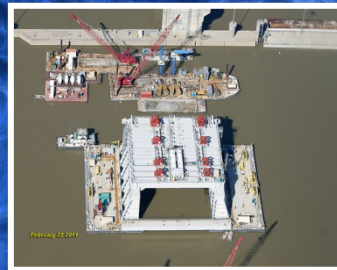


January 8, 2013

Revised Final Independent External Peer Review Report Olmsted Locks and Dam 52 and 53 Replacement Project Method of Construction Alternative Analysis (Olmsted Dam In-The-Dry Study)



Prepared by
Battelle Memorial Institute

Prepared for
Department of the Army
U.S. Army Corps of Engineers
Louisville District

Contract No. W912HQ-10-D-0002
Task Order: 0033

Errata

Revised Final IEPR Report

Olmsted ITD Study IEPR

The original IEPR report was submitted to USACE on January 3, 2013. The original report has been revised to correct nomenclature errors identified in Final Panel Comment (FPC) 1 and FPC 5 as follows:

1. Page A-1, FPC 1, Basis for Comment, second paragraph, first sentence, fourth line: The unit of distance “*stories*” was replaced with the unit distance of “*feet*.”
2. Page viii, 30th Acronym; and Page A-8, FPC 5, Basis for Comment, second bullet, first sentence, first line: The term “Real Estate” was replaced with “Resident Engineer.”

Additionally, minor typographical errors were found in Section 4, Panel Description. As a result, the biographies of *Mr. Douglas Spaulding* (pp. 15-16) and *Mr. C. Deane Fowler* (pp. 17-18) were revised.

The errors described in this errata did not affect the technical validity of the IEPR report or the associated Final Panel Comments.

**Revised Final Independent External Peer Review Report
Olmsted Locks and Dam 52 and 53 Replacement Project Method of Construction
Alternative Analysis (Olmsted Dam In-The-Dry Study)**

by

**Battelle
505 King Avenue
Columbus, OH 43201**

for

**Department of the Army
U.S. Army Corps of Engineers
Louisville District**

January 8, 2013

**Contract Number: W912HQ-10-D-0002
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REVISED FINAL
INDEPENDENT EXTERNAL PEER REVIEW REPORT
for the
Olmsted Locks and Dam 52 and 53 Replacement Project Method of Construction
Alternative Analysis (Olmsted Dam In-The-Dry Study)

EXECUTIVE SUMMARY

Project Background and Purpose

The Olmsted Locks and Dam project provides for a navigation facility near Ohio River Mile 964.4 that will replace the existing Locks and Dam 52 and 53. The facility will consist of twin 110-foot by 1,200-foot locks adjacent to the Illinois bank, five tainter gates, a right boat abutment, a 1,400-foot navigable pass, a left boat abutment, and a fixed weir extending into the Kentucky bank. During low-flow conditions, an upper pool having an elevation of 300 feet at the dam will extend upstream a distance of 47 miles to the Smithland Locks and Dam. Open river conditions will exist from the dam site downstream a distance of approximately 17 miles to the mouth of the Ohio River.

The Olmsted Locks and Dam project was authorized in Section 3(a) (6) of the Water Resources Development Act (WRDA) of 1988 (Public Law 100-676). The Olmsted Dam Method of Construction Alternative Analysis (In-The-Dry [ITD] Study) was directed by the CECW-ZA memorandum, dated 30 January 2012, subject: Olmsted Locks and Dam Project Direction and Guidance.

The Olmsted Dam is currently being built using an in-the-wet (ITW) method of construction. The purpose of the Olmsted Dam ITD Study was to develop near-feasibility-level designs and associated cost estimates for ITD (i.e., within cofferdams) construction of the dam that could be compared to the current ITW method. The ITW construction contractor has completed a significant portion of the tainter gate section of the dam. Therefore, it was considered appropriate to focus this study for ITD construction method for the remaining portion of the dam consisting of the right boat abutment, navigable pass, and left boat abutment.

The fixed weir portion of the dam was constructed under an earlier contract. The total project estimate was recently updated for the entire Olmsted Locks and Dam project in the Post Authorization Change Report (PACR), revised April 2012. The cost and schedule presented in the PACR assumes that the dam construction will be completed using the ITW construction methodology. The current total cost estimate (price level October 2011) is \$2,918,000,000.

A design was developed for constructing the navigable pass portion of the dam using the conventional method of construction (i.e., cofferdams). The design effort established project features to be costed, proved feasibility, and created documentation of criteria, assumptions, analyses, and drawing details. It was assumed that the current configuration of the dam would remain unchanged. The plan view shape, cross-section, and foundation support for the dam would be the same.

The Olmsted Dam ITD Study (dated 31 May 2012) found that the use of two cellular sheet-pile cofferdams, staged for consecutive construction, was the best course of action for this method of construction. Two cofferdams represented optimum conditions from a constructability and schedule standpoint while minimizing impacts on navigation. The study also recommended that the first cofferdam to be constructed should be the one nearest the Kentucky bank. Each cofferdam cell will be 62.66 feet in diameter and filled with sand. The top of each cofferdam will be at El. 329 and the typical sheet pile tip will be at El. 234, giving a typical sheet pile length of 95 feet.

Cost estimates and schedules were prepared to a comparable level of detail for ITD and the current ITW construction methods. A cost and schedule risk analysis (CSRA) was performed to establish the 80 percent confidence level for both cost and schedule.

Independent External Peer Review Process

USACE is conducting an Independent External Peer Review (IEPR) of the Olmsted Locks and Dam 52 and 53 Replacement Project Method of Construction Alternative Analysis (Olmsted Dam In-The-Dry Study) (hereinafter: Olmsted ITD Study 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 Olmsted ITD Study. Independent, objective peer review is regarded as a critical element in ensuring the reliability of scientific analyses. The IEPR was external to the agency and conducted following USACE and Office of Management and Budget (OMB) guidance described in USACE (2012), USACE (2007), and OMB (2004). This final report describes the IEPR process, describes the panel members and their selection, and summarizes the Final Panel Comments of the IEPR Panel (the Panel).

Five panel members were selected for the IEPR from more than 30 identified candidates. Based on the technical content of the Olmsted ITD Study and the overall scope of the project, the final panel members were selected for their technical expertise in the following key areas: structural engineering, hydraulic engineering, geotechnical engineering, engineering cost estimation, and project scheduling. USACE was given the list of candidate panel members, but Battelle made the final selection of the Panel.

The Panel received electronic versions of the Olmsted ITD Study documents, totaling more than 2,392 pages required for review, along with supplemental background information for use as reference material but not required for review. The Panel was provided a charge that solicited comments on specific sections of the documents to be reviewed. The charge was prepared by USACE according to guidance provided in USACE (2012) and OMB (2004). Battelle reviewed the charge questions, developed sub-charge questions as needed, and suggested revisions for consistency and clarity, additions, or deletions. USACE was given the opportunity to provide comments and revisions, and subsequently approved the final charge questions.

The USACE Project Delivery Team briefed the Panel and Battelle during a kick-off meeting held via teleconference prior to the start of the review. Other than this teleconference, there was no direct communication between the Panel and USACE during the peer review process. The Panel produced more than 81 individual comments in response to the 12 multi-part charge questions.

IEPR panel members reviewed the Olmsted ITD Study documents individually. The panel members then met via teleconference with Battelle to review key technical comments, discuss charge questions for which there were conflicting responses, 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, or low); and (4) recommendations on how to resolve the comment. Overall, 14 Final Panel Comments were identified and documented. Of these, 11 had medium significance, and 3 had low significance.

Results of the Independent External Peer Review

The panel members agreed among one another 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 Olmsted ITD Study. The Panel generally agreed that the adequacy and acceptability objectives of the ITD Study presented above were achieved. The Panel found the Olmsted Dam ITD Study to be a good analysis and summary of the issues identified by changing from ITW to ITD. The high level of effort put forth by USACE to develop the Olmsted Study, Cost Estimate, and Schedule are evident in the quality of the final product.

Table ES-1 lists the Final Panel Comments statements by level of significance. The full text of the Final Panel Comments is presented in Appendix A of this report. The following statements summarize the Panel’s findings.

