risks and uncertainty.

Basis for Comment

Table 6-4 (Draft DSMR/DEA, p. 6-5) presents a ranking of the various action alternatives. Action Alternative 6A, which uses an IEIT to reduce the potential for occurrence of PFM 1A-2 and a weighted inverted filter in the Ponding Area to reduce the potential for occurrence of PFM 1A-4, is ranked as the preferred alternative (#1). The reasoning provided in Table 6-4 in favor of Action Alternative 6A is "Lowest cost, most efficient plan to meet risk management objective. Good effectiveness and reduction of risk. Good robustness. Little redundancy." In comparison, Action Alternative 10A, ranked #2, is considered to be "Most effective, best reduction in risk & more robust than 6A. Good redundancy. Same risk reduction as 3A & 4A for less cost." It appears that the primary reason for selecting Action Alternative 6A, which has little redundancy, as the preferred alternative is its lowest cost ($8.01 million), compared to Action Alternative 10A ($13.02 million), which has much more redundancy. The Panel does not understand why the lowest cost (efficiency) is considered more important than other selection criteria (Table 6-1, Draft DSMR/DEA; p. 6-1), especially redundancy.

Table 6-1 (Draft DSMR/DEA, p. 6-1) presents a comparison of differentiating evaluation factors for Action Alternatives 3A, 4A, 6A, 7A, and 10A. The table shows that Action Alternatives 3A, 4A, and 10A have good redundancy, with Action Alternative 4A having the most redundancy, compared to Action Alternative 6A which has little redundancy The discussion about the comparison of action alternatives in the Draft DSMR/DEA (pp. 6-1 to 6-13) shows that the higher level of redundancy of Action Alternative 3A is due to the use of relief wells in conjunction with IEIT, that of Action Alternative 4A is due to the use of partial weighted filter berm and partial relief wells in conjunction with IEIT, and that of Action Alternative 10A is due to the use of partial weighted filter berm in conjunction with IEIT. In comparison, Action Alternative 6A (the preferred alternative) primarily uses IEIT with a much smaller weighted filter berm than 10A and, therefore, has little redundancy.

During a discussion of the preferred alternative, Appendix I (p. I-13) states: "It is important to understand that this remediation measure, while based on more recent theory and research and while not found in design manuals, is simply intended to provide some reduction in risk for PFM 1A-2." Since the risk reduction capability of Action Alternative 6A cannot be quantified, it needs to have redundancy.

The Panel understands USACE's selection of a cost-effective, research-based, innovative technique as its preferred action alternative, but there needs to be a backup plan (i.e., redundancy) in case the preferred action alternative does not work as intended. The Panel is concerned that the preferred alternative has little redundancy given the risks and uncertainty, especially the geologic uncertainty, estimated at the Zoar Levee & Diversion Dam.

According to Drawing CS501 and the description provided in Appendix I (p. I-15), the IEIT will be extended a minimum of 10 feet below the ground surface and a minimum of 5 feet beneath the bottom of the alluvium. It will be constructed with either #9 aggregate or C-33 fine aggregate (p. I-15). Even if the IEIT were a proven system, in the Panel's opinion, there is still a risk of BEP failure since the IEIT does not completely extend through fine sands, which exhibit piping risk, and the filtering characteristics calculations in Appendix I appear to not meet the requirements typical of filter design (Addendum I). Since IEIT, as described in Appendix I, will have residual risk, it is important that it has good redundancy.

Significance – High

Redundancy should be an important requirement of a risk reduction alternative, especially one that has no record of effectiveness and reliability and that results in only partial risk reduction. Lack of redundancy will potentially affect the success of the preferred alternative.

Final Panel Comment 2

Recommendation for Resolution

1. Consider whether widening of the weighted filter berm, to be used in conjunction with IEIT, will provide additional redundancy and reduced risk.
2. Consider whether the weighted filter berm should be designed as a graded filter blanket or whether filter fabric may be used between in situ soils and the installed berm to provide additional redundancy and risk minimization from piping and boils.
3. Assess whether relief wells, found in Action Alternatives 3A and 4A, would provide more redundancy.

Final Panel Comment 3

The effectiveness, completeness, and reliability of the IEIT concept for a dam or levee are untested.

Basis for Comment

The Draft DSMR/DEA for Zoar Levee & Diversion Dam documents the completion of a Dam Safety Modification Study (DSMS) to identify a risk management plan and reduce unacceptable dam safety risk. It predicts two PFMs will present annual probabilities of breach prior to overtopping that are above USACE Tolerable Risk Guidelines. Both PFM 1A-2 and PFM 1A-4 are related to risks of Backward Erosion Piping (BEP) through fine pervious soils underlying Zoar Levee. Action Alternative 6A has been identified as the selected RMP/PAA to prevent BEP and minimize risk of piping for the Ball Field Reach (PFM 1A-2, Action Alternative 6A).

In response to the Panel's question on the IEIT during the site visit, USACE responded that they had not previously used this procedure. Research conducted by the Panel also indicates the IEIT has not been used in the United States or anywhere else in the world to prevent BEP. The Panel found no case histories of its successful application. The concept of IEIT is based on preliminary experimental studies conducted in the Netherlands by Van Beek et al. (2008; 2010). It is the Panel's opinion that the effectiveness, robustness, resiliency, and reliability of the IEIT have not been tested, especially in areas similar to Zoar, where a significant amount of geologic heterogeneity and uncertainty exists, and therefore the risk reduction capabilities of IEIT are questionable.

A discussion of the IEIT in Appendix I (p. I-13) states: "It is important to understand that this remediation measure, while based on more recent theory and research and while not found in design manuals, is simply intended to provide some reduction in risk for PFM 1A-2." In the Panel's opinion, the effectiveness and completeness of the selected RMP/PAA is questionable and risk reduction cannot be quantified when using an unproven and untested technology.

A review of boring logs indicates the IEIT is installed to a minimum of 5 feet in depth into the fine sands. USACE has identified fine sands underlying the levee as a material susceptible to piping. Appendix I (p. I-11) indicates the possibility exists of impermeable layers in contact with fine sand. This may lead to concentrations of flow and possibly reduce the effectiveness of the selected RMP/PAA. The IEIT is proposed to be installed to limited depth and does not always penetrate the fine sands identified in the boring logs. In the Panel's opinion, piping may continue to occur beneath the IEIT, even if this procedure is considered an acceptable risk reduction measure.

There is the potential for fine-grained piped material, carried by underseepage, clogging the IEIT, especially near the trench walls, thereby decreasing its permeability, deteriorating its filtering ability, and reducing its effectiveness and reliability over time. The Netherlands' research also expresses concerns about clogging (Koelewijn et al., 2014).

IEIT installation procedures, identified by USACE during the site visit, require that installation be performed using a form of shielding the trench and installing material as construction progresses. The technique does not consider the potential variability of material that is likely to occur over the length of installation. Typical toe drain installations, in dam and levee design, allow for multiple materials to achieve a graded filter approach for installation. This would not be possible with planned IEIT construction procedures.

Groundwater conditions at the time of excavation for the IEIT may create additional complications. Table 2-5, Appendix I (p. I-46), shows that between Stations 15+00 and 24+00 the depth to groundwater will be less than the trench depth, allowing groundwater to enter the trench. High-speed pumping of this water may lead to piping of the fine-grained soils from the adjacent areas.

The IEIT, as described, will be designed to prevent BEP, but will not prevent new boils and seeps from occurring on the Village side of the levee, nor will it prevent buildup of artesian pressures noted during the

Final Panel Comment 3
2008 event (Appendix A, Volume 1, p. 2-57). This indicates lack of robustness and resiliency.
Significance – High
Risk reduction measures for BEP using IEIT technology are not a proven technology to minimize the two key risk reduction failure modes identified in the Draft DSMR/DEA.
Recommendation for Resolution
1. Consider whether IEIT technology risk can be adequately quantified as a risk reduction measure since it is an unproven and untested technology. 2. Consider whether other action alternatives are more appropriate for risk reduction, such as extension of weighted filter blankets and use of relief wells, and would reduce risk to acceptable levels in a manner that is quantifiable. 3. Conduct additional subsurface investigations during the PED phase to better characterize geologic conditions along the length of IEIT excavation and at deeper levels of glacial outwash.

Literature Cited:

Van Beek, V., A. Koelewijn, G. Kruse, H. Sellmeijer, and F. Barends (2008). Piping phenomena in heterogeneous sands – experiments and simulations. Fourth International Conference on Scour and Erosion. Available online at: http://vzb.baw.de/publikationen.php?file=icse4/0/c_12.pdf

Van Beek, V.M., H.T.J. de Bruijn, J.G. Knoeff, A. Bezuijen, and U. Forster (2010). Levee failure due to piping: a full-scale experiment. Fifth International Conference on Scour and Erosion, San Francisco, California. November 7-10. Available online at: http://ascelibrary.org/doi/abs/10.1061/41147%28392%2927

Koelewijn, A.R., G. de Vries, H. van Lottum, U. Forster, V.M. van Beek, and A. Bezuijen (2014). Full-scale testing of piping prevention measures: three tests at the IJkdijk: Physical Modelling in Geotechnics, Proceedings of the 8th International Conference on Physical Modelling in Geotechnics, Perth, Australia, January 14-17 (Gaudin & White (eds.). CRC Press, London.

Final Panel Comment 4

A comprehensive risk assessment appears to have been conducted on the Zoar Village levee system, but the methods used to characterize the analysis have not been documented in a manner consistent with ER 1105-2-100, Appendix E.

Basis for Comment

USACE guidance in ER 1105-2-100, Appendix E (USACE, 2000) directs using a systematic approach to determine degrees of reliability in existing levee systems:

> "Investigations for flood damage prevention involving the evaluation of the physical effectiveness of existing levees and the related effect on the economic analysis shall use a systematic approach to resolving indeterminate, or arguable, degrees of reliability. Reasonable technical investigations shall be pursued to establish the minimum and, to the extent possible, the maximum estimated levels of physical effectiveness. Necessary information and summary of analyses shall be included in report presentations of plan formulation and shall be documented in appropriate supporting materials."

While it appears that USACE conducted a comprehensive risk assessment, it is not clear whether the assessment meets or exceeds the existing levee systems requirements described above. The Draft DSMR/DEA does not document this compliance with 1105-2-100, Appendix E. Even though this project is not formulated to maximize net National Economic Development (NED) benefits, the policy requirement still applies.

While the elevation of the existing levee well exceeds the stages predicted by the estimated probable maximum flood (PMF), overtopping is not the only failure mode that could occur in the study area. The Zoar levee system has seen estimated 35- and 40-year flood events in relatively recent history, and experienced piping and underseepage problems with both.

Piping and underseepage have resulted in catastrophic levee failures elsewhere in the country, especially with levee systems constructed by the Works Progress Administration (WPA) in the 1930s. In the estimated 75- and 60-year events at Elba, Alabama in 1990 and 1998 respectively, piping and/or underseepage led to catastrophic failures. This was also a WPA-constructed levee.

Significance –Medium/High

For studies of existing levee systems, documenting compliance with ER 1105-2-100, Appendix E, is a policy and technical requirement.

Recommendation for Resolution

1. Explain, if possible and in detail, how the comprehensive levee risk analysis meets or exceeds the requirements of ER 1105-2-100, Appendix E.
2. Delineate levee reaches or river stations using appropriate economic, geotechnical, and hydrologic/hydraulic criteria.
3. Assign probable non-failure and failure elevations to the levees for each location in a manner compliant with ER 1105-2-100, pp. 105-107.
4. Estimate consequences of failure, even if those consequences are non-NED.
5. Provide a summary of the analyses conducted, as recommended in Recommendations 2-4 (above) in the Main Report and Economic, Geotechnical, and H&H Appendices.

Literature Cited:

USACE (2000). Planning – Planning Guidance Notebook. Engineer Regulation (ER) 1105-2-100. Department of the Army, U.S. Army Corps of Engineers, Washington, D.C. April 22.

Final Panel Comment 5

Potential pool storage elevations for Dover Dam related to climate change and recent dam modifications, which could impact impoundment and levee performance, are not fully described in the Draft DSMR/DEA.

Basis for Comment

The Draft DSMR/DEA indicates that the Zoar Levee & Diversion Dam was built in the 1930s to protect Zoar Village from flood water storage behind Dover Dam. According to the Draft DSMR/DEA (p. i), the purpose and need for Federal action is to reduce and manage incremental risks that are above the USACE Tolerable Risk Guidelines. Incremental risk is defined as that attributed to a breach prior to, or subsequent to, overtopping, or due to component malfunction or misoperation.

Although climate change is discussed in the Draft DSMR/DEA, potential storage and pool elevation risk are not fully quantified. Should significant increases in discharge occur at a constant rate over the period from 2015 to 2064, there is a subsequent increase in risk of pool storage elevation and increased risk of BEP and breach. There is insufficient justification that climate change would result in increases to base flow only in the last 10 to 15 years. Recent pool storage, in 2008 and 2011, indicates there may be a risk of impoundments, taking into account climate change, exceeding El. 909 feet. The following examples are risks associated with potential increased pool storage and pool elevation:

- The base flood event is defined as an event having a one percent chance of being equaled or exceeded in any given year. The approximate elevation of the base flood event is 912.5 feet, therefore the maximum pool storage is anticipated to be at this elevation. Table 1-1 (Draft DSMR/DEA, p. 1-18) provides details of the history of construction, events, and repairs/ remediation that have occurred from the original completion of the dam in 1939 (original crest elevation of 919 feet) and the current crest elevation of 928.5 feet completed during the levee raise in 1950/1951. Therefore the Panel agrees with the assessment for the base flood event that the incremental risk is primarily attributed to a breach from BEP as a result of seeps, boils, piping channels, and potential collapse that might result in a breach.
- Table 1-3 (p. 1-20) indicates that in 2008 an emergency seepage blanket was installed that does not meet filter design criteria and is not designed for impoundments over elevation (El.) 909 feet. It further states the levee toe drain and relief well collector system is also not designed for impoundments over El. 909 feet.
- Section 3.4.2 (pp. 3-47, 3-48) discusses the potential consequences of pump inundation. When Dover Dam pool elevation reaches El. 896 feet, the pumps become inundated and are no longer operational. It further states that "… it is likely that the rate at which water was rising would increase significantly once the pumps became inundated."
- It is likely that river discharge in the Muskingum Basin would increase by 15 percent above the base year's flow and that this likely would occur in the last 10 to 15 years of the period of analysis (Draft DSMR/DEA, p. 1-23).
- There is a risk of high pool storage elevations, since significant events occurred in 1947, 1952, 1959, 2005, 2008, 2011, and 2014 (Draft DSMR/DEA, pp. 1-15, 1-18, and 3-30). The 1947 event resulted in a record pool at El. 902.7 feet. The 2005 event resulted in a pool at El. 907.4 feet and the 2008 event in a pool at El. 904.6 feet.

In addition, Dover Dam has also had recent modifications to the parapet wall and use of a stop log system, which may result in additional risk under peak flows to the impoundment and pool storage elevation that are not described in the Draft DSMR/DEA .

Final Panel Comment 5

Significance –Medium/High

The risks associated with potential increased Dover Dam pool storage and pool elevation due to climate change have not been evaluated in sufficient detail and could affect the success of the project.

Recommendation for Resolution

1. Evaluate more fully the pool elevation that may occur from climate change, and evaluate the potential impacts flooding may have on piping or levee breach.
2. Consider adding a narrative to the Draft DSMR/DEA that more fully describes recent changes to Dover Dam and any risks associated with potential increased pool elevation, flooding risk in Zoar village, breach of Zoar levee, or impacts to pump inundation.

Final Panel Comment 6

The proposed filter design for the Ponding Area does not appear to adequately protect against piping, considering the lack of geologic information in this area.

Basis for Comment

The selected RMP/PAA proposes to use an inverted filter to mitigate the piping problem in the Ponding Area (PFM 1A-4) (Draft DSMR/DEA, Table 4-3, p. 4-12). Figure 4-5 of the Draft DSMR/DEA (p. 4-14) shows a schematic cross-section of the Ponding Area and the proposed filter. The Draft DSMR/DEA describes the filter-construction steps as follows (p. 4-12): (1) dredge the existing sediment within the Ponding Area to a depth of approximately 5 to 7 feet; (2) replace the dredged material with an approximately 4-foot thick gravel filter; and (3) armor the filter with stone large enough to allow for periodic dredging of the Ponding Area without damaging the underlying filter material. Appendix I (pp. I-30 to I-33) states that a multistage filter consisting of a 2-foot layer of #9 gravel in contact with the foundations, a 2-foot layer of #57 gravel, and a final layer of #2 stone will be used. Sheet drawing CG303, Appendix I, shows the details of the proposed gravel filter, designating these filter layers as first stage, second stage, and third stage filter layers, respectively. Drawing CG303 also indicates that a filter fabric, if needed, might be used between the gravel filter and the foundation soil.

In the Panel's opinion, such a filter design for the Ponding Area may not adequately protect against piping, especially if a filter fabric is not used. Since the geologic conditions in the Ponding Area is not well understood, additional geologic information will be required to confirm the adequacy of this design in terms of the gradations and thicknesses of the proposed filter layers, or to modify it. This is supported by the following statement from Appendix A, Volume 1 (p. 8-69):

> "Specifically, the team recognized that there was little known about the materials at the bottom of the Pump Station Pond (seepage exit point). The mechanism by which this material would heave and displace (allowing eroded particles to move through this material and deposit on the surface) is not well understood."

If additional geologic investigations indicate a large variability in grain size distributions, a filter fabric may be needed, as indicated in drawing CG303. However, during the site visit, the Panel was informed that USACE no longer considers filter fabric use as appropriate.

Significance – Medium/High

An inverted filter in the Ponding Area is an important component of the selected RMP/PAA, designed to prevent piping problems associated with PFM 1A-4. The adequacy of the filter design depends on a thorough understanding of geologic conditions at this location, which are relatively unknown at this stage.

Recommendation for Resolution

1. Clarify whether a filter fabric will be needed, as indicated in drawing CG303, or if filter fabric use is no longer appropriate, based on information provided during the site visit.
2. Conduct additional subsurface investigations of the Ponding Area during the design phase to gain a better understanding of the geologic conditions, especially the horizontal and vertical variability of grain size distributions and the hydrologic conditions anticipated during construction.
3. Assess if the proposed 4-foot thick filter will be adequate to counter the anticipated uplift pressures associated with large storm events, including the PMF.

Final Panel Comment 7

The limited width of the weighted filter berm in the Ball Field Reach, to be used in conjunction with the IEIT, does not provide resiliency and redundancy to assist in controlling migration of fines from piping.

Basis for Comment

The Draft DSMR/DEA describes the selected RMP/PAA in Section 6.2.1 (p. 6-5). The RMP/PAA consists of an IEIT along the Ball Field Reach and filter at the Ponding Area (PFM 1A-2, Action Alternative 6A IEIT for Ball Field Reach and PFM1A-4, Action Alternative 6A Filter for Ponding Area, as per Table 6-3). Although much of the main report identifies Action Alternative 6A as solely an IEIT, other narratives describe the alternative (p. 4-18) as a full-length IEIT offset from the levee toe with a small weighted filter berm installed. This is not clearly documented throughout the Draft DSMR/DEA, but can be clearly seen in Figures 6-2 and 6-3.

Action Alternative 6A consists of a full-length IEIT in the Ball Field Reach, with a small weighted filter berm whose primary purpose is to resist heave. According to the Draft DSMR/DEA (p. 4-17), the purpose of the IEIT is to block BEP. Figure 6-4 shows BEP (p. 6-9), indicating pre-existing defects, however, the location and depth of pre-existing defects are not documented in any investigation. It is the Panel's opinion that, even if the IEIT works as envisioned, seeps and boils will likely occur if the weighted filter berm is not graded and may also occur outside the limits of the weighted filter berm as shown in Figure 6-3 (p. 6-9).

It is the Panel's opinion that future boils, seeps, and erosion may potentially occur beneath the maximum depth of the IEIT or, if clogging does not occur, they may develop in the IEIT. The second case would result in a higher permeability layer that potentially would allow fine sands to continue to migrate through the IEIT. In either case, the risks are hard to quantify for the IEIT to be successful.

Significance – Medium/High

Should the IEIT not function as intended or should erosion paths occur below the base of the IEIT, continued seeps, boils, and piping may occur, potentially leading to levee failure.

Recommendation for Resolution

1. Modify the weighted filter berm limits to provide more resiliency and redundancy within areas where it could be expanded to mitigate risk of piping along the full length of the IEIT.
2. Use either a graded weighted filter berm or a filter fabric between the weighted filter berm and the confining layer to prevent fine sand migration during flood storage events that may lead to significant seeps, boils, and piping.
3. Clearly identify in the DSMR/DEA that a small weighted filter berm is included in Action Alternative 6A, since most of the Draft DSMR/DEA documentation only indicates an IEIT for PFM 1A-4, Action Alternative 6A for the Ball Field Reach, in tables, figures, and narrative throughout the report.

Final Panel Comment 8

Piezometer data are inconsistent and incomplete, and many piezometers are often inaccessible or nonfunctional during large-flood events, creating data gaps.

Basis for Comment

For a project like Zoar Levee & Diversion Dam, which is subject to extensive seepage, uplift pressures, and associated piping problems during large flood events (site visit briefing, slides 11, 13, 14, 40), piezometer data are of critical importance in monitoring the performance of Zoar Levee & Diversion Dam, as well as the performance of the selected RMP/PAA. However, the Panel is concerned that the piezometer data have been collected infrequently and do not exhibit consistent trends. During large flood events, many piezometers are not accessible and cannot be read, leaving gaps in the data.

The following quotes from Appendix A, Volume 1, indicate an urgent need to overhaul the piezometer data collection system.

- "…[T]he flashy nature of Goose Run impoundment does not allow for adequate capturing of the piezometer response under the current reading schedule." (p. 2-70)
- "In 2005, numerous piezometers overflowed or were frozen during the peak pool (Figure 2-68 and Figure 2-69). Lastly, in 2011, a minimal number of piezometer readings were collected (Figure 2-73, Figure 2-74, and Figure 2-75). Given the incompleteness of piezometer data collected, a comprehensive analysis of the piezometers is problematic." (p. 2-70)
- "The groundwater component is not clearly understood due to the limited frequency of piezometer readings that are not monitored for a sufficient period of time during rising and falling pools. These data gaps prevent the formulation of clear understanding of the piezometer response. Numerous piezometers in the ballfield reach and rock knoll exhibit unexpected behavior such as unusual lag times for rising and falling pools, higher than expected readings during pool and non-pool events, and generally unpredictable piezometer response from event to event." (p. 2-101)
- "Any potential remedial measures should take this and the other issues outlined above into consideration." (p. 2-101).

Significance – Medium

Properly functioning piezometers and a streamlined protocol for piezometer data collection are essential for monitoring the long-term performance of the selected RMP/PAA and for identifying problematic areas with respect to seepage and piping.

Recommendation for Resolution

1. Streamline the monitoring procedure for piezometer data collection so that data are collected regularly and frequently, leaving no data gaps.
2. Replace nonfunctional piezometers with new piezometers.
3. Automate piezometers as part of the selected RMP/PAA so that accessibility is not a problem and comprehensive data collection is possible under all loading and weather conditions.

Final Panel Comment 9

Pump station performance during low-frequency floods, including PMF, has not been fully characterized.

Basis for Comment

Successful operation of the pump stations is essential to the performance of the Zoar Levee & Diversion Dam flood risk management system. During recent relatively low-frequency events, the pump stations exhibited problems with overheating.

Overheating could be caused by any of several problems: overheating of the engines used to drive the pumps; the transmission of kinetic energy from the engines to the pumps themselves; problems with interior pump lubrication systems; wear or damage of drive shafts or bearings in the pumps; trash and debris inhibiting performance of the pumping systems; and lack of ventilation and cooling to minimize heat in the building structure. Each of these causes is typically investigated to identify the root cause of the overheating.