Structural Engineering – The Panel agreed that the Olmsted ITD Study structural calculations generally meet the stated objectives, but areas requiring additional discussion or analysis were identified. Specifically, the study proposes to support the structural sections for the navigable pass on steel pipe piles; however, the computations contained in Appendix B of the review documents do not describe the design of this piling system. The effect of pump failure on the cofferdam of the navigable pass does not appear to have been thoroughly addressed. The left boat abutment counterfort wall is designed as a ‘beam,’ but it is not immediately evident from the information provided that this is an appropriate design.

Hydraulic Engineering – The Panel agreed that the approach and analysis seems to be reasonable based on the timing of the overall project. However, in certain cases, assumptions are made without providing the corresponding technical computations or analysis to support the assumptions. One example is the assumption that the cost to raise the height of the cofferdam would be greater than costs associated with one overtopping event based on cleanup, repairs, and associated delays. The Panel also noted that the elevation-frequency curve is based on linear interpolation of the gage stations located upstream and downstream of the project site, but no mention is made in the study on whether or not the flood profiles would contain a significant

change in slope that would affect the interpolated results. The Panel's experience at another lock and dam indicates that the use of the lock chambers to pass high river flows may result in the deposition of gravel sediments in the bottom of the lock chamber. These sediments can erode the concrete bottom of the lock by producing a "milling operation" during normal lock operations.

Geotechnical Engineering – The Panel agreed that the Olmsted Locks and Dam ITD study provides a general review and analysis of the issues associated with the ITD procedures. Within the limits of available data and information, the study addresses issues such as the cellular sheet pile design concerns, overtopping impacts, navigation issues, and dewatering procedures. The study was performed to a feasibility level of detail, which means that there are both additional information needs and additional studies that will be required prior to final design.

The Panel noted several areas that may require additional discussion and analysis. The geotechnical computations for stability and other design requirements indicate an assumed average cross-section with the top of the McNairy I formation at El. 240.0, but the potential impacts of the actual variation of the McNairy are not discussed. The stability analysis uses an anisotropic assumption regarding the shear strength for the McNairy I formation, but there is no justification and discussion of the parameters and procedures used for this approach. Also, it appears that the stability procedures used in the analysis for the stability of the cells as described in Appendix B of the review documents do not conform to the procedures stated in EM1110-2-2503, Design of Sheet Pile Cellular Structures.

Engineering Cost Estimating – The Panel generally agreed in its assessment of the engineering cost estimating, and thought that the Olmsted ITD Study is well structured and the report provided a very thorough analysis of the proposed construction method. However, there may be opportunities to provide additional benefits to the project that were not explored. For example, the use of a project labor agreement (PLA) has not been discussed as a means to control labor costs, or the use of fuel rate adjustment clauses in equipment lease agreements. In addition, the types of contract lettings (i.e., Design-Bid-Build, Design-Build, or Cost Reimbursable) and contract incentive clauses are not discussed as a means to improve construction cost performance. Contractor use and/or purchase of government-owned equipment and materials like sheet pilings should be clarified prior to bid letting. Finally, taking a closer look at the overall project schedule, there appear to be some potential cost economies to be made. Design efforts could be consolidated and site work/restoration efforts could be done earlier to shorten or eliminate the estimated two-year ITD extension. The Panel believes that further consideration of these issues could improve the cost performance of the ITD method of construction.

Project Scheduling – The basic assumptions stated in the study appear to be sound whether they relate to the excavation to El 250.0 for both Phases, sequence of construction and filling of the cells, establishment of pile tip elevations to control seepage from the McNairy formation, or actions to take when river elevations exceed El 303.5.

However, the contingencies are ambitious and do not adequately take into account difficulties with adverse river conditions when constructing in the middle of the Ohio River. Furthermore, the contingency activities are not always incorporated into the logical link within activities of the

network, nor are they hammocked with other activities and they have only a small ability to absorb any changes without significant impact on the operational date of the navigation pass.

Table ES-1. Overview of 14 Final Panel Comments Identified by Olmsted ITD Study IEPR Panel

No.	Final Panel Comment
Significance – Medium	
1	The study design relies heavily on data and procedures from the In-The-Wet (ITW) Study and lacks sufficient new analysis to validate the current study design and detect potential critical deficiencies.
2	Components of the cost and schedule risk analysis (CSRA), including labor costs, equipment costs, design costs, and contracts, are not sufficiently discussed to determine the 80% confidence level of the cost estimate.
3	Contingencies discussed in the In-The-Dry (ITD) Study and shown in the project schedule are broad in nature and scope and do not accurately account for difficulties that may affect project construction.
4	Project activities such as Value Engineering, contingencies, and the development of the Second Supplemental Environmental Impact Statement (S2EIS) are not tied logically in the Critical Path Network.
5	There may be opportunities to compress the project schedule that do not appear to have been considered.
6	The assumption that the cost to raise the height of the cofferdam would be greater than the cost associated with one overtopping event is not supported by a cost estimate.
7	Design conditions for the cells forming the cofferdam system may be affected by potential differences in the assumed top elevation of the McNairy I formation.
8	The planned use of the existing lock chamber to pass river flows during Stage 2 of the navigable pass construction may result in the deposition of gravel in the baffle system for the lock.
9	It cannot be determined if the linear interpolated values used to generate the elevation-frequency curve would be affected by a significant change in flood profile slope.
10	It could not be determined if the left boat abutment counterfort wall was designed according to EM 1110-2-2104.
11	The rationale for ignoring uplift pressures and assuming pumps will be effective has not been supported.
Significance – Low	
12	The procedures used in analyzing the stability of the sheet pile cells, as described in Appendix B, do not conform to the procedures stated in EM 1110-2-2503.
13	The assumed shear strength of the McNairy I formation is an important element of the design of cellular sheet pile structure, but the basis for selecting the shear strength is not adequately described.
14	The computations and references contained in Appendix B do not support the design of the structural sections of the piling system proposed for the navigable pass as shown in Appendix A.

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LIST OF ACRONYMS

ACI	American Concrete Institute
ATR	Agency Technical Review
CCM	Certified Construction Manager
CDT	Construction Documents Technologist
COI	Conflict of Interest
CPE	Certified Professional Estimator
CPP	Critical Path Project
CSRA	Cost and Schedule Risk Analysis
CWWBS	Civil Works Work Breakdown Structure
DrChecks	Design Review and Checking System
EAP	Emergency Action Plan
EDC	Engineering During Construction
EM	Engineering Manual
FS	Factor of Safety
IEPR	Independent External Peer Review
ITD	In-The-Dry Study
ITW	In-The-Wet Study
IWUB	Inland Waterways Users Board
MCACES	Micro-Computer Aided Cost Engineering System
NAS	Network Analysis Systems
O&M	Operations and Maintenance
OEO	Outside Eligible Organization
OMB	Office of Management and Budget
PACR	Post Authorization Change Report
PED	Planning, Engineering, and Design
PLA	Project Labor Agreement
PMI	Project Management Institute
PgMP	Program Management Professional
POP	Period of Performance
RE	Resident Engineer
S2EIS	Second Supplemental Environmental Impact Statement
USACE	United States Army Corps of Engineers
USCG	United States Coast Guard
WRDA	Water Resources Development Act

1. INTRODUCTION

The Olmsted Locks and Dam project provides for a navigation facility near Ohio River Mile 964.4 that will replace the existing Locks and Dam 52 and 53. The facility will consist of twin 110-foot by 1,200-foot locks adjacent to the Illinois bank, five tainter gates, a right boat abutment, a 1,400-foot navigable pass, a left boat abutment, and a fixed weir extending into the Kentucky bank. During low-flow conditions, an upper pool having an elevation of 300 feet at the dam will extend upstream a distance of 47 miles to the Smithland Locks and Dam. Open river conditions will exist from the dam site downstream a distance of approximately 17 miles to the mouth of the Ohio River.

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The Olmsted Dam ITD Study (dated 31 May 2012) found that the use of two cellular sheet-pile cofferdams, staged for consecutive construction, was the best course of action for this method of construction. Two cofferdams represented optimum conditions from a constructability and schedule standpoint while minimizing impacts on navigation. The study also recommended that the first cofferdam to be constructed should be the one nearest the Kentucky bank. Each cofferdam cell will be 62.66 feet in diameter and filled with sand. The top of each cofferdam

will be at El. 329 and the typical sheet pile tip will be at El. 234, giving a typical sheet pile length of 95 feet.