If one or more pumps or pump stations must be taken offline during low-frequency events under either the without- and with-project conditions, then the integrity of the entire flood risk management system is compromised and the risk of catastrophic failure increases.

It is the Panel's understanding that fans and buildings' ventilation have been added. However, verification of the heat generated and cooling requirements should be considered as part of the evaluation to determine if this is the root cause of the heat problem and whether heat dissipation is sufficient using the recent additions to ventilation and cooling of the structures housing the pumping systems.

Significance – Medium

Without a thorough analysis of the pump station performance and the root causes of previous performance issues, the entire system's integrity under both without- and with-project conditions is not well-understood.

Recommendation for Resolution

1. Describe how previous pump station performance events were evaluated.
2. Discuss the proximate cause of pump station performance issues.
3. Describe the types of pump systems employed on the Zoar Levee & Diversion Dam flood risk management system.
4. Describe how the performance issues will be addressed during PED.
5. Describe and compare the heat generation versus cooling procedures used.

Final Panel Comment 10

Considering the extensive seepage and piping observed in the Rock Knoll area during the flood events of 2005 and 2008, the emergency seepage blanket may not be adequate to minimize future piping problems.

Basis for Comment

The Draft DSMR/DEA, Appendix A addresses the issue of the emergency seepage blanket as follows:

- The emergency blanket placed on the Village side of the Rock Knoll area of the levee (Figure 2-37. p.2-41; Figure 4-1, p.2-41), which experienced extensive piping and large concentrated water seeps during the 2005 and 2008 flood events (Figures 2-52, 2-53, 2-54, and 2-56, pp. 2-55 to 2-60) was not designed as a filter blanket (p. 2-5).
- "The granular material provided some immediate filtering capability for the flow from existing concentrated seep exits, and the weight of the blanket helped to prevent the formation of new seep exits as Dover Dam's impoundment dropped. The blanket was designed to provide an additional confidence of performance if Dover's impoundment reached El. 909 feet, which was a forecasted possibility at the time." (p. 4-5)
- "The 2008 Emergency Seepage Blanket was designed only as a temporary seepage control feature and does not meet filter criteria for the finer foundation soils known to abut the Rock Knoll. The blanket also serves as an impediment to surveillance activities, obscuring potential performance scars. The seepage blanket was principally designed to provide risk reduction benefits at times when Dover's impoundment is lower than El. 909 feet." (p. 4-6)
- "For a long term benefit, the filtering capability of the blanket should be addressed. Replacing portions of the emergency blanket with a blanket that is filter compatible with foundation and/or embankment soils, is recommended in the long term." (p. 10-2).

The Panel agrees with the recommendation of replacing portions of the emergency seepage blanket with a blanket that is filter-compatible with foundation and embankment soils. However, details about the extent and nature of blanket modification are not provided. Also, the Panel is uncertain about the definition of "long term."

Considering the past history of seepage and piping problems in the Rock Knoll area, the Panel is concerned that the emergency seepage blanket may not be able to minimize piping problems or provide a filtered exit for the seeping water during future flood events, especially those exceeding El. 909 feet, if significant portions of the emergency blanket are not modified to serve as a filter blanket and if the recommendation is not implemented in conjunction with the selected RMP/PAA.

Significance – Medium

Without filtering capability, a seepage blanket designed to reduce piping potential is not complete and may not be able to serve its intended purpose, especially if Dover Dam impoundment exceeds El. 909 feet.

Recommendation for Resolution

1. Modify the seepage blanket to serve as a filter blanket as part of the selected RMP/PAA rather than a long-term recommendation.
2. Monitor the drainage ditch around the blanket and the associated weir after all flood events for presence of sediment.

Final Panel Comment 11

The possible migration of sand and silt size particles from the glacial outwash that comprises the levee foundation, which could result in foundation adjustment and detrimental settlement of the levee, has not been evaluated.

Basis for Comment

Piping along the contact between uniform sand and alluvium layers, which requires heaving and cracking of the alluvium layer, is the dominant mechanism of subsurface erosion, leading to formation of boils on the Village side of the levee (site visit briefing, slides 74-78). However, neither the Draft DSMR/DEA nor Appendix A considers the possibility that prolonged periods of elevated pool behind the levee, and the associated high hydraulic gradients, could move fine sand and silt-size particles from the heterogeneous glacial outwash that comprises the levee foundation. This possibility is supported by the presence of SP (poorly graded sand) and SP-SM (poorly graded sand to silty sand) material in deeper portions of the outwash with coefficient of uniformity (C_u) values falling between 1.7 and 3 (Appendix A, Volume 1, p. 2-21). Although such a movement of fine material from glacial outwash will not result in the formation of pipes, it can result in foundation adjustment and detrimental settlement of the levee, especially after multiple loadings and especially where the alluvium layer is either absent (Appendix A, Volume 1, p. 2-23), consists of SP/SP-SM material (Appendix A, Volume 1, p. 2-21), or has been disturbed by construction activities on the Village side of the levee such as the Ponding Area or some reaches of the Ball Field segment of the levee.

No data are presented on the sediment carried by large seeps (not associated with piping) observed in the emergency seepage blanket area following the 2005 and 2008 storm events (Appendix A, Figure 2-52, p. 2-55). Also, neither the Draft DSMR/DEA nor Appendices A, B, and I present any evidence or data about the actual heaving and cracking of the fine-grained layer of alluvium at all locations where piping or concentrated seeps occurred, although this is the basic model used to explain the formation of boils. In the Panel's opinion, boils and seeps can develop in places where the alluvium layer consists of SP/SP-SM material.

Significance – Medium

Considering all possible mechanisms of removal of fine-grained material from the heterogeneous glacial outwash that comprises the levee foundation will add to the completeness of the methods and analyses used for assessment of the levee-breach risk.

Recommendation for Resolution

1. Evaluate the potential for migration of fines from the Zoar levee foundation, in addition to piping, during future infrequent storm events.
2. Monitor future large-size seeps for the presence of sediment.

Final Panel Comment 12

Pipes or channels beneath the levee may lead to unknown risk of a levee collapse and breach.

Basis for Comment

Two potential failure modes (PFM 1A-2, Ball Field Reach, and PFM 1A-4, Rock Knoll area) have been identified in the Draft DSMR/DEA. Both are associated with BEP through pervious soils underlying Zoar Levee and could lead to a levee breach. According to the Draft DSMR/DEA (p. i), the final array of alternatives was designed to reduce the probability of BEP by lowering the water pressures on the Village side of the levee and reducing BEP risk that may start on the Village side and progress underneath the levee leading to a breach.

As described in the Draft DSMR/DEA (p. 1-15), a Dover Dam impoundment occurred in January 2005 leading to a pool elevation of 907.4 feet. This resulted in concentrated small "pin" boils and concentrated seeps that led to a DSAC 2 rating for Zoar levee citing "extensive seepage and small boils" and a rating of "Probably Inadequate" for seepage and piping under "Normal" conditions. This was followed by a March 2008 event with a pool elevation of 904.6 feet for Dover dam impoundment, peaking 3 feet below the 2005 event, which led to large concentrated seepage or boils at several locations on the Village side of the levee.

The Draft DSMR/DEA documentation indicates that as sands erode out of the underlying uniform sand layer, beneath the levee, the overlying layer does not collapse to fill in the resulting void, providing a pipe or channel that continues to erode with each successive flood event. The Draft DSMR/DEA (p.3-13) further indicates "These pipes or channels grow and connect (enlarge), basically eroding the foundation from underneath the levee; and the levee collapses under its own weight and a breach occurs." This mechanism is known as BEP.

A similar BEP process can occur both in the Ball Field Reach and Rock Knoll Section of the levee. The only significant difference between PFM 1A-2 and PFM 1A-4 is the confining layer and its ability to resist the water pressure.

The Draft DSMR/DEA (p. 4-17) states that the IEIT "…would not reduce the amount of seepage or boils expected to occur for any future event." When considering that there have been a number of flood events in the past in which seeps and boils have been observed, with some transport of material, the extent of any pipes or channels that may have formed beneath the levee system is not clear. While the IEIT is intended to prevent BEP, it is possible that piping channels may already exist beneath the levee and may contribute to increased flow. If, because of the pre-existing piping channels, seeps or boils occur in the future on the Village side of the levee, it is unclear how migration of fines will be controlled and whether piping risk is higher than anticipated.

It is the Panel's opinion the risk may be higher than anticipated, leading to unexpected consequences and that the IEIT may not reduce the risk of the potential failure mechanism associated with any pre-existing piping channels.

Significance – Medium

Should pipes or channels exist, connect, or enlarge, the potential for future levee collapse may be higher than anticipated, resulting in less robust alternatives to minimize risk of the BEP.

Recommendation for Resolution

1. Consider whether additional trenching inspection, boreholes, or geophysical techniques may be used to identify pipes or channels.
2. Consider whether suitable techniques may be employed to retard or minimize flow paths if pre-existing channels or pipe paths can be identified. If channels can be identified, determine how this might impact the alternatives analysis presented in the Draft DSMR/DEA.

Final Panel Comment 13

Potential recreation benefits have not been estimated in sufficient detail to reinforce its importance to the area.

Basis for Comment

Recreation is a significant aspect of the Zoar Levee & Diversion Dam study's importance to the region. The area currently enjoys significant tourist traffic to the Village's historical sites, and also offers towpath trails for hikers, cyclists, and horses, and walking trails in 50 acres of woodlands. Some analysis of potential recreation benefits would be helpful in reinforcing this notion.

This study area has been described as an important resource, and could likely be unique. As a result, some estimation of the recreation benefits associated with protecting it should be included. The recreation analysis need not be extensive or complex. It can include something as rudimentary as a Unit Day Value (UDV) estimation performed by USACE or a regional model performed by outside sources, including Contingent Valuation Method/Survey (CVM or CVS) or Travel Cost Method (TCM).

Significance – Medium/Low

While this project is not formulated based on economic outputs, recreation benefits accruing to such a valuable resource could be significant, even if not used for project justification.

Recommendation for Resolution

1. Perform a UDV recreation benefit analysis.
2. Investigate whether CVM/CVS or TCM studies have been performed and determine whether they could be applicable to this study.

Final Panel Comment 14

Regional Economic Development outputs have not been analyzed, and could convey the message that all effects on regional employment and income in Zoar Village have been considered.

Basis for Comment

Although the Regional Economic Development (RED) account is not used for formulation in the Zoar Levee & Diversion Dam study, regional outputs associated with protecting Zoar Village could be significant and deserve some evaluation and discussion. A qualitative analysis of the effects on regional employment and income (the most commonly employed measures of regional impacts) associated with the selected RMP/PAA would be sufficient.

Including such analyses and discussion in the Draft DSMR/DEA would demonstrate that the study has considered all impacts associated with protecting Zoar Village and that all identifiable outputs have been evaluated and incorporated. These analyses would also demonstrate to the public that, while economic impacts did not drive plan formulation, the selected RMP/PAA does have tangible economic benefits nonetheless. These tangible economic benefits are not currently described in the Draft DSMR/DEA.

Significance – Medium/Low

Without an analysis of RED impacts, there is insufficient information to determine whether all outputs associated with the project have been considered.

Recommendation for Resolution

1. Perform an RED analysis of the selected RMP/PAA.
2. Determine if others outside USACE have studied the regional economic effects of protecting Zoar Village and describe how these external studies are appropriate for inclusion and discussion.

Final Panel Comment 15

The Draft DSMR/DEA defines the Programmatic Agreement as a document that will account for all impacts on all social, economic, and recreational resources, but this exceeds the scope and intent of the agreement as established in 36 CFR 800.14 and ER 1105-2-100.

Basis for Comment

The Programmatic Agreement (PA) between USACE, Huntington District, the Village of Zoar, the Zoar Community Association, the Ohio State Historic Preservation Office, the Ohio History Connection, and the Advisory Council on Historic Preservation was developed in accordance with 36 CFR 800.14(b)(1)(ii)) and Appendix C of ER 1105-2-100 (USACE, 2000) and is presented as Appendix A, Addendum 2 to the Draft DSMR/DEA. As outlined in these regulations, the PA is intended to address the potential effects on historic properties that cannot be fully determined prior to final approval of a preferred alternative. Hence, the primary intent of the PA is to ensure USACE's Section 106 responsibilities (36 CFR 800.14(b)(1)(ii)) are met. Further, the PA stipulates that the involved consulting parties noted above are in agreement that adverse effects on the Zoar Village's residential and business community during implementation of any of the alternatives could negatively affect the town's heritage tourism industry and possibly diminish the integrity of design, materials, workmanship, and/or historic setting and feeling of its historic properties, which would impact its listing as a historic district.

The PA, Attachment 4, identifies 15 actions of concern and their potential effects on social, economic, recreational, and aesthetic resources, demonstrating how any of these could potentially affect individual historic properties and the historic district. Within the PA, the symbiotic relationship of certain social, economic, recreational, and aesthetic resources with cultural resources is well-demonstrated. However, in summarizing the PA, the Draft DSMR/DEA risks departing from the intent of programmatic agreements as noted in 36 CFR 800.14, using language that suggests that the entire spectrum of social, economic, and recreational resources is linked to cultural/historical resources. Such text occurs primarily within Sections 5.3.1 (pp. 5-17 to 5-19) and 5.3.1.3 (pp. 5-20 to 5-22). For example, the fifth paragraph of Section 5.3.1.3 notes that:

> "With the advent of this Programmatic Agreement, any additional impacts or adverse effects identified from any of the action alternative risk management plans to social, economic, recreational resources, as well cultural/historical resources shall be managed to avoid, minimize or mitigate for them appropriately."

As used in the Draft DSMR/DEA, this and other similar statements seem to misrepresent the PA, widening the intent of its scope beyond Section 106 coordination and compliance as it is originally intended under 36 CFR 800.14 and Appendix C of ER 1105-2-100. As written, the PA is not intended to address the full range of adverse impacts on social, economic, and recreational resources, only those that are linked "to the maintenance of Zoar Village/Zoar Village Historic Site/Zoar District's historical integrity and significant character defining features" (PA, p. 3).

Significance – Low

The characterization of the PA in the Draft DSMR/DEA affects the understanding of the project and its potential adverse effects on social, economic, and recreational resources, but will not affect the recommendation or justification of the project.

Recommendation for Resolution

1. Reword text in the Draft DSMR/DEA that discusses social, economic, and recreational resources in tandem with cultural resources to note that the relationship is symbiotic only for those social, economic, and recreational resources that support or are linked with the town's heritage tourism industry, which relies on preserved integrity of its historic properties/district (see Draft DSMR/DEA, p. 3-31, 2nd paragraph for an example).

5. REFERENCES

Koelewijn, A.R., G. de Vries, H. van Lottum, U. Forster, V.M. van Beek, and A. Bezuijen (2014). Full-scale testing of piping prevention measures: three tests at the IJkdijk: Physical Modelling in Geotechnics, Proceedings of the 8th International Conference on Physical Modelling in Geotechnics, Perth, Australia, January 14-17 (Gaudin & White (eds.). CRC Press, London.

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APPENDIX A

IEPR Process for the Zoar Levee Project

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

Table A-1 presents the schedule followed in executing the Draft Dam Safety Modification Report (DSMR) & Environmental Assessment (EA) for Zoar Levee & Diversion Dam, Zoar Village, Tuscarawas County, Ohio Independent External Peer Review (hereinafter: Zoar Levee IEPR). Due dates for milestones and deliverables are based on the award/effective date of January 12, 2015. The review documents were provided by U.S. Army Corps of Engineers (USACE) on January 13, 2015. Note that the work items listed under Task E occur after the submission of this report. Battelle will enter the 15 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. Zoar Levee Complete IEPR Schedule

Task	Action	Due Date
A	Award/Effective Date	1/12/2015
	Review documents available	1/13/2015
	Public comments available	2/17/2015
	Battelle submits draft Work Plan[a]	1/16/2015
	USACE provides comments on draft Work Plan	1/21/2015
	Battelle submits final Work Plan[a]	1/27/2015
B	Battelle requests input from USACE on the conflict of interest (COI) questionnaire	1/14/2015
	USACE provides comments on COI questionnaire	1/15/2015
	Battelle submits list of selected panel members[a]	1/19/2015
	USACE confirms the panel members have no COI	1/21/2015
	Battelle completes subcontracts for panel members	1/28/2015
C	Battelle convenes kick-off meeting with USACE	1/16/2015
	Battelle sends review documents to panel members	1/29/2015
	Battelle convenes kick-off meeting with panel members	2/2/2015
	Battelle convenes on-site meeting with USACE and panel members to view project-specific locations (Travel days are: 2/9 and 2/11/2015)	2/10/2015
	Battelle convenes Mid-Review Teleconference for panel members to ask clarifying questions of USACE	N/A

Table A-1. Zoar Levee Complete IEPR Schedule (continued)

Task	Action	Due Date
D	Panel members complete their individual reviews	2/26/2015
	Battelle provides panel members with talking points for Panel Review Teleconference	3/6/2015
	Battelle convenes Panel Review Teleconference	3/6/2015
	Battelle provides Final Panel Comment templates and instructions to panel members	3/7/2015
	Panel members provide draft Final Panel Comments to Battelle	3/12/2015
	Battelle provides feedback to panel members on draft Final Panel Comments; panel members revise Final Panel Comments	3/13 – 3/18/2015
	Panel finalizes Final Panel Comments	3/19/2015
	Battelle receives the public comments from USACE	2/17/2015
	Battelle sends public comments to Panel	2/27/2015
	Panel completes its review of the public comments	3/6/2015
	Battelle and Panel review Panel's charge question responses to public comments during the panel review teleconference	3/6/2015
	Panel drafts Final Panel Comment regarding public comments, if necessary	N/A
	Panel finalizes Final Panel Comment regarding public comments	N/A
	Battelle provides Final IEPR Report to panel members for review	3/20/2015
	Panel members provide comments on Final IEPR Report	3/20/2015
	Battelle submits Final IEPR Report to USACE[a]	3/23/2015
E[b]	Battelle inputs Final Panel Comments to DrChecks and provides Final Panel Comment response template to USACE	3/23/2015
	Battelle convenes teleconference with USACE to review the Post-Final Panel Comment Response Process	3/24/2015
	Battelle convenes teleconference with Panel to review the Post-Final Panel Comment Response Process	3/24/2015
	USACE Project Delivery Team (PDT) provides draft Evaluator Responses to USACE Risk Management Center (RMC) for review	3/30/2015
	USACE RMC reviews draft Evaluator Responses and works with USACE PDT regarding clarifications to responses, if needed	3/31/2015
	USACE RMC provides draft PDT Evaluator Responses to Battelle; Battelle provides the panel members the draft PDT Evaluator Responses	3/31/2015
	Panel members provide Battelle with draft BackCheck Responses	4/3/2015
	Battelle convenes teleconference with panel members to discuss draft BackCheck Responses	4/6/2015

Table A-1. Zoar Levee Complete IEPR Schedule (continued)

Task	Action	Due Date
	Battelle convenes Comment-Response Teleconference with panel members and USACE	4/7/2015
	USACE inputs final PDT Evaluator Responses to DrChecks; Battelle provides final PDT Evaluator Responses to panel members	4/9/2015
	Panel members provide Battelle with final BackCheck Responses	4/10/2015
	Battelle inputs the panel members' final BackCheck Responses to DrChecks and submits pdf printout of DrChecks project file[a]	4/13/2015
	Contract End/Delivery Date	6/12/2015

a Deliverable.

b Task E occurs after the submission of this report

N/A indicates the milestone did not occur because it was found not to be necessary or because no additional comments were identified.

At the beginning of the Period of Performance for the Zoar Levee IEPR, Battelle held a kick-off meeting with USACE to review the preliminary/suggested schedule, discuss the IEPR process, and address any questions regarding the scope (e.g., clarify expertise areas needed for panel members). Any revisions to the schedule were submitted as part of the final Work Plan. In addition, 27 charge questions were provided by USACE and included in the draft and final Work Plans. Battelle added two questions that sought summary information from the IEPR Panel and one charge question on the public comments. In total, 30 charge questions were provided to the IEPR Panel. 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 two days of their subcontracts being finalized, all members of the Panel attended a kick-off meeting via teleconference planned and facilitated by Battelle in order to review the IEPR process, the schedule, the site visit logistics, communication procedures, and other pertinent information for the Panel. Before the kick-off meeting, the IEPR Panel received an electronic version of the final charge as well as the Zoar Levee 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.[1]

- DSMR/EA – Main Report (170 pages)
- Appendix A – Existing & Future Without-Action Condition (Two Volumes) (1,400 pages)
- Appendix B – Future With-Action Risk (70 pages)
- Appendix C – Cost Estimate (81 pages)

[1] Note: Appendices E, F, H, and K were not provided by USACE and did not undergo IEPR.

- Appendix D – Baseline Planning Studies & Environmental Data (7 Addenda) (2,500 pages plus 1,500 of reference material)
- Appendix G – Cost and Risk Schedule 17-Nov-14 (5 pages)
- Appendix I – Engineering (2,000 pages)
- Appendix J – Real Estate Plan (11 pages)
- Appendix L – District Quality Control and Agency Technical Review (200 pages)
- Appendix M – Measures Screened (7 pages)
- Appendix N – August 2014 Interior Event (16 pages)

Supporting Information

General

- EC 1105-2-412, Assuring Quality of Planning Models, 31 March 2011
- EC 1165-2-214, Civil Works Review, 15 December 2012
- EC 1165-2-210, Water Resources Policies and Authorities - Water Supply Storage and Risk Reduction Measures for Dams, 9 April 2010
- EP 1110-2-13, Dam Safety Preparedness, 28 June 1996
- ER 1110-1-12, Engineering and Design - Quality Management, 31 March 2011 (change 2)
- ER 1110-2-1150, Engineering and Design - Engineering and Design for Civil Works Projects, 31 August 1999
- ER 1110-2-1155, Engineering and Design - Dam Safety Assurance Program, 12 September 1997
- ER 1110-2-1156, Engineering and Design - Safety of Dams - Policy and Procedures, 31 March 2014
- ER 1110-1-8159, Engineering and Design - DrChecks, 10 May 2001
- National Academy of Sciences, “Policy and Procedures on Committee Composition and Balance and Conflicts of Interest for Committees Used in the Development of Reports,” May 2003 for General Scientific and Technical Studies and Assistance: General Scientific and Technical Studies and Assistance. Available at: http://www.nationalacademies.org/coi/index.html

- Water Resources Development Act of 2007, Sections 2034 & 2035, Pub. L. 110-114. Privacy Act, 5 U.S.C. § 522a as amended

Environmental/Planning

- ER 1105-2-100, Guidance for Conducting Civil Works Planning Studies. CECW-P, 28 Dec 1990
- Council on Environmental Quality. 1978. Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act. 40 CFR Parts 1500-1508. Washington, DC: U.S. Government Printing Office (November 29, 1978).
- ER 200-2-2, Environmental Quality, Procedures for Implementing NEPA. CECWRE (now CECW-A), 4 March 1988
- National Environmental Policy Act of 1969
- National Historic Preservation Act of 1966
- 36 CFR 800

Geotechnical Engineering

- EM 1110-2-1901, Engineering and Design - Seepage Analysis and Control for Dams, 30 April 1993
- EM 1110-2-1913, Engineering and Design - Design and Construction of Levees, 30 April 2000
- EM 1110-2-1914, Engineering and Design – Design, Construction, and Maintenance of Relief Wells, 29 May 1992
- EM 1110-2-2300, Engineering and Design - General Design and Construction Considerations For Earth and Rock-Fill Dams, 30 July 2004

Hydraulic Engineering

- EM 1110-2-2902, Engineering and Design - Conduits, Culverts, and Pipes, 31 March 1998
- EM 1110-2-3600, Engineering and Design - Management of Water Control Systems, 30 November 1987
- ER 1110-8-2 (FR), Inflow Design Floods for Dams and Lakes, 1 March 1991
- ER 1110-2-240, Water Control Management, 8 October 1998
- ER 1130-2-530, Flood Control Operations and Maintenance Policies, 30 October 1996
- ER 1110-2-8156, Preparation of Water Control Manuals, 31 August 1995

Documents for Reference

- 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.2 Site Visit

Approximately one week after the review began, on February 10, 2015, Battelle planned and facilitated a site visit held at the Zoar School House, in Zoar Village, Ohio. During this in-person site visit, USACE presented project details to the Panel. Three of the four panel members and one Battelle staff member attended the meeting and the subsequent site visit. A list of all attendees can be found in Table A-2. The meeting was conducted in two parts. The first part involved a detailed briefing by USACE on the project history, issues, actions, and Dam Safety Modification Report & Environmental Assessment. Panel members asked several questions during the presentation, and an open discussion ensued. The second part of the meeting was the site visit. USACE led Battelle staff and the panel members on a tour of the Zoar Levee & Diversion Dam, stopping at various points along the levee to observe key issues, including various geologic, geotechnical, and NEPA considerations.