Cost estimates and schedules were prepared to a comparable level of detail for ITD and the current ITW construction methods. A cost and schedule risk analysis (CSRA) was performed to establish the 80% confidence level for both cost and schedule

The objective of the work described here was to conduct an Independent External Peer Review (IEPR) of the Olmsted ITD Study in accordance with procedures described in the Department of the Army, U.S. Army Corps of Engineers (USACE) Engineer Circular *Civil Works Review*, (EC 1165-2-214) (USACE, 2012), USACE CECW-CP memorandum *Peer Review Process* (USACE, 2007), and Office of Management and Budget (OMB) bulletin *Final Information Quality Bulletin for Peer Review* (OMB, 2004). Independent, objective peer review is regarded as a critical element in ensuring the reliability of scientific analyses.

This final report details the IEPR process, describes the IEPR panel members and their selection, and summarizes the Final Panel Comments of the IEPR Panel on the existing engineering, cost and scheduling analyses contained in the Olmsted ITD Study. The full text of the Final Panel Comments is presented in Appendix A.

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) and USACE (2007).

In general, the purpose of peer review is to strengthen the quality and credibility of the USACE decision documents in support of its Civil Works program. IEPR provides an independent assessment of the engineering, cost and scheduling analysis of the project study. In particular, the IEPR addresses the technical soundness of the project study's assumptions, methods, analyses, and calculations and identifies the need for additional data or analyses to make a good decision regarding implementation of alternatives and recommendations.

In this case, the IEPR of the Olmsted ITD Study was conducted and managed using contract support from Battelle, which is an Outside Eligible Organization (OEO) (as defined by EC 1165-2-214) under Section 501(c)(3) of the U.S. Internal Revenue Code with experience conducting IEPRs for USACE.

3. METHODS

This section describes the method followed in selecting the members for the IEPR Panel (the Panel) and in planning and conducting the IEPR. The IEPR was conducted following procedures described by USACE (2012) and in accordance with USACE (2007) and OMB (2004) guidance. 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).

3.1 Planning and Schedule

At the beginning of the Period of Performance (POP), 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.

Table 1 defines the schedule followed in executing the IEPR. Due dates for milestones and deliverables are based on the award/effective date of November 16, 2012. Note that the work items listed in Task 7 occur after the submission of this report. Battelle will enter the 14 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.

Table 1. Olmsted ITD Study IEPR Schedule

Task	Action	Due Date
1	Award/Effective Date	11/16/2012
	Review documents available	11/16/2012
	Battelle submits draft Work Plan ¹	11/27/2012
	USACE provides comments on draft Work Plan and Charge	11/28/2012
	Battelle convenes teleconference	11/28/2012
	Battelle submits final Work Plan ¹	11/29/2012
2	Battelle requests input from USACE on the conflict of interest (COI) questionnaire	11/19/2012
	USACE provides comments on COI questionnaire	11/19/2012
	Battelle submits list of selected panel members ¹	11/21/2012
	USACE provides comments on selected panel members	11/26/2012
	Battelle completes subcontracts for panel members	12/3/2012
3	USACE provides Charge to be included in Work Plan	11/16/2012
	Battelle develops Sub-Charge Questions to be included in Work Plan	11/27/2012
4	USACE/Battelle hold kick-off meeting	11/20/2012
	Battelle/Panel hold kick-off meeting	12/4/2012
	USACE/Battelle/Panel hold kick-off meeting	12/4/2012
5	Panel members complete their individual reviews	12/11/2012
	Battelle provides Panel merged individual comments and talking points for Panel Review Teleconference	12/13/2012
	Panel members provide draft Final Panel Comments to Battelle	12/20/2012
6	Battelle submits Final IEPR Report to USACE ¹	1/3/2013

Table 2. (Continued)

Task	Action	Due Date
6	Battelle submits Revised Final IEPR Report to USACE ^{1,2}	1/8/2013
7 ³	Battelle convenes teleconference with USACE to review the Post-Final Panel Comment Response Process	1/4/2013
	USACE provides draft Project Delivery Team (PDT) Evaluator Responses to Battelle	1/8/2013
	Battelle convenes teleconference with Panel and USACE to discuss Final Panel Comments and draft responses	1/11/2013
	USACE inputs final PDT Evaluator Responses in DrChecks	1/15/2013
	Battelle inputs the Panel's BackCheck Responses in DrChecks	1/17/2013
	Battelle submits pdf printout of DrChecks project file ¹	1/18/2013
	Contract End/Delivery Date	3/22/2013

¹Deliverable

²Deliverable revisions denoted in the errata

³Task 7 occurs after the submission of this report

3.2 Identification and Selection of IEPR Panel Members

The candidates for the Panel were evaluated based on their technical expertise in the following key areas: structural engineering, hydraulic engineering, geotechnical engineering, engineering cost estimation, and project scheduling. These areas correspond to the technical content and overall scope of the Olmsted ITD Study 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 initially identified more than 30 candidates for the Panel, evaluated their technical expertise, and inquired about potential COIs. Of these, Battelle chose the most qualified candidates and confirmed their interest and availability, and ultimately proposed five experts for the final Panel. Information about the candidate panel members, including brief biographical information, highest level of education attained, and years of experience, was provided to USACE for feedback. Battelle made the final selection of panel members according to the selection criteria described in the Work Plan.

The five proposed primary reviewers constituted 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.^{a,b} These COI questions were intended to 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^b in the Olmsted Locks and Dam 52 and 53 Replacement Project Method of Construction Alternative Analysis (Olmsted Dam In-The-Dry Study).
- Previous and/or current involvement by you or your firm^b related to navigation studies in Ballard County, Kentucky, Pulaski County, Illinois, or in the vicinity of Ohio River Mile 964.
- Previous and/or current involvement by you or your firm^b in the Olmsted Locks and Dam 52 and 53 Replacement Project Method of Construction Alternative Analysis (Olmsted Dam In-The-Dry Study) related projects.
- Previous and/or current involvement by you or your firm^b in the conceptual or actual design, construction, or operation and management (O&M) of any projects in the Olmsted Locks and Dam 52 and 53 Replacement Project Method of Construction Alternative Analysis (Olmsted Dam In-The-Dry Study) related projects.
- Current employment by the U.S. Army Corps of Engineers (USACE).
- Previous and/or current involvement in paid or unpaid expert testimony related to Olmsted Locks and Dam 52 and 53 Replacement Project Method of Construction Alternative Analysis (Olmsted Dam In-The-Dry Study).
- Previous and/or current employment or affiliation with members of the cooperating agencies or local sponsors (for pay or pro bono).
- Past, current, or future interests or involvements (financial or otherwise) by you, your spouse, or your children related to Olmsted Locks and Dam 52 and 53 Replacement Project Method of Construction Alternative Analysis (Olmsted Dam In-The-Dry Study) in Ballard County, Kentucky, Pulaski County, Illinois, or in the vicinity of Ohio River Mile 964.
- Current personal involvement in other USACE projects, including whether involvement was to author any manuals or guidance documents for USACE. If yes, provide titles of

^a 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."

^b Includes any joint ventures in which your firm is involved and if your firm serves as a prime or as a subcontractor to a prime. Please clarify which relationship exists.

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 Louisville District.