Throughout the site visit, USACE staff pointed out specific project features to help the panel members better comprehend issues associated with the existing project features and the intent of the project remediation. USACE staff then answered questions posed by the panel members. This tour provided an opportunity for the panel members to see the project area and project features and to ask clarifying questions of the USACE Project Delivery Team (PDT).

Following the site visit, the USACE PDT provided Battelle with the presentation slides, videos of seepage and levee boils around Zoar, the 2009 and 2014 conduit inspections, and various reference articles. Battelle sent these materials to the Panel.

Table A-2. Battelle, the Panel, USACE, and the Town of Zoar Personnel Attending the Site Visit

Name	Affiliation	Role on IEPR
Abdul Shakoor	Kent State University	IEPR – Engineering Geologist
Karen Miller	Huntington District USACE	Plan Formulation PDT
Susan Stafford	Huntington District USACE	Environmental Analysis PDT
Josh Haefner	Hicks & Company	IEPR – Cultural Resources/NEPA
Mike Hartley	PND Engineers	IEPR – Geotechnical
Adam Kays	Huntington District, DSPC, USACE	Geotechnical PDT
Mike Nield	Huntington District, DSPC-GS, USACE	Geologist PDT
Darin White	Huntington District, DSPC-GE, USACE	Lead Engineer PDT
Ken Woodard	Huntington District, PM-PP	USACE Project Manager
Dick Uhler	Battelle	IEPR PM Representative
Larry Bell	Zoar	Town of Zoar Mayor
John Elsasser	Zoar	Zoar Community Association

A.3 Review of Individual Comments

Although originally scheduled, the Panel determined that a mid-review teleconference was not warranted due to the majority of their questions being answered during the site visit. The Panel did ask three questions during the review, which were answered by USACE prior to completion of the review.

In addition, throughout the review period, USACE provided documents at the request of panel members. Two documents were provided to Battelle and then sent to the Panel as additional information only and were not part of the official review:

- Pump Chart (PDF)
- Pump Assembly Drawing.

The Panel was instructed to address the charge questions/discussion points in 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 overall recurring themes, areas of potential conflict, and other overall impressions. At the end of the review, Battelle summarized the individual comments in a preliminary list of 15 overall comments and discussion points. Each panel member's individual comments were shared with the full Panel in a merged individual comments table.

A.4 Conduct of the Public Comment Review

Battelle received a PDF file containing three pages of public comments on the Zoar Levee from USACE on February 17, 2015. Battelle then sent the public comments to the panel members on February 27, 2015 with one charge question to which they were asked to respond:

1. Does information provided, or do concerns raised by the public, identify any additional discipline-specific technical issues with regard to the overall report?

The Panel produced individual comments in response to the charge question. Battelle reviewed the comments to identify any new technical concerns that had not been previously identified during the initial IEPR. Upon review and further discussion during the panel review teleconference, Battelle determined, and the Panel confirmed, that no new issues or concerns were identified other than those already covered in their original comments.

A.5 IEPR Panel Teleconference

Battelle facilitated a three-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 one specific charge question where there appeared to be disagreement among panel members. The conflicting comment was resolved based on the professional judgment of the Panel, and all sets of comments were determined not to be conflicting.

At the end of these discussions, the Panel identified 17 comments and discussion points that should be brought forward as Final Panel Comments.

A.6 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 Zoar Levee 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 one of the Final Panel Comments could be either dropped or merged into other Final Panel Comments, therefore, the total Final Panel Comment count was reduced to 16. An additional Final Panel Comment no longer met the criteria for at least a low level of significance, therefore, the total Final Panel Comment count was further reduced to 15. At the end of this process, 15 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.

APPENDIX B

Identification and Selection of IEPR Panel Members for the Zoar Levee Project

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B.1 Panel Identification

The candidates for the Dam Safety Modification Report & Environmental Assessment for Zoar Levee & Diversion Dam, Zoar Village, Tuscarawas County, Ohio (hereinafter: Zoar Levee IEPR) Panel were evaluated based on their technical expertise in the following key areas: cultural resources/National Environmental Policy Act (NEPA), plan formulation/economics, engineering geology, and geotechnical engineering. These areas correspond to the technical content of the Zoar Levee IEPR review documents and overall scope of the Zoar Levee project.

To identify candidate panel members, Battelle reviewed the credentials of the experts in Battelle's Peer Reviewer Database, sought recommendations from colleagues, contacted former panel members, and conducted targeted Internet searches. Battelle evaluated these candidate panel members in terms of their technical expertise and potential conflicts of interest (COIs). Of these candidates, Battelle chose the most qualified individuals, confirmed their interest and availability, and ultimately selected four experts for the final Panel. The remaining candidates were not proposed for a variety of reasons, including lack of availability, disclosed COIs, or lack of the precise technical expertise required.

The candidates were screened for the following potential exclusion criteria or COIs.[2] 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.

- Previous and/or current involvement by you or your firm[3] in the Draft Dam Safety Modification Report (DSMR) & Environmental Assessment (EA) for Zoar Levee & Diversion Dam, Zoar Village, Tuscarawas County, Ohio, or technical appendices.

- Previous and/or current involvement by you or your firm[2] in dam safety modification in the Muskingum River Basin System.

- Previous and/or current involvement by you or your firm[2] in projects related to the Draft Dam Safety Modification Report (DSMR) & Environmental Assessment (EA) for Zoar Levee & Diversion Dam, Zoar Village, Tuscarawas County, Ohio.

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[2] 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."

[3] 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.

- Previous and/or current involvement by you or your firm[2] in the conceptual or actual design, construction, or operation and maintenance (O&M) of any projects related to the Draft Dam Safety Modification Report (DSMR) & Environmental Assessment (EA) for Zoar Levee & Diversion Dam, Zoar Village, Tuscarawas County, Ohio.

- Current employment by the U.S. Army Corps of Engineers (USACE).

- Previous and/or current involvement with paid or unpaid expert testimony related to the Draft Dam Safety Modification Report (DSMR) & Environmental Assessment (EA) for Zoar Levee & Diversion Dam, Zoar Village, Tuscarawas County, Ohio.

- Previous and/or current employment or affiliation with members of the non-Federal sponsors or any of the following cooperating Federal, state, county, local, and regional agencies, environmental organizations, and interested groups: Ohio History Connection (previously the Ohio Historical Society); State Historic Preservation Office; Zoar Community Association; National Park Service; and Muskingum Watershed Conservancy District, for pay or pro bono.

- Past, current, or future interests or involvements (financial or otherwise) by you, your spouse, or your children related to the Draft Dam Safety Modification Report (DSMR) & Environmental Assessment (EA) for Zoar Levee & Diversion Dam, Zoar Village, Tuscarawas County, Ohio.

- 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, Engineer Research and Development Center [ERDC], etc.), and position/role. Please highlight and discuss in greater detail any projects that are specifically with the Huntington District.

- Previous or current involvement with the development or testing of models that will be used for, or in support of the Draft Dam Safety Modification Report (DSMR) & Environmental Assessment (EA) for Zoar Levee & Diversion Dam, Zoar Village, Tuscarawas County, Ohio project.

- Current firm[2] involvement with other USACE projects, specifically those projects/contracts that are with the Huntington District. If yes, provide title/description, dates, and location (USACE district, division, Headquarters, ERDC, etc.), and position/role. Please also clearly delineate the percentage of work you personally are currently conducting for the Huntington District. Please explain.

- Any previous employment by USACE as a direct employee, notably if employment was with the Huntington District. If yes, provide title/description, dates employed, and place of employment (district, division, Headquarters, ERDC, etc.), and position/role.

- Any previous employment by USACE as a contractor (either as an individual or through your firm[2]) within the last 10 years, notably if those projects/contracts are with the Huntington 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 dam safety modification, and include the client/agency and duration of review (approximate dates).

- Pending, current, or future financial interests in the Draft Dam Safety Modification Report (DSMR) & Environmental Assessment (EA) for Zoar Levee & Diversion Dam, Zoar Village, Tuscarawas County, Ohio or related contracts/awards from USACE.

- A significant portion (i.e., greater than 50%) of personal or firm[2] revenues within the last 3 years from USACE contracts.

- A significant portion (i.e., greater than 50%) of personal or firm[2] revenues within the last 3 years from contracts with the non-Federal sponsor (Muskingum Watershed Conservancy District).

- Any publicly documented statement (including, for example, advocating for or discouraging against) related to the Draft Dam Safety Modification Report (DSMR) & Environmental Assessment (EA) for Zoar Levee & Diversion Dam, Zoar Village, Tuscarawas County, Ohio.

- Participation in prior and/or current Federal studies relevant to this project.

- Previous and/or current participation in prior non-Federal studies relevant to this project.

- Is there any past, present, or future activity, relationship, or interest (financial or otherwise) that could make it appear that you would be unable to provide unbiased services on this project? If so, please describe.

Other considerations:

- Participation in previous USACE technical review panels

- Other technical review panel experience.

B.2 Panel Selection

In selecting the final members of the Panel, Battelle chose experts who best fit the expertise areas and had no COIs. Two of the four final reviewers are affiliated with consulting companies; the third is affiliated with a university; the fourth is an independent consultant. 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, but Battelle selected the final Panel.