- Previous or current involvement in the development or testing of models that will be used for or in support of the Olmsted Locks and Dam 52 and 53 Replacement Project Method of Construction Alternative Analysis (Olmsted Dam In-The-Dry Study) project.
- Current firm^b involvement in other USACE projects, specifically those projects/contracts that are with the Louisville 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 Louisville District. Please explain.
- Any previous employment by USACE as a direct employee or contractor (either as an individual or through your firm^b) within the last 10 years, notably if those projects/contracts are with the Louisville 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 navigation studies, and include the client/agency and duration of review (approximate dates).
- Pending, current, or future financial interests in Olmsted Locks and Dam 52 and 53 Replacement Project Method of Construction Alternative Analysis (Olmsted Dam In-The-Dry Study).related contracts/awards from USACE.
- A significant portion (i.e., greater than 50%) of personal or firm^b revenues within the last 3 years came from USACE contracts.
- A significant portion (i.e., greater than 50%) of personal or firm^b revenues within the last 3 years from contracts with the non-Federal sponsor.
- Any publicly documented statement (including, for example, advocating for or discouraging against) related to Olmsted Locks and Dam 52 and 53 Replacement Project Method of Construction Alternative Analysis (Olmsted Dam In-The-Dry Study).
- Participation in prior Federal studies relevant to this project and/or Olmsted Locks and Dam 52 and 53 Replacement Project Method of Construction Alternative Analysis (Olmsted Dam In-The-Dry Study).
- Previous and/or current participation in prior non-Federal studies relevant to this project and/or Olmsted Locks and Dam 52 and 53 Replacement Project Method of Construction Alternative Analysis (Olmsted Dam In-The-Dry Study).
- 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, including:
 - a. Previous employment by the inland navigation towing industry? If yes, in what capacity?

- b. Previous contractual relationship with the Inland Waterways Users Board (IWUB)? If yes, in what capacity or project were you involved?
- c. Having previously briefed IWUB? If yes, what was the subject matter?

In selecting the final members of the Panel from the list of candidates, Battelle chose experts who best fit the expertise areas and had no COIs. The five final reviewers were either affiliated with consulting companies or were independent engineering consultants. 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 made the final selections of the Panel. Section 4 of this report provides names and biographical information on the panel members.

Prior to beginning their review and within one day of their subcontracts being finalized, all members of the Panel attended a kick-off meeting via teleconference planned and facilitated by Battelle in order to review the IEPR process, the schedule, communication procedures, and other pertinent information for the Panel.

3.3 Preparation of the Charge and Conduct of the IEPR

The charge was prepared by USACE according to guidance provided in USACE (2012) and OMB (2004). Battelle reviewed the charge questions, developed sub-charge questions as needed, and suggested revisions for consistency and clarity, additions, or deletions. USACE was given the opportunity to provide comments and revisions, and subsequently approved the final charge questions, which were included in the draft and final Work Plans. In addition to a list of 12 multi-part charge questions/discussion points, the final charge included general guidance for the Panel on the conduct of the peer review (provided in Appendix B of this final report).

Battelle planned and facilitated a final kick-off meeting via teleconference during which USACE presented project details to the Panel. Before the meeting, the IEPR Panel received an electronic version of the final charge as well as the Olmsted ITD Study documents and the supplemental 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.

- **Olmsted In The Dry Study (main report dated 31 May 2012)**
- **Appendix A Drawings**
- **Appendix B Engineering Calculations**
- **Appendix C Hydraulics and Hydrology**
- **Appendix D Cost, Schedule, Risk (2012-05-13)**
- **Appendix D-1 Total Project Cost Summary**
- **Appendix D-2 MII Reports**
- **Appendix D-3 Primavera P6 Schedule**
- **Appendix D-4 Cost and Schedule Risk Analysis**
- **Appendix D-5 ATR Documentation**
- **Appendix D-6 Quality Control**
- **Appendix D-7 Tainter Gate Contract Backup**
- **Appendix D-8 NavPass Contracts Backup**

- **Appendix D-9 Out Year Contracts Backup**
- **Appendix D-10 Prior Expenditures**
- **Appendix D-11 Team Resumes**
- **Appendix D-12 URS Corp 2011 Rebaseline Estimate**
- Olmsted Dam In-The-Dry Study (dated 31 May 2012)
 - Appendix E: Economics
- Olmsted Locks and Dam PACR and Appendices
 - Appendix A: Economics Update
 - Appendix B: Modifications During Construction
 - Appendix C: Section 902 Maximum Project Cost Computations
 - Appendix D: Olmsted Locks and Dam Program Year (PY) PB-3
 - Appendix E: Certification of Independent Technical Review
 - Appendix F: Baseline Cost Estimate for the PACR
 - Appendix G: Revised PACR Certification – November 2011
 - Appendix H: Review Plan and Review Plan Approval Memo
 - Appendix I: Independent External Peer Review Documents
- USACE guidance *Civil Works Review*, (EC 1165-2-214) dated December 15, 2012
- CECW-CP Memorandum dated March 30, 2007
- Office of Management and Budget’s *Final Information Quality Bulletin for Peer Review* released December 16, 2004.

3.4 Review of Individual Comments

The Panel was instructed to address the charge questions/discussion points within a comment-response form provided by Battelle. At the end of the review period, the Panel produced 81 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. As a result of the review, Battelle summarized the 81 comments into 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.

3.5 IEPR Panel Teleconference

Battelle facilitated a 4-hour teleconference with the Panel so that the panel members, many of whom are from diverse scientific backgrounds, 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 high-level importance to the findings, and merged any related individual comments. In addition, Battelle confirmed each Final Panel Comment's level of significance with the Panel, and that there were no conflicting issues among the panel members.

At the end of these discussions, the Panel identified 14 comments and discussion points that should be brought forward as Final Panel Comments.

3.6 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 Olmsted ITD Study:

- **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 other IEPR panel members 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, 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 problem with the project that could affect the recommendation, success, or justification of the project. Comments rated as high indicate that the Panel analyzed or assessed the methods, models, and/or analyses and determined that there is a “showstopper” issue.
 2. **Medium:** Affects the completeness of the report in describing the project, but will not affect the recommendation or justification of the project. Comments rated as medium indicate that the Panel does not have sufficient information to analyze or assess the methods, models, or analyses.
 3. **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 (tables, figures, equations, discussions) that was mislabeled or incorrect or data or report sections that were not clearly described or presented.

- **Guidance 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).

At the end of this process, 14 Final Panel Comments were prepared and assembled. 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. 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 Appendix A of this report.

4. PANEL DESCRIPTION

Candidates for the Panel were identified using Battelle's Peer Reviewer Database, targeted Internet searches using key words (e.g., technical area, geographic region), searches of websites of universities or other compiled expert sites, and referrals. Battelle prepared a draft list of primary and backup candidate panel members (who were screened for availability, technical background, and COIs), and provided it to USACE for feedback. Battelle made the final selection of panel members.

An overview of the credentials of the final five primary members of the Panel and their qualifications in relation to the technical evaluation criteria is presented in Table 2. More detailed biographical information regarding each panel member and his area of technical expertise is presented in the text that follows the table.

Table 3. Olmsted ITD Study IEPR Panel: Technical Criteria and Areas of Expertise

Technical Criteria	Dotson	Lesué	Spaulding	Rosenow	Fowler
Structural Engineering (one expert needed)					
Registered P.E. with a minimum 15 years' experience and graduate study in the structural engineering field	X				
Experience evaluating dam structural elements	X				
Experience evaluating reinforced concrete structures with emphasis on seismic analysis and design for industry codes standards	X				
Experience evaluating reinforced concrete structures with emphasis on USACE design regulations	X				
Active participation in related professional societies	X				
Minimum M.S. degree in structural engineering	X				
Hydraulic Engineering (one expert needed)					
Registered P.E. with a minimum 10 years' experience in hydraulic engineering		X			
Minimum 5 years' experience working with numerical modeling applications		X			
Familiarity with USACE standard hydrologic and hydraulic computer models		X			
Active participation in related professional societies		X			
Minimum B.S. degree in engineering		X			
Geotechnical Engineering (one expert needed)					
Registered P.E. with a minimum 15 years' experience and graduate study in soils engineering or related field			X		
Dam experience through participation in dam safety expert panels, or similar experience with hydraulic retaining structures			X		

Table 2. (Continued)

Technical Criteria	Dotson	Lesué	Spaulding	Rosenow	Fowler
Geotechnical Engineering (one expert needed) (Continued)					
Several years of direct experience with hydraulic retaining structure projects as either designer or construction project engineer			X		
Design experience with:			X		
– Cofferdams			X		
– Embankment stability			X		
– Foundation preparation			X		
Design or construction experience evaluating seismic loads			X		
Active participation in related professional societies			X		
Minimum M.S. degree in geotechnical engineering			X		
Engineering Cost Estimating (one expert needed)					
Minimum 10 years' experience or combined equivalent of education and experience working with estimating complex, phased costing of multi-year civil construction projects				X	
Minimum 5 years' experience in the development of estimated construction costs and construction methods related to large civil works navigation projects				X	
Certified cost engineer or certified estimating professional				X	
Familiarity with all applicable USACE regulations that require extensive knowledge of Micro-Computer Aided Cost Engineering System (MCACES) 2nd Generation (MII)				X	
Familiarity with Civil Works Work Breakdown Structure (CWWBS) and critical path project scheduling				X	
Active participation in related professional societies				X	
B.S. degree in construction management				X	