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

Table B-1. Zoar Levee IEPR Panel: Technical Criteria and Areas of Expertise

Technical Criterion	Haefner	Luckie	Shakoor	Hartley
Cultural Resources/NEPA				
Meets Professional Qualification Standards set forth in the Secretary of the Interior's Standards and Guidelines for Archeology and Historic Preservation (48 FR 44716) in architectural history, history, archeology, and/or historic architecture	X			
Strong background in implementing or helping implement Federal projects that have significantly impacted cultural resources and historic properties in compliance with all relevant and applicable cultural resource laws, regulations, and policies	X			
Working knowledge of the National Environmental Policy Act (NEPA) process and requirements, and other pertinent environmental statutes and policies	X			
Experience working on or developing Environmental Assessments and the statutes and regulations that govern that process	X			
Five years' experience working directly on Federal projects (highly recommended)	X			
Plan Formulator/Economist				
Extensive experience in the plan formulation process, particularly with USACE 6-step planning process		X		
Familiarity with evaluation of alternative plans		X		
Ability to evaluate the appropriateness of cost/benefit analysis		X		
Experience dealing directly with Hydrologic Engineering Center Flood Damage Reduction Analysis (HEC-FDA)		X		
Familiarity with risk and uncertainty analysis (i.e., Monte Carlo type simulation)		X		
Experience with National Economic Development (NED) analysis procedures, particularly as they relate to flood risk management projects		X		
Degree in economics or a related field		X		
Engineering Geologist				
Senior-level geologist familiar with identification of geological hazards, exploration techniques, field and laboratory testing, and instrumentation			X	
Proficiency in assessing seepage and piping potential failure modes in the foundation beneath dams and levees constructed on alluvial material such as glacial outwash, stream, and flood deposits			X	

Table B-1. Zoar Levee IEPR Panel: Technical Criteria and Areas of Expertise (Continued)

Technical Criterion	Haefner	Luckie	Shakoor	Hartley
Experience in the design and construction of remediation measures for correcting seepage and piping issues			X	
Experience in failure mode analysis, risk assessment of embankment dams or levees, evaluation of risk reduction measures for dam safety projects, and familiarity with USACE dam safety guidance			X	
Working knowledge of all applicable USACE design criteria			X	
Licensed Professional Geologist			X	
Geotechnical Engineer				
Senior-level geotechnical engineer with extensive experience in the field of geotechnical engineering related to the analysis, design, and construction of embankment dams and levees, including rehabilitations of these structures				X
Knowledge and experience in the evaluation of seepage and piping potential failure modes in the foundations of embankment dams and levees				X
Knowledge and experience in the development, design, and construction of remediation alternatives for correcting seepage and piping issues				X
Experience in failure mode analysis				X
Experience in risk assessment of embankment dams or levees				X
Experience in evaluation of risk reduction measures for dam safety assurance projects				X
Familiar with USACE dam safety guidance				X
Working knowledge of all applicable USACE design criteria				X
Licensed Professional Engineer				X

B.3 Panel Member Qualifications

J. Joshua Haefner

Role: Cultural resources/NEPA expert
Affiliation: Hicks & Company Environmental, Archeological and Planning Consultants

Mr. Haefner is a senior archeologist/project manager at Hicks & Company Environmental/Archeological Consultants in Austin, Texas. He earned his M.A. in anthropology from Texas State University, San Marcos, Texas and has more than 12 years of professional experience that includes field work in Belize, Central America, Texas, Alabama, Louisiana, Arizona, Oklahoma and Utah. He has also authored or co-authored more than 40 technical reports, background studies, and probability models and has contributed chapters to Environmental Impact Statements (EISs), Environmental Assessments (EAs), and technical training manuals. He meets the Professional Qualification Standards set forth in the Secretary of the Interior's Standards and Guidelines for Archeology and Historic Preservation (48 FR 44716) in architectural history, history, archeology, and/or historic architecture (the Secretary of the Interior's standards and Guidelines for archeology require an M.A. in archeology, anthropology, or closely related field and one year professional experience, four months of supervised field and analytical experience, and the ability to carry research to completion). He has more than five years' experience working on Federal projects, including work for the Bureau of Land Management, the Departments of Transportation (DOT) for the states of Utah, Louisiana, Alabama, and Texas; the Ute Indian Tribe; and in energy-related projects reviewed by the Federal Energy Regulatory Commission (FERC).

Mr. Haefner has a strong background implementing or assisting in the implementation of Federal projects that have significantly impacted cultural resources and historic properties in compliance with all relevant and applicable cultural resource laws, regulations, and policies. Recent experience includes projects under Section 106 of the National Historic Preservation Act (NHPA) review where impacts on cultural resources determined eligibility in the National Register. Examples include studies at the Crystal City WWII Internment Camp Site, Federal Highway Administration (FHWA) border highway extension project, studies for the Bureau of Land Management (BLM) in Utah, and for the Disaster Relief Recovery Act through the Texas General Land Office. For the BLM project, he spent three years as a project archeologist and liaison for oil exploration on the Tribal lands for the Federally recognized Ute Indian tribe of the Uintah and Ouray Reservation.

Mr. Haefner is familiar with the NEPA process and requirements, and other pertinent environmental statutes and policies and has participated as principal investigator, project archeologist, field director, and field technician in more than 40 projects that required review under Section 106 of the NHPA. He has experience coordinating projects in order to meet Section106 compliance such as supervising an archeological survey and backhoe trenching for proposed grade stabilization water control structures and waterway locations at the U.S. Department of Agriculture Grazing Lands Research Laboratory in El Reno, Oklahoma.

As project manager at Hicks & Company, his duties include consulting on various infrastructure projects such as pipelines, transmission lines, fiber optic lines, public and private development, and highways at local, state, and Federal levels that require review and clearance under Section 106. Additionally, as a contract employee for the Texas DOT, his primary role was assisting in Native American consultation and impact evaluations under Section 106 and FHWA guidelines.

Mr. Haefner is responsible for many of the archeological projects that are completed in tandem with, or for EISs and EAs. He has experience working on or developing EAs and is familiar with the statutes and regulations that govern that process. He has also contributed directly to other environmental studies that include geology, soils, visual/aesthetics, and community cohesion. For example, he was a contributing author on the EA of the Topography, Geology and Soils section and the Compliance with Antiquities Code of Texas section for the city of Austin's Proposed Dunlap Energy Substation in Travis County, Texas. He has also reviewed cultural resource studies prepared by other firms for EISs and EAs.

David Luckie

Role: Plan formulation/economics expert
Affiliation: Independent consultant

Mr. Luckie is an independent consultant with more than 25 years of professional experience in water resource economics, planning, plan formulation, benefit-cost analysis, and risk-based analysis. He earned his B.S. in economics and finance from the University of South Alabama in 1986 and his professional experience includes working with multidisciplinary teams to provide complex planning for flood risk management, ecosystem restoration, and water supply and water quality studies. He is intimately familiar with ER 1105-2-100 and the USACE 6-Step Planning Process and has prepared, supervised, or reviewed numerous planning studies in his career.

Mr. Luckie is familiar with the evaluation of alternative plans, and has conducted, supervised, or reviewed a number of water resource studies featuring numerous alternative plans constructed from an array of different management measures. Examples of such studies include the Village Creek Watershed Feasibility Study in Birmingham, Alabama and the Buffalo Bayou General Reevaluation Report in Houston, Texas. He has also served as an IEPR panel member on the Success Dam and Lake Isabella dam safety modification studies in California where he applied his knowledge of ER 1105-2-100 and the 6-Step Planning Process to these dam safety projects. He is familiar with the evaluation of alternative plans and as a regional economist with the USACE, Mobile District (1988-2006), Mr. Luckie conducted, supervised, or reviewed benefit-cost analyses for a variety of water resource projects, including single- and multi-purpose projects covering the full range of USACE missions. Relevant studies include the Apalachicola Chattahoochee Flint and Alabama Coosa Tallapoosa Comprehensive Studies and the draft Programmatic Environmental Impact Statements covering the states of Alabama, Florida, and Georgia, and the Hunting Bayou General Reevaluation Report (GRR) in Houston, Texas.

Mr. Luckie has dealt directly with HEC-FDA since its testing and introduction in the 1990s, having constructed and run HEC-FDA models and reviewed the work of both internal and external teams. His experience with HEC-FDA is reflected in such studies as the Flint River at Albany, Georgia study and the Upper White Oak Bayou GRR in Houston, Texas. He is also familiar with risk and uncertainty analysis, and understands Monte Carlo simulations, having employed them before the introduction of HEC-FDA. He has constructed or reviewed project-specific risk analysis models on such projects as the Choctawhatchee, Pea, and Yellow Rivers Section 22 study and the Okaloosa County Water Supply Shortage Risk Analysis.

Mr. Luckie has extensive experience in performing National Economic Development (NED) analysis procedures, specifically as they relate to flood risk management. For more than 25 years, he has performed, supervised, or reviewed NED procedures for technical accuracy, compliance with policy and

guidance, and accepted planning principles. Such studies as the Village Creek Watershed Feasibility Study and Buffalo Bayou GRR reflect this expertise.

Abdul Shakoor, Ph.D., C.P.G., P.G.

Role: Engineering geology expert
Affiliation: Kent State University

Dr. Shakoor is a professor of engineering geology at Kent State University and also an independent consultant. He earned a Ph.D. in engineering geology from Purdue University in 1982 and is a registered professional geologist (P.G.) in Pennsylvania and a certified professional geologist (C.P.G.) through the American Institute of Professional Geologists. He has more than 45 years of applied and academic experience in structural geology, engineering geology, physical geology, environmental geology, soil mechanics, rock mechanics, rock slope stability, foundation engineering, geohydrology, and remote sensing. His primary research focuses on the engineering behavior of weak rocks (shales, claystones, mudstones, etc.), stability of slopes in both soils and rocks, evaluation of construction materials, engineering applications of waste materials, and environmental hazards such as lakeshore erosion, mine subsidence, and structural damage due to blasting operations. His research in these areas involves extensive field and laboratory studies, with a number of his research projects regularly conducted in collaboration with local engineering firms as well as government organizations such as the Ohio DOT and the Ohio Environmental Protection Agency. He is very familiar with geological hazards, including hazards associated with slope movements, volcanic eruptions, earthquakes, expansive soils and rocks, mine subsidence, and floods, and has developed with his students a rockfall hazard rating system and a cut-slope design manual for Ohio DOT. He has also authored or co-authored numerous papers on slope stability and expansive soils and rocks.

Dr. Shakoor is well versed in the evaluation of internal erosion associated with seepage and piping and the problems associated with embankment dams, and has significant experience in evaluating these problems and the associated modes of failure. In addition, several of his academic courses focus on dam engineering with a focus on seepage, uplift pressures, piping, and internal erosion. He investigated the failure of the Upper Ivex Dam on the Chagrin River, Ohio. This was a 90 foot high combination structure consisting of a masonry arch and a long, homogeneous, embankment dike where the main failure mode and safety issue were the seepage and piping along the contact between the two types of structures. He also worked as a geologist at Mangla Dam, Pakistan, a 250 foot high and 1 mile long zoned embankment dam. The auxiliary dams at this project experienced seepage and piping problems that were addressed using graded filters. He participated in numerous field trips to the Tarbella Dam (designed by Casagrande), Pakistan, a zoned earth and rockfill dam on the Indus River, with up to 400 foot thick alluvial foundation. This dam is well known for its seepage and piping problems, which resulted in sinkhole development in the upstream clay blanket. Dr. Shakoor has also served as an engineering geology expert for other USACE peer reviews of dams and levees constructed on alluvial material, giving him further experience and insight into the design and construction of remediation measures for correcting seepage an piping issues such as cutoff walls, internal and external filter blankets, ponding area filtering, upstream clay blankets, relief wells, collector systems, and grouting of the abutment rock.

Dr. Shakoor is familiar with all applicable USACE guidance criteria, including USACE dam safety guidance and procedures. He is familiar with the probability-based analysis currently used by USACE and has working knowledge of all applicable USACE design criteria and related documents. In addition, having served as an IEPR engineering geology expert for the Dover and Bolivar Dams (Ohio), Bluestone

Dam (West Virginia), the Lake Isabella Dam (California), the Center Hill Dam (Tennessee), and the Joe Pool Dam (Texas), he has gained considerable experience in failure mode analysis (both the embankment and the foundation), risk assessment for embankment dams and levees, and the evaluation of risk reduction measures for dam safety projects.

Michael Hartley, P.E.

Role: Geotechnical engineering expert
Affiliation: PND Engineers, Inc.

Mr. Hartley is a senior vice president of PND Engineers, Inc. He earned his M.S. in civil/geotechnical engineering in 1979 from Oregon State University and is a registered professional engineer in the states of Alaska, Washington, and Oregon. He has 36 years of experience providing civil, coastal, and geotechnical engineering services for projects throughout the United States and overseas. His geotechnical engineering experience includes the studies and design for marine infrastructure, levees, dams, buildings, roads, trails, bridges, breakwaters, and dredging projects. He is also recognized in the Federal court system as an expert in civil, coastal, and geotechnical engineering.