Table 2. (Continued)

Technical Criteria	Dotson	Lesué	Spaulding	Rosenow	Fowler
Project Scheduling (one expert needed)					
Minimum 10 years' experience in the preparation and/or analysis of Network Analysis Systems (NAS) for large civil works navigation projects					X
Familiarity with all applicable USACE regulations which require extensive knowledge of Primavera P6					X
PMI-PgMP certification					X
Active participation in related professional societies					X
Minimum of a B.S. degree in engineering or an M.S. in construction management					X

Don Dotson, Ph.D., P.E., S.E., D.GE

Role: Structural engineering

Affiliation: AMEC Environment and Infrastructure

Dr. Dotson is a professional engineer with AMEC Environment and Infrastructure in Nashville, Tennessee, with more than 30 years of engineering experience performing geotechnical and structural design of deep foundation designs, ground modification, drilling and grouting programs for structural and water cutoff applications, dam inspections, dam remediation, underpinning, soil liquefaction detection and mitigation, retaining wall and shoring designs, and slope stability analysis and repair. He earned his M.S. in engineering (geotechnical-structural) from Tennessee State University in 1993 and his Ph.D. in science and technology from Union Institute. He is a registered professional engineer in 29 states, a registered structural engineer in Utah, and an Engineer of Record for the Georgia Department of Natural Resources' Safe Dams Program. Dr. Dotson is Adjunct Professor of Civil Engineering, Tennessee State University, is a peer reviewer for the ASCE Journal of Geotechnical and Geoenvironmental Engineering, and is a Diplomate, Geotechnical Engineering by the Academy of Geo-Professionals.

Dr. Dotson is experienced in evaluating dam structural elements and has participated in the Type II IEPR for East Branch Dam, Pennsylvania, and the Independent Technical Design Reviews of Upper Clear Boggy Creek Floodwall Retarding Structures (FRSs) Nos. 33 & 34, Oklahoma, and the Lake Fork Pump Station, Dallas, Texas. He has experience evaluating reinforced concrete structures with emphasis on seismic analysis and design for industry codes standards, including his structural review for the dam rehabilitation design for two embankment FRSs in Oklahoma. These reviews were completed to ensure that design and construction procedures and decisions reflected safety considerations, addressed all potential dam safety deficiencies, safely and effectively met the stated design objectives, addressed unique site conditions, and were consistent with industry dam safety practices.

Having worked at USACE, Dr. Dotson is experienced in evaluating USACE-designed reinforced concrete structures. A relevant study is the Retaining Wall Value Engineering Change Proposal for the Huntington District's Martin Redevelopment Non-structural Flood Mitigation Plan, which involved the design of multiple tiers of anchored soldier pile retaining walls with permanent cast-in-place facing and sand drains for settlement mitigation.

Dr. Dotson is a member of the American Society of Civil Engineers (ASCE), the Deep Foundations Institute (DFI), the Association of Drilled Shaft Contractors (ADSC), the International Society for Micropiles (ISM), and the American Institute of Steel Construction (AISC).

Jacob Lesué, P.E.

Role: Hydraulic engineering

Affiliation: O'Brien Engineering Inc.

Jacob Lesué is an engineer with O'Brien Engineering, Inc. in Dallas, Texas, with 11 years of focused experience in hydraulic engineering, including providing complex hydraulic, hydrologic, and hydrodynamic modeling, analysis, and design using many of the industry's most specialized software programs. He earned his M.S. in civil engineering from Brigham Young University, is a registered professional engineer in Texas, and is a Certified Floodplain Manager.

He has more than 10 years' experience working with numerical modeling applications including HEC-RAS, HEC-HMS, HEC-1, HEC-2, HEC-GeoHMS, HEC-GeoRAS, HEC-DSS, HEC-DSSVue, XPSWMM's XPSstorm (hydrodynamic capabilities), SMS, WMS, WISE, TR-55, HY-8, ADCIRC, HMR51, and HMR52. Relevant studies that required model application include hydrologic and hydraulic evaluations, breach analysis, preparation of inundation maps, and preparation of the emergency action plan (EAP) for Clayton Lake and Carlton Lake Dams, Oklahoma; the dam inspections and spillway adequacy, and the watershed contribution modeling for the New Mart Lake Dam Safety Evaluation, Texas; and the hydraulic and hydrologic numerical modeling analysis in support of floodplain mapping for USACE's Cedar Creek Hydraulic/Hydrologic Modeling and Flood Study.

Mr. Lesué is familiar with USACE standard computer models and has developed hundreds of hydrologic and hydraulic computer models for such projects as the Buckeye/Sun Valley Area Drainage Master Study for the Flood Control District of Maricopa County, Arizona, where he used numerical modeling to create and link complex hydraulic models; the Southwest Nature Preserve Dam Safety Evaluation, Arlington, Texas Emergency Repair, and Rehabilitation, where he prepared hydraulic models to determine the design flows and the 100-year and PMF and provided analysis and design for the rehabilitation of the spillway and dam; and the preparation of revised digital flood maps for FEMA Flood Insurance Rate Map Modernization for McLennan, Bell, Bosque, and Bell Counties, Texas. Mr. Lesué is a member of the Texas Society of Professional Engineers (TSPE).

Douglas Spaulding, P.E.

Role: Geotechnical engineering

Affiliation: Spaulding Consultants, LLC

Douglas Spaulding is a Principal and geotechnical engineer with Spaulding Consultants, LLC, where he is responsible for a variety of water resource projects, including dam, levee, and floodwall design and inspection. He earned his M.S. in civil engineering (geotechnical) from Purdue University, and is a registered professional engineer in Wisconsin, Minnesota, Michigan, and North Dakota. He has more than 40 years of experience as a geotechnical engineer and served as the Chief of the Levee and Channel Design Section for USACE from 1973 to 1978.

Mr. Spaulding has extensive dam experience. His dam safety expertise is reflected in his service as facilitator for the Federal Energy Regulatory Commission for more than 60 Potential Failure Mode Analyses on dams located in an 11-state area and having served on the IEPR Panel for the

Fargo-Moorhead Flood Control Project and the East St. Louis Seepage Rehabilitation Project. He has provided more than 100 independent consultant inspections for hydroelectric projects located throughout the upper Midwest and has served on several USACE IEPR Panels. He has several years of direct experience with hydraulic retaining structure projects and has direct design supervision experience on four earth embankment dam projects, in addition to being responsible for the preliminary and final design of three hydroelectric project powerhouses and over 10 dam rehabilitation projects in the United States.

Mr. Spaulding's experience includes the design and supervision of design effort for a number of earth and sheet pile cofferdam structures including earth cofferdam structures designed for the Lafarge Dam Project, a cellular sheet pile and earth fill cofferdam for the St. Cloud Hydroelectric Project, and a sheet pile bulkhead cofferdam for the Lower St. Anthony Falls Hydroelectric Project. He was responsible for developing embankment stability computer applications that were used by USACE and was responsible for the evaluation of the stability of the Sylvan Hydroelectric Embankment and the High Falls and Eau Pliene Hydroelectric Dam Embankment Rehabilitation. These latter evaluations included use of finite element analysis to evaluate seepage induced pore pressures and their impact on the stability of a 100-year old earth embankment. He is also experienced in foundation preparation, with recent project experience including foundation densification using compaction grouting as well as providing design specifications for foundation preparation for both lock and dam foundations. Mr. Spaulding was the facilitator for the evaluation of failure modes and responsible for seismic analyses review for a variety of structures located in the western United States, including the 602-ft. high Mossy Rock arch dam and the Hebgen earth embankment. He has also performed liquefaction studies for lower height loose fill earth embankments at projects in the Midwest.

Mr. Spaulding is a member of the ASCE, the Society of American Military Engineers (SAME), and the American Arbitration Association.