Mr. Hartley is knowledgeable and experienced in the evaluation of seepage and piping potential failure modes in the foundations of embankment dams and levees. He has been performing seepage and piping evaluation for dams and levees since 1979. Studies have involved intermediate and high head earthfill dams, levees, and impoundments for roads. He has performed many dam safety inspections for FERC and the State of Alaska Dam Safety Division of the Department of Natural Resources. He has also performed dam design or rehabilitation assessment for concrete gravity, concrete arch, and earthfill dams and levees. This has included many challenging projects such as the design of a 1,000 foot long, 30-foot head earthfill dam constructed at temperatures of less than -30 degrees Fahrenheit. He is the Senior Geotechnical Engineer responsible for quality assurance (QA) oversight and training of personnel in flow net, seepage, and piping analysis at PND. He recently assisted in QA analysis for piping and seepage analysis of three football-size cofferdams constructed in New Orleans for the Permanent Canal Closures and Pumps (PCCP) project.

Mr. Hartley is experienced in the development, design, and construction of remediation alternatives for correcting seepage and piping issues and has evaluated various dam and levee structures for remediation using hydromax panels, clay cores, sheetpile, and other techniques to mitigate piping and seepage issues. He has served on numerous panels as a geotechnical engineering expert involving large high-head dams performing peer review of proposed seepage corrections. Relevant design modifications include Campbell Lake dam safety studies and design of rehabilitation measures using sheetpile. He is experienced in both failure mode analysis and risk assessment of embankment dams and using risk-based procedures, most recently having reviewed the risk assessment for levees in Mt. Vernon and Burlington. He evaluated the procedures used by two separate geotechnical firms for levee stability assessments as part of the USACE Skagit River, Washington IEPR.

Mr. Harley has experience in the evaluation of risk reduction measures for dam safety assurance projects, reflected in his efforts in support of USACE IEPR dam safety assurance projects for the Dover, Bluestone, and Bolivar Dams, as well as other construction-phase review services. He has testified in Federal court on risk-based assessment analysis and is very familiar with probabilistic methods of geotechnical assessment of levees. He recently performed a risk assessment IEPR review for the Skagit river levee system in Washington state. Relevant projects include Sherwood Estates Dam, Campbell Lake Dam,

Valdez Creek Dam, and levee assessment for Skagit County. He is very familiar with USACE dam safety guidance and has used USACE publications in the design, risk-based assessment, and review of flood control dam and levee reviews. Example experience includes previous USACE peer reviews and current PCCP cofferdam design for USACE New Orleans District. He is also familiar with all applicable USACE design criteria and USACE engineering manuals, and has used these in the design of projects and in the peer review of designs by others. Examples include the West Bank Levee designs peer review for WBV 12, 14f.2, and 18 levees, and the geotechnical design analysis for the PCCP cofferdams in New Orleans.

APPENDIX C

Final Charge to the IEPR Panel Submitted to USACE on January 27, 2015, for the Zoar Levee Project

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Charge Questions and Guidance to The Panel Members tor the Lepr of The Dam Safety Modification Report & Environmental Assessment for Zoar Levee & Diversion Dam, Zoar Village, Tuscarawas County, Ohio

BACKGROUND

The Zoar Dam Safety Modification Report & Environmental Assessment (DSMR/EA) is being prepared in accordance with Engineer Regulation (ER) 1110-2-1156 (USACE Safety of Dams – Policy and Procedures), Section 102(C) & (D) of National Environmental Policy Act of 1969 (NEPA) and its implementing regulations, 40 CFR 1500-1508 and ER 200-2-2 (Procedures for Implementing NEPA). Zoar Levee & Diversion Dam is part of the Muskingum River Basin System. The Muskingum River Basin is the site of Ohio's first multiple-purpose water management and land conservation river basin project. In response to the State of Ohio's Flood of 1913, which killed over 400 people and destroyed over 20,000 homes, the Muskingum Watershed Conservancy District (MWCD) was created on June 3, 1933. The MWCD has missions of flood control, water conservancy, erosion control, and other general uses of water within 8,000 square miles of drainage basin that ultimately enters the Ohio River at Marietta, Ohio.

An initial plan developed by MWCD to reduce flood risks in the basin called for 14 flood control reservoirs. In 1933, the Public Works Administration (PWA) awarded a grant of $22.09 million to the U.S. Army Corps of Engineers (USACE) to construct the proposed plan. In 1934, the Federal Government executed a contract with the MWCD to allow USACE to conduct investigations and draft a final plan. This official plan for the basin was approved by the MWCD on November 19, 1934. Construction of the project began in 1935, and the completed system was turned over to the MWCD in 1938. The Flood Control Act of 1939 returned the dams to the Federal government and flood control operations back to USACE. Today the USACE, Huntington District (District) manages these projects. Zoar Levee & Diversion Dam is an appurtenant structure to the Dover Dam and is located approximately 4 miles upstream of the dam on the Tuscarawas River. Dover Dam is a dry dam and retains pools only during events to attenuate downstream flooding in coordination with other Muskingum Basin projects. Zoar Levee provides flood damage reduction benefits to the Village of Zoar and provides protection from flooding when Dover Dam is retaining a pool above elevation (El.) 890 feet (a 3-year event). As such, the original crest elevation of the Zoar Levee was designed to correspond to the spillway elevation of Dover Dam of 916.0, with an additional 3 feet of freeboard for a resulting crest elevation of 919.0. The current crest elevation, following levee and interior drainage modification work in 1951, is 928.5.

Zoar Diversion Dam is located on Goose Run, about 1,000 feet upstream of Zoar Levee, and was built to work in conjunction with the levee. The Diversion Dam is a retention structure for runoff in the Goose Run watershed, which flows into a ponding area for the Zoar Levee pump station. A spillway, or diversion channel, connects the Diversion Dam impoundment to the Tuscarawas River, via Goose Run.

The Village of Zoar is located in east central Ohio, along the Tuscarawas River in Tuscarawas County, about 70 miles south of Cleveland, Ohio. Zoar Levee protects approximately 98 buildings or structures from being inundated by flood waters being retained by Dover Dam. According to the 2010 census, the population of Zoar Village is estimated to be approximately 169 people.

The area protected by Zoar Levee & Diversion Dam has become the heart of a nationally significant historical site with unparalleled historical integrity that is symbiotically supported by an active, thriving municipal jurisdiction, as well as internal and external private and public interests. Between 2001 and July 2012, 114,226 people have visited Zoar Village, and the Zoar Community Association (ZCA) has earned a combined total of $523,000 in revenue from its stores, programs, and events. Between 1999 and 2011,

ZCA reports that approximately $900,000 was granted to Zoar Village for the restoration of buildings and other interpretative improvements. In 2001, the Tuscarawas County Convention and Visitors Bureau estimated that Zoar Village's tourism contributed over $10.5 million to the local economy.

The Village of Zoar was established in 1817 by a group of German separatists called the Society of Separatists of Zoar. Although founded primarily as a religious community, the separatists introduced a communal system to pay their debts for land and guarantee their economic and social security.

The Village of Zoar is unique in the State of Ohio because it contains a significant collection of German folk architecture from a 19th century utopian community. Original documentation concerning the decision to construct the levee versus removing the town from Dover Dam's flowage easement indicates that USACE considered the historical significance of the community when it originally constructed the levee.

A 1949 design memorandum concerning the capacity of the Zoar pump station states that "…*protection of the village instead of evacuation was adopted because of its historical significance*…"

A 1950 memorandum concerning raising the crest of Zoar Levee stated: "*At the time Dover Dam was being planned, consideration was given to evacuating the population of 200 persons. However, since the village is of considerable historical importance and since two state-owned museums are located there, it was decided to protect the site by constructing earth levees rather than to evacuate the population*."

Further, a 2001 article from the National Park Service's magazine titled CRM stated: "…*in 1929, under pressure from the U.S. Army Corps of Engineers to move the town to higher ground to accommodate a nearby flood-control dam, the villagers began to recognize their heritage and restored the central garden and opened a museum. A levee was built instead*."

Much of Zoar was documented in 1936 by the Historic American Building Survey (HABS). In the 1960s, the Ohio General Assembly appropriated $300,000 to purchase significant buildings in Zoar to preserve, restore, and interpret them. The Ohio History Connection (OHC), previously the Ohio Historical Society (OHS), now operates several buildings in the Village of Zoar. The OHC is also contracted by the State of Ohio to operate the State Historic Preservation Office. In 1967, ZCA was founded to ensure the preservation of the Village of Zoar and the surrounding areas and to assist in the maintenance of the economic vitality of the Zoar area. This community association hosts several festivals and events each year, and the village is a regional asset associated with tourism. The ZCA is now under contract to manage and run tours of several of the buildings in Zoar for the OHC. For more information concerning the community, please visit http://historiczoarvillage.com/ or http://www.ohiohistory.org/museums-and-historicsites/ museum--historic-sites-by-name/zoar-village.

The Zoar State Memorial Historic District was placed on the National Register of Historic Places (NRHP) in 1969, and its boundary was increased in 1975. The community is listed under Criterion A for its association with the 19th century German separatist movement and under Criterion C for its outstanding examples of 19th century architecture. As currently listed, its period of significance extends from 1817 to 1899. In 2013, OHC resubmitted a revised NRHP nomination to the National Park Service in the hopes of securing a National Historic Landmark (NHL) designation for Zoar Village. NHLs are nationally significant historic places designated by the Secretary of the Interior because they possess exceptional value or quality in illustrating or interpreting the heritage of the United State. Zoar Village was currently slated to be reviewed for NHL status in the Spring of 2005.

The historic district measures 176.7 total acres, 54 acres of which are located within the protective limits of Zoar Levee at El. 916.0 feet. Approximately one-fifth of the historic District is above El. 916.0 feet.

OBJECTIVES

The objective of this work is to conduct an independent external peer review (IEPR) of the Draft DSMR/ EA for Zoar Levee & Diversion Dam, Zoar Village, Tuscarawas County, Ohio. (hereinafter: Zoar Levee IEPR) in accordance with the Department of the Army, USACE, Water Resources Policies and Authorities' *Civil Works Review* (Engineer Circular [EC] 1165-2-214, December 15, 2012), and the Office of Management and Budget's *Final Information Quality Bulletin for Peer Review* (December 16, 2004) and as required by Chapter 9 of ER 1110-2-1156 and in accordance with Section 2034 of the Water Resources Development Act of 2007.

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 Zoar Levee 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 cultural resources/NEPA, plan formulation/economics, engineering geology, and geotechnical engineering issues relevant to the project. They will also have experience applying their subject matter expertise to dam safety 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 PROVIDED

The following is a list of documents, supporting information, and reference materials that will be provided for the review.

Documents for Review

The following documents are to be reviewed by designated discipline:

Title	Approx. No. of Pages	Required Disciplines
DSMR/EA – Main Report	170	All Disciplines
Appendix A – Existing & Future Without-Action Condition (Two Volumes)	1,400	Plan Formulator/Economist – main report of Appendix A only. Engineering Geologist and Geotechnical Engineer – all
Appendix B – Future With-Action Risk	70	Engineering Geologist and Geotechnical Engineer
Appendix C – Cost Estimate	81	Plan Formulator/Economist, Engineering Geologist, and Geotechnical Engineer
Appendix D – Baseline Planning Studies & Environmental Data (7 Addenda)	2,500 (+1,500 of reference material)	Cultural Resources/NEPA – all. Plan Formulator/Economist – Addendum 4 (~10 pgs)
Appendix G – Cost and Risk Schedule 17-Nov-14	5	All Disciplines
Appendix I – Engineering	2,000	Engineering Geologist and Geotechnical Engineer
Appendix J – Real Estate Plan	11	All Disciplines
Appendix L – District Quality Control and Agency Technical Review	200	All Disciplines
Appendix M – Measures Screened	7	All Disciplines
Appendix N – August 2014 Interior Event	16	All Disciplines
Total Page Count (not including reference material)	**6,460**	

Note: Appendices E, F, H, and K are not provided and will not undergo IEPR.