Earl Rosenow, CPE, LEED

Role: Engineering cost estimating

Affiliation: Alpha Corporation

Earl Rosenow is a cost engineer in the Project Control division of Alpha Corporation in Baltimore, Maryland. He earned his B.S. degree in civil construction management from the University of Denver in 1966 and is an American Society of Professional Estimators (ASPE) Certified Professional Estimator. He specializes in risk and cost analysis and has more than 40 years' experience in the practice of engineering with specific emphasis on consultation and evaluation of transportation systems, structures, and utilities. He has in-depth experience in cost estimating, change order review, negotiation, and value engineering for a variety of governmental and non-governmental projects at various stages of design and construction. He has estimated and managed projects from initial review through project buyout and his duties have included quantity take-off, pricing, bid summaries, design-build proposals, and project management.

Mr. Rosenow's experience in estimating complex, phased costing of multi-year Civil Works construction projects includes his role as Chief Estimator for multiple complex civil construction

projects, including the National Parks Service/USACE Tamiami Trail Bridge, Florida Improvements, which involved environmental sensitivities and historical monuments; Chincoteague Bridge in Virginia, which involved bridge work spanning two water way channels; Brightman Street Bridge, Massachusetts, which involved massive bridge caisson foundations, river bank stabilization, and pilings.

Mr. Rosenow is familiar with all applicable USACE regulations that require extensive knowledge of MCACES MII and has been an Estimator/PM for numerous USACE projects on U.S. forts and bases over the past 30 years, including projects at the Aberdeen Proving Grounds. He is familiar with Civil Works Work Breakdown Structure (CWWBS) and critical path project (CPP) scheduling and has extensive knowledge of CPM through practical applications on USACE projects.

He actively participates in ASPE and U.S. Green Building Council (USGBC), has published in ASPE National Magazine, attends ASPE National Conferences, and serves in multiple officer roles in his local ASPE Chapter.

C. Deane Fowler P.E., CCM, CDT, PgMP

Role: Project scheduling

Affiliation: Independent Consultant

C. Deane Fowler is an independent consultant with 35 years of experience in cost engineering, estimating, phased costing, and scheduling of multi-year civil construction projects. He earned his M.S. in civil engineering/construction management in 1986 from the University of Florida, is a registered professional engineer in Florida and Virginia, and is a Construction Documents Technologist (CDT), Certified Construction Manager (CCM), and Program Management Professional (PgMP). He has program, project, facilities, and construction contract management experience and has held positions in every facet of engineering, including daily and long-term budgeting, planning, scheduling, operations, and executive level management. He served with USACE from 1976 to 1998, ultimately as Deputy Commander for the Jacksonville District and was the principal engineer/Senior Officer/project manager on multiple USACE civil engineering projects for the Baltimore, Mobile and Jacksonville Districts, USACE.

His experience in the preparation and/or analysis of Network Analysis Systems (NAS) for large Civil Works navigation projects has been demonstrated in such projects as Levee Inspection Clatsop 1 & 7, Svensen Levee Systems for Portland District; and as project manager (under contract with USACE-MVN) for the Morganza to the Gulf of Mexico Hurricane Protection and Navigation; East Baton Rouge Parish Flood Control; St Charles Parish Flood Risk Reduction; and St John the Baptist Flood Risk Reduction Projects. His efforts included schedule and cost analysis of multiple alternatives (Primavera, MII cost estimating) in support of review of economic storm damage analysis and projections and the coordination between in-house and outside design organizations including Federal, state, and private engineering, USACE District staff, local resource agencies, and sponsor.

Mr. Fowler is familiar and experienced with USACE regulations that require extensive knowledge of Primavera P6. Relevant projects include approximately 150 different navigation,

flood control, and environmental projects in Florida, Puerto Rico, and the U.S. Virgin Islands, varying in size from 100 activities to more than 3,000 activities per project. Mr. Fowler's training includes Primavera Instruction on P6, and detailed training on USACE P2 software.

He actively participates in related professional societies, including being a Life Member of SAME, Chi Epsilon, and is a current member of the Certified Construction Management Association (CCMA) and Project Management Institute (PMI).

5. SUMMARY OF FINAL PANEL COMMENTS

The panel members agreed among one another 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 Olmsted ITD Study. The Panel generally agreed that the adequacy and acceptability objectives of the ITD Study presented above were achieved. The Panel found the Olmsted Dam ITD Study to be a good analysis and summary of the issues identified by changing from ITW to ITD. The high level of effort put forth by USACE to develop the Olmsted Study, Cost Estimate, and Schedule are evident in the quality of the final product.

Table 3 lists the 14 Final Panel Comment statements by level of significance. The full text of the Final Panel Comments is presented in Appendix A. The following statements summarize the Panel's findings.

Structural Engineering – The Panel agreed that the Olmsted ITD Study structural calculations generally meet the stated objectives, but areas requiring additional discussion or analysis were identified. Specifically, the study proposes to support the structural sections for the navigable pass on steel pipe piles; however, the computations contained in Appendix B of the review documents do not describe the design of this piling system. The effect of pump failure on the cofferdam of the navigable pass does not appear to have been thoroughly addressed. The left boat abutment counterfort wall is designed as a ‘beam,’ but it is not immediately evident from the information provided that this is an appropriate design.

Hydraulic Engineering – The Panel agreed that the approach and analysis seems to be reasonable based on the timing of the overall project. However, in certain cases, assumptions are made without providing the corresponding technical computations or analysis to support the assumptions. One example is the assumption that the cost to raise the height of the cofferdam would be greater than costs associated with one overtopping event based on cleanup, repairs, and associated delays. The Panel also noted that the elevation-frequency curve is based on linear interpolation of the gage stations located upstream and downstream of the project site, but no mention is made in the study on whether or not the flood profiles would contain a significant change in slope that would affect the interpolated results. The Panel's experience at another lock and dam indicates that the use of the lock chambers to pass high river flows may result in the deposition of gravel sediments in the bottom of the lock chamber. These sediments can erode the concrete bottom of the lock by producing a “milling operation” during normal lock operations.

Geotechnical Engineering – The Panel agreed that the Olmsted Locks and Dam ITD study provides a general review and analysis of the issues associated with the ITD procedures. Within the limits of available data and information, the study addresses issues such as the cellular sheet pile design concerns, overtopping impacts, navigation issues, and dewatering procedures. The study was performed to a feasibility level of detail, which means that there are both additional information needs and additional studies that will be required prior to final design.

The Panel noted several areas that may require additional discussion and analysis. The geotechnical computations for stability and other design requirements indicate an assumed average cross-section with the top of the McNairy I formation at El. 240.0, but the potential impacts of the actual variation of the McNairy are not discussed. The stability analysis uses an anisotropic assumption regarding the shear strength for the McNairy I formation, but there is no justification and discussion of the parameters and procedures used for this approach. Also, it appears that the stability procedures used in the analysis for the stability of the cells as described in Appendix B of the review documents do not conform to the procedures stated in EM1110-2-2503, Design of Sheet Pile Cellular Structures.

Engineering Cost Estimating – The Panel generally agreed in its assessment of the engineering cost estimating, and thought that the Olmsted ITD Study is well structured and the report provided a very thorough analysis of the proposed construction method. However, there may be opportunities to provide additional benefits to the project that were not explored. For example, the use of a project labor agreement (PLA) has not been discussed as a means to control labor costs, or the use of fuel rate adjustment clauses in equipment lease agreements. In addition, the types of contract lettings (i.e., Design-Bid-Build, Design-Build, or Cost Reimbursable) and contract incentive clauses are not discussed as a means to improve construction cost performance. Contractor use and/or purchase of government-owned equipment and materials like sheet pilings should be clarified prior to bid letting. Finally, taking a closer look at the overall project schedule, there appear to be some potential cost economies to be made. Design efforts could be consolidated and site work/restoration efforts could be done earlier to shorten or eliminate the estimated two-year ITD extension. The Panel believes that further consideration of these issues could improve the cost performance of the ITD method of construction.

Project Scheduling – The basic assumptions stated in the study appear to be sound whether they relate to the excavation to El 250.0 for both Phases, sequence of construction and filling of the cells, establishment of pile tip elevations to control seepage from the McNairy formation, or actions to take when river elevations exceed El 303.5.

However, the contingencies are ambitious and do not adequately take into account difficulties with adverse river conditions when constructing in the middle of the Ohio River. Furthermore, the contingency activities are not always incorporated into the logical link within activities of the network, nor are they hammocked with other activities and they have only a small ability to absorb any changes without significant impact on the operational date of the navigation pass.

Table 4. Overview of 14 Final Panel Comments Identified by the Olmsted ITD IEPR Panel

No.	Final Panel Comment
Significance – Medium	
1	The study design relies heavily on data and procedures from the In-The-Wet (ITW) Study and lacks sufficient new analysis to validate the current study design and detect potential critical deficiencies.
2	Components of the cost and schedule risk analysis (CSRA), including labor costs, equipment costs, design costs, and contracts, are not sufficiently discussed to determine the 80% confidence level of the cost estimate.
3	Contingencies discussed in the In-The-Dry (ITD) Study and shown in the project schedule are broad in nature and scope and do not accurately account for difficulties that may affect project construction.
4	Project activities such as Value Engineering, contingencies, and the development of the Second Supplemental Environmental Impact Statement (S2EIS) are not tied logically in the Critical Path Network.
5	There may be opportunities to compress the project schedule that do not appear to have been considered.
6	The assumption that the cost to raise the height of the cofferdam would be greater than the cost associated with one overtopping event is not supported by a cost estimate.
7	Design conditions for the cells forming the cofferdam system may be affected by potential differences in the assumed top elevation of the McNairy I formation.
8	The planned use of the existing lock chamber to pass river flows during Stage 2 of the navigable pass construction may result in the deposition of gravel in the baffle system for the lock.
9	It cannot be determined if the linear interpolated values used to generate the elevation-frequency curve would be affected by a significant change in flood profile slope.
10	It could not be determined if the left boat abutment counterfort wall was designed according to EM 1110-2-2104.
11	The rationale for ignoring uplift pressures and assuming pumps will be effective has not been supported.
Significance – Low	
12	The procedures used in analyzing the stability of the sheet pile cells, as described in Appendix B, do not conform to the procedures stated in EM 1110-2-2503.
13	The assumed shear strength of the McNairy I formation is an important element of the design of cellular sheet pile structure, but the basis for selecting the shear strength is not adequately described.
14	The computations and references contained in Appendix B do not support the design of the structural sections of the piling system proposed for the navigable pass as shown in Appendix A.

6. REFERENCES

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APPENDIX A

Final Panel Comments

on the

Olmsted ITD Study

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Comment 1

The study design relies heavily on data and procedures from the In-The-Wet (ITW) Study and lacks sufficient new analysis to validate the current study design and detect potential critical deficiencies.

Basis for Comment:

The planning approach and design details contained in the In-The-Dry (ITD) Study are an extension of the planning and design procedures used in the development of the In-The-Wet (ITW) Study. The ITD Study, however, does not take into account the significant differences in the practicalities of constructing the two phased cofferdams in a heavily trafficked navigable waterway. Nor does it include a Value Engineering review during preliminary design, which would allow independent analysis of the entire process and help identify potential problems.

In its review of the ITD Study, the Panel identified issues associated with a cofferdam with no ready access to shore that require further analysis: hazards of moving personnel, equipment, and material daily over water, marine traffic maneuvering with obstructions in the way, and working 70 feet below the upper elevation of the cell walls, which is subject to periodic overtopping [at least one incident in five years (Olmsted Dam ITD Study main report, Sections 3a(1)(c)3 and 5, pp. 14 and 16]. Incidents of marine traffic striking obstructions in a navigable waterway occur all too frequently and should be anticipated for in the planning and development of the ITD design (USCG, 2012). The increase in river velocity at the pass between the cofferdams and the gates and the reduced navigable space increase the likelihood of marine accidents, including collisions with tow barges and the deflectors/cofferdam cells during storm events, and reduced visibility.

Several comments in the ITD Study [Olmsted Dam ITD Study main report, Section 3a(1)(c)4, p. 16; Sections 3d(3),(4), and (5), p. 99; and Section 5a(2)(a)1b, p. 109] suggest that, prior to construction, there is a need for a detailed hydraulic analysis other than the HEC-RAS model, study of scour and its impact on foundations, changes to river flow due to the placement of the deflectors, and further structural design review of the cast-in-place foundations for both boat abutments. In addition, the Panel believes that Value Engineering activities such as multiple pile driving rigs for Phases I and II to enhance the sequential nature of the pile driving operation (Activity IDs NPS1200 -1280) could shorten the construction time (reduce the 19 months difference between operation completion of the ITW and ITD studies). This would significantly improve the benefit/cost ratio and allow benefits to be realized at or before the ITW Study.

Significance – Medium:

Relying on the existing ITW Study as the basis for the ITD Study can transfer undetected oversights in process and procedure from one study to the other.

Recommendations for Resolution:

1. Consider conducting a constructability review of the ITD design. This could be accomplished by a team of independent engineers and consultants knowledgeable in riverine construction procedures.
2. Review and document the analysis (as appropriate) of all incidents of marine traffic striking stationary objects occurring in the river systems of the U.S. in the last 20 years.
3. Develop preventive measures (lighting, signage, public notices, etc.) to raise awareness of the hazards of the temporary structures in the navigable spaces of the river associated with the project.
4. Conduct further modeling analysis (including ship modeling) of the impacts of the marine structures in the navigable spaces of the river. Analyze the actions to be taken in the event a river incident occurs and document them in the study.
5. Incorporate the related additional studies identified in the ITD Study (scour, structural, etc.) and add a Value Engineering review to the design process.

Literature cited

USCG (2012). Proceedings of the Marine Safety & Security Council, the Coast Guard Journal of Safety & Security at Sea. Fall 2012 Report, Volume 69, Number 3.
<http://www.uscg.mil/proceedings/>

Comment 2

Components of the cost and schedule risk analysis (CSRA), including labor costs, equipment costs, design costs, and contracts, are not sufficiently discussed to determine the 80% confidence level of the cost estimate.

Basis for Comment:

The Panel identified major components of the Olmsted In-The-Dry (ITD) Study CSRA that appear to require further analysis to determine the 80% confidence level of the cost estimate required by USACE.

Labor costs have been adjusted to current Davis-Bacon wage rates. Specific provisions for future increases of these wage rates are not apparent in the estimate. Inasmuch as the Olmsted project is the largest project in the wage determination area, it is in effect setting these wage rates. It is not apparent in the ITD Study main report or appendices whether a project labor agreement (PLA) was ever considered as a means to control or predict rising labor costs over the life of the project (Appendix D [Cost Estimate], Schedule, and Risk, p. 25, paragraphs 4.2.2 and Table 5).

Equipment fuel costs were based on 2009 data adjusted for current local costs. There is no discussion of fuel rate adjustment clauses in the CSRA for equipment lease agreements. Future increases or decreases of diesel fuel costs that power most construction equipment have not been examined (Appendix D, p. 25, paragraph 4.2.2.4).

Equipment and tools will be procured to operate and maintain the dam. It is not clear if this is a capital expense chargeable to the job, or an operating expense of Louisville District Operations personnel chargeable to another budget center (Appendix D, p. 12, paragraph 3.2.4.3).

Engineering during construction (EDC) costs of \$1.75 M per year are based on historical data from the last 2 to 5 years and are projected from FY2012 until the end of the Tainter Gate Contract (FY2016). If the work is fully designed in the Planning, Engineering, and Design (PED) effort, it would seem EDC design efforts should fall into the Contractor Means and Methods category and be borne by the contractor. In addition, it would seem the EDC design needs would be less in the later stages of the 4-year work period after the initial engineering challenges have been met. Inasmuch as the cofferdam design is relatively simple and repetitive, \$7M (4 years x \$1.75M) for EDC seems high (Appendix D, p. 23, paragraph 4.1.2.3 and p. 27, paragraph 4.2.2.6).

Contract claims during ITD construction has been raised as a possibility. There are no apparent provisions in the estimate, other than the overall contingency, to service future claims. Due to the higher risk of marine construction methods, future claims could play a large role in meeting, or not meeting, project budgets (Olmsted ITD Study main report, p. g, Key Project Risk Items).