Supporting Information

General

- EC 1105-2-412, Assuring Quality of Planning Models, 31 March 2011
- EC 1165-2-214, Civil Works Review, 15 December 2012
- EC 1165-2-210, Water Resources Policies and Authorities - Water Supply Storage and Risk Reduction Measures for Dams, 9 April 2010
- EP 1110-2-13, Dam Safety Preparedness, 28 June 1996
- ER 1110-1-12, Engineering and Design - Quality Management, 31 March 2011 (change 2)
- ER 1110-2-1150, Engineering and Design - Engineering and Design for Civil Works Projects, 31 August 1999
- ER 1110-2-1155, Engineering and Design - Dam Safety Assurance Program, 12 September 1997
- ER 1110-2-1156, Engineering and Design - Safety of Dams - Policy and Procedures, 31 March 2014
- ER 1110-1-8159, Engineering and Design - DrChecks, 10 May 2001
- National Academy of Sciences, "Policy and Procedures on Committee Composition and Balance and Conflicts of Interest for Committees Used in the Development of Reports," May 2003 for General Scientific and Technical Studies and Assistance: General Scientific and Technical Studies and Assistance. Available at: http://www.nationalacademies.org/coi/index.html
- Water Resources Development Act of 2007, Sections 2034 & 2035, Pub. L. 110-114. Privacy Act, 5 U.S.C. § 522a as amended

Environmental/Planning

- ER 1105-2-100, Guidance for Conducting Civil Works Planning Studies. CECW-P, 28 Dec 1990
- Council on Environmental Quality. 1978. Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act. 40 CFR Parts 1500-1508. Washington, DC: U.S. Government Printing Office (November 29, 1978).
- ER 200-2-2, Environmental Quality, Procedures for Implementing NEPA. CECWRE (now CECW-A), 4 March 1988
- National Environmental Policy Act of 1969
- National Historic Preservation Act of 1966
- 36 CFR 800

Geotechnical Engineering

- EM 1110-2-1901, Engineering and Design - Seepage Analysis and Control for Dams, 30 April 1993
- EM 1110-2-1913, Engineering and Design - Design and Construction of Levees, 30 April 2000
- EM 1110-2-1914, Engineering and Design – Design, Construction, and Maintenance of Relief Wells, 29 May 1992
- EM 1110-2-2300, Engineering and Design - General Design and Construction Considerations For Earth and Rock-Fill Dams, 30 July 2004

Hydraulic Engineering

- EM 1110-2-2902, Engineering and Design - Conduits, Culverts, and Pipes, 31 March 1998
- EM 1110-2-3600, Engineering and Design - Management of Water Control Systems, 30 November 1987
- ER 1110-8-2 (FR), Inflow Design Floods for Dams and Lakes, 1 March 1991
- ER 1110-2-240, Water Control Management, 8 October 1998
- ER 1130-2-530, Flood Control Operations and Maintenance Policies, 30 October 1996
- ER 1110-2-8156, Preparation of Water Control Manuals, 31 August 1995

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 January 13, 2015, receipt of the final review documents. 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	1/29/2015
	Battelle convenes kick-off meeting with panel members	2/2/2015
	Battelle convenes kick-off meeting with USACE and panel members	2/2/2015
	Battelle convenes on-site meeting with USACE and panel members to view project specific locations (Travel days are: 2/9 and 2/11/2015)	2/10/2015
	If necessary, Battelle convenes Mid-Review Teleconference for panel members to ask clarifying questions of USACE	2/18/2015

Task	Action	Due Date
	Panel members complete their individual reviews	2/26/2015
Prepare Final Panel Comments and Final IEPR Report	Battelle provides panel members with talking points for Panel Review Teleconference	3/2/2015
	Battelle convenes Panel Review Teleconference	3/3/2015
	Battelle provides Final Panel Comment templates and instructions to panel members	3/3/2015
	Panel members provide draft Final Panel Comments to Battelle	3/10/2015
	Battelle provides feedback to panel members on draft Final Panel Comments; panel members revise Final Panel Comments	3/11-3/16/2015
	Panel finalizes Final Panel Comments	3/17/2015
	Battelle receives the public comments from USACE	1/30/2015
	Battelle sends public comments to Panel	2/27/2015
	Panel completes their review of the public comments	3/4/2015
	Battelle and Panel review Panel's charge question responses to public comments	3/5/2015
	Panel drafts Final Panel Comment, if necessary	3/12/2015
	Panel finalizes Final Panel Comment regarding public comments	3/16/2015
	Battelle provides Final IEPR Report to panel members for review	3/18/2015
	Panel members provide comments on Final IEPR Report	3/20/2015
	Battelle submits Final IEPR Report to USACE*	3/23/2015
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	3/23/2015
	Battelle convenes teleconference with Panel to review the Post-Final Panel Comment Response Process	3/24/2015
	USACE Project Delivery Team (PDT) provides draft Evaluator Responses to USACE Risk Management Center (RMC) for review	3/30/2015
	USACE RMC reviews draft Evaluator Responses and works with USACE PDT regarding clarifications to responses, if needed	3/31/2015
	USACE RMC provides draft PDT Evaluator Responses to Battelle	3/31/2015
	Battelle provides the panel members the draft PDT Evaluator Responses	3/31/2015
	Panel members provide Battelle with draft BackCheck Responses	4/03/2015
	Battelle convenes teleconference with panel members to discuss draft BackCheck Responses	4/06/2015
	Battelle convenes Comment-Response Teleconference with panel members and USACE	4/7/2015
	USACE inputs final PDT Evaluator Responses to DrChecks	4/9/2015

Task	Action	Due Date
	Battelle provides final PDT Evaluator Responses to panel members	4/9/2015
	Panel members provide Battelle with final BackCheck Responses	4/10/2015
	Battelle inputs the panel members' final BackCheck Responses to DrChecks	4/13/2015
	Battelle submits pdf printout of DrChecks project file*	4/13/2015

* Deliverables

CHARGE FOR PEER REVIEW

Members of this IEPR Panel are asked to determine whether the technical approach and scientific rationale presented in the Zoar Levee IEPR 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 Zoar Levee IEPR 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 (Rachel Sell, sellr@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 Rachel Sell, **sellr@battelle.org**, no later than February 26, 2015, 10 pm ET.

Independent External Peer Review

of the

Dam Safety Modification Report (DSMR) & Environmental Assessment (EA) for Zoar Levee & Diversion Dam, Zoar Village, Tuscarawas County, Ohio

Charge Questions and Relevant Sections as Supplied by USACE

General (4)

1. Were risk and uncertainty sufficiently estimated and characterized for the existing, future without-and future with-project conditions?

2. Were risk and uncertainty sufficiently considered during the study?

3. In your opinion, are there sufficient data upon which to base the selection of a risk management plan?

4. In your opinion, is the proposed Risk Management Plan/Preferred Action Alternative (RMP/PAA) appropriate given the risks and uncertainty estimated at Zoar Levee & Diversion Dam?

Existing and Future Without Project Resources (5)

5. Are the methods used to estimate the risk adequate and appropriate given the circumstances?

6. Have all the significant potential failure modes been identified and appropriately considered?

7. Has anything significant been overlooked in the existing project risk? Do you agree that future without-project risks are generally going to be the same as existing risks, given the probability of pool loadings over the period of analysis?

8. Have the social, financial, and cultural resources within the study area been adequately captured for the existing and future without-action risk conditions?

9. Are future Operation, Maintenance, Repair, Replacement, and Rehabilitation efforts adequately described, and are the estimated cost of those efforts reasonable for future without-action risk condition?

Plan Formulation / Evaluation (5)

10. Was a reasonably complete array of possible measures considered in the development of alternatives, including non-structural measures, such as removing the project?

11. In your professional opinion, are the metrics used in the alternatives evaluation and screening, that lead to a final array of alternatives, acceptable?

12. Please comment on the evaluation and comparison of the proposed alternatives. Were the evaluation criteria applied correctly, and was the final array of alternatives compared appropriately?

13. Have the potential benefits and impacts of each alternative been clearly and adequately presented?

14. Were the engineering, economic, and environmental analyses used for this study consistent with generally accepted methodologies? Why or why not?

Recommended Plan (2)

15. Does the proposed RMP/PAA meet the study objectives and avoid violating the study constraints?

16. Please comment on the completeness of the proposed RMP/PAA (i.e., will any additional efforts, measures, or projects be needed to realize the expected benefits)?

Dam Safety (2)

17. Has the condition of the project, including the design and construction of the project and appurtenant features, project maintenance, previous remediation, and the dam's performance over time, been clearly described?

18. Is there sufficient information presented to identify, explain, and comment on assumptions that underlie engineering analyses? Why or why not?

Environmental Assessment Questions (4)

19. Have the affected environment and environmental consequences of all alternatives been adequately described? Specifically, was the significance of Zoar Village adequately characterized? If not, please elaborate.

20. Should any other resources be considered for the affected environment? If yes, please elaborate.

21. Do you agree based on the data presented in the DSMR, and considering the development of a Programmatic Agreement in accordance with 36 CFR 800.14(b)(1)(ii) "Use of programmatic agreements", and Paragraph C-4.d(5)(C) of Appendix C "Environmental Evaluation and Compliance" of ER 1105-2-100 "USACE Planning Guidance Notebook," that the threshold of negligible adverse impact on significant environmental resources has been met? If not, please elaborate.

22. Have all pertinent Federal acts, regulations, and executive orders been considered and compliance demonstrated? If not, please elaborate.

Safety Assurance Review (SAR) (4)

23. In accordance with ER 1110-2-1150, are the quality and quantity of the surveys, investigations, and engineering sufficient for a concept design?

24. Are the models used to assess hazards appropriate?

25. Are the assumptions made for the hazards appropriate?

26. Does 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?

Final Overview Question (1)

27. What is the most important concern you have with the document or its appendices that was not covered in your answers to the questions above?

Summary Questions added by Battelle (2)

28. Please identify the most critical concerns (up to five) you have with the project and/or review documents. These concerns can be (but do not need to be) new ideas or issues that have not been raised previously.

29. Please provide positive feedback on the project and/or review documents.

Public Comment Question (1)[4]

1. Does information provided, or do concerns raised by the public, identify any additional discipline-specific technical issues with regard to the overall report?

[4] This charge question has been renumbered/restarted at 1 because it is a charge question asked after the initial IEPR review was completed.

APPENDIX D

Conflict of Interest Questionnaire

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Conflicts of Interest Questionnaire

Independent External Peer Review

Zoar Levee and Diversion Dam

The purpose of this document is to help the U.S. Army Corps of Engineers identify potential organizational conflicts of interest on a task order basis as early in the acquisition process as possible. Complete the questionnaire with background information and fully disclose relevant potential conflicts of interest. Substantial details are not necessary; USACE will examine additional information if appropriate. Affirmative answers will not disqualify your firm from this or future procurements.

NAME OF FIRM: **Battelle Memorial Institute Corporation Operations**
REPRESENTATIVE'S NAME: **Gina M. Crabtree**
TELEPHONE: **614-424-5097**
ADDRESS: **505 King Avenue, Columbus, OH 43201**
EMAIL ADDRESS: **crabtreeg@battelle.org**

I. INDEPENDENCE FROM WORK PRODUCT. Has your firm been involved in any aspect of the preparation of the subject study report and associated analyses (field studies, report writing, supporting research etc.) No X Yes (if yes, briefly describe):

II. INTEREST IN STUDY AREA OR OUTCOME. Does your firm have any interests or holdings in the study area, or any stake in the outcome or recommendations of the study, or any affiliation with the local sponsor? No X Yes (if yes, briefly describe):

III. REVIEWERS. Do you anticipate that all expert reviewers on this task order will be selected from outside your firm? No Yes X (if no, briefly describe the difficulty in identifying outside reviewers):

IV. AFFILIATION WITH PARTIES THAT MAY BE INVOLVED WITH PROJECT IMPLEMENTATION. Do you anticipate that your firm will have any association with parties that may be involved with or benefit from future activities associated with this study, such as project construction? No X Yes (if yes, briefly describe):

V. ADDITIONAL INFORMATION. Report relevant aspects of your firm's background or present circumstances not addressed above that might reasonably be construed by others as affecting your firm's judgment. Please include any information that may reasonably: impair your firm's objectivity; skew the competition in favor of your firm; or allow your firm unequal access to nonpublic information.

Curia Crabtree _____ 12/18/14

YOUR SIGNATURE DATE

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