Closer analysis of the above listed components will contribute to the 80% confidence level by providing greater accuracy in the estimated amounts.

Significance – Medium:

To determine the monetary impact on the overall project budget it is important to provide details or estimates for common, yet sometimes less apparent, costs that have the potential for significant increase.

Recommendations for Resolution:

1. Project labor cost increases over the entire project duration and investigate the use of a PLA to control labor costs.
2. Review project contracts that use heavy equipment for provisions for adjusting fuel rates. Include fuel rate adjustment clauses in equipment lease agreements for both government- and contractor-owned equipment.
3. Estimate and detail design costs for each type of ITD construction rather than apply a fixed percentage or monetary value.

Comment 3

Contingencies discussed in the In-The-Dry (ITD) Study and shown in the project schedule are broad in nature and scope and do not accurately account for difficulties that may affect project construction.

Basis for Comment:

Contingencies account for risks through rough estimates of time and budget when there are too many unknowns to accurately plan for different scenarios and unforeseen conditions. For example, a contingency discussed in the ITD Study that is broad in scope involves adverse river conditions that may be encountered at critical times during the seven plus years of construction for Phase I and II cofferdams. The ITD Study projects one overtopping event to occur during the project's life (Olmsted Dam ITD Study main report, Section 3a(1)(c)3, p. 14). To rely on a contingency activity to capture all of the effects of the overtopping event to the project personnel, equipment, costs, and schedule is very optimistic. The Panel feels the potential impact of the overtopping is not being considered with sufficient detail in the ITD Study.

Furthermore, it is important that contingency activities be uniformly incorporated into the logical link within activities of the Critical Path Network (Network), or hammocked (grouped) with other activities. Normal construction contingencies are very different from those unique to a marine project where there is construction over the water and its associated increased risk. For example, the reliance on Locks and Dam 52 and 53 continuing to perform without requiring a major repair (full closure) during the construction of the new replacement dam is a large risk. That risk has not been incorporated into the schedule with a sufficient level of detail to account for the impact that a major repair would have on the new project.

Significance – Medium:

Differentiating between normal construction contingencies and those unique to a project of this type would assist in clarifying potential adverse conditions and the corresponding response activities.

Recommendations for Resolution:

1. Provide additional rationale and detail that support the contingencies in the ITD Study. This information will help ensure that adverse river conditions (i.e., overtopping events) are more accurately reflected.
2. Incorporate contingency activities into the logic of the Network.
3. Provide further explanation as to the sequence of events and impact should Locks and Dam 52 and 53 require major repairs during the construction of the new navigation pass.

Comment 4

Project activities such as Value Engineering, contingencies, and the development of the Second Supplemental Environmental Impact Statement (S2EIS) are not tied logically in the Critical Path Network.

Basis for Comment:

The goal of the Critical Path Network (Network) described in Appendix D-3 (Primavera P6® Schedule) is to graphically depict the sequential nature of project events through the completion of interrelated tasks or activities. This process simulates the procedures that are followed to accomplish a project by logically linking tasks through successor/predecessor constraints on the path in the project schedule. The dependence of one task starting prior to the initiation of a follow-on activity is fundamental to planning how the project will be constructed. However, the Panel identified numerous critical activities that are not tied logically to successor activities in the Network. Without logical ties, the activities have not constrained the critical path (simulated the construction sequencing), nor are they aiding in the time management of the In-The-Dry (ITD) Study.

For example, activities for Demolition of Locks and Dam 52 and 53 (DEMO 52 and DEMO 53) are not being constrained by the completion of the new navigation pass. This is important since Locks and Dam 52 and 53 must remain operational until the new dam is complete. Furthermore, the 18-month term for development and approval of the S2EIS (Olmsted ITD Study main report, Section 7, p. 115) would normally constrain any of the construction activities that are dependent on the S2EIS and the Record of Decision for approval. There is an activity, ENV1000, with a duration of 300 days, but it does not include the scope of work required for the S2EIS.

Including Value Engineering/Constructability Review in the Network could help identify shortcuts in the design/construction requirements and reduce the 19-month construction delay imposed under the ITD Study. These internal and external reviews by knowledgeable engineers and consultants could replace the large contingencies currently in the schedule, which act as place holders to cover future unknowns. Adding Value Engineering activities to the Network could also save costs by shortening the construction time and thereby significantly improving the benefit/cost ratio by allowing benefits to be realized at or before the ITW Study (e.g., use multiple pile driving rigs for Phase I and II cofferdams, thus enhancing the sequential nature of the pile driving operation; Activity IDs NPS1200-1280).

Significance – Medium:

The project schedule requires that activities be linked logically so that the Critical Path Network can identify changes and help manage the design and construction tasks.

Recommendations for Resolution:

1. Consider including a dedicated constructability review to the ITD design process before preparing final bid documents.
2. Ensure all activities in the Network are logically linked with predecessors/successors, as appropriate.
3. Consider including a Value Engineering/Constructability review by knowledgeable contractors/consultants to the Network to help identify improvements that would shorten the construction duration of the ITD Study and allow benefits to be realized earlier than currently projected.

Comment 5

There may be opportunities to compress the project schedule that do not appear to have been considered.

Basis for Comment:

Currently the design efforts for Cofferdams #1 and #2 are staggered (Olmsted In-The-Dry (ITD) Study main report, Executive Summary, Figure E-1, p. d), with each effort taking more than two years. Due to their similar nature, these design efforts could be done concurrently by one designer. The Panel identified several scheduling items that could expedite project completion:

- Completing the building and grounds work is not on the Critical Path, and three years to complete that scope of work seems excessive.
- A period of 2.5 years to complete the Resident Engineer (RE) office conversion appears to be longer than required to convert an existing building; six to 12 months would be more appropriate. This work could be moved back to coincide with the lock startup.
- Unless limited by fiscal year budget constraints, site restoration and county road paving could be started sooner to more closely coincide with the RE office conversion. Additional explanation of this work activity will provide task durations for closer analysis.
- Demolition of existing Locks and Dam 52 and 53 does not appear to be critical to the on-line operation of the new lock and dam. These locks are at a separate upstream site, and this work will be let as a separate contract without affecting the project close-out.
- Potential repair closure durations for Locks and Dam 52 and 53 have not been quantified or factored into the schedule.
- Schedule activities do not reflect needed resources for issues associated with annual budget limitations and seasonal issues with the river wet season.
- The two-year delay associated with the proposed ITD method of construction could potentially be recovered with proper Value Engineering efforts and by providing incentive contract opportunities to the construction bidders.

Significance – Medium:

A closer examination of the many schedule related expenses that impact the total project cost (e.g., overhead, escalation, wages, contingency, etc.) could decrease the total project time line.

Recommendations for Resolution:

1. Re-examine the project schedule for work items that may be consolidated through Value Engineering/Constructability analysis.
2. Identify work segments that are not on the critical path to lock and dam completion and operation, and reschedule them to an earlier start; finish whenever possible.
3. Consider providing contract incentives for contractors to finish earlier.

Comment 6

The assumption that the cost to raise the height of the cofferdam would be greater than the cost associated with one overtopping event is not supported by a cost estimate.

Basis for Comment:

The purpose of the study is to develop the design basis for constructing the Olmsted Dam Navigable Pass In-The-Dry (ITD), which includes evaluating the feasibility of such a construction method and preparing a cost estimate for the ITD construction. The Olmsted Dam ITD Study indicates that the height of the cofferdams to be constructed was determined from the elevation-frequency analysis, elevation-duration analysis, the available cofferdam materials, and the previously constructed lock cofferdam. The study suggests that the cofferdam be constructed to an elevation of 329.0 feet based on time constraints, past studies, including one overtopping event in the cost estimate, and the relatively low probability of multiple overtopping events. It concludes that it is reasonable to select a top of cofferdam elevation of 329.0 feet and not perform an updated Cofferdam Height Study (Memorandum, “2012 Olmsted Elevation-Duration Curve Development,” 17 April 2012, under the section titled, “Risk of Cofferdam Overtopping”).

The concluding assumption may be valid and additional considerations may have been evaluated to understand the increased costs associated with raising the height of the cofferdam; however, the study does not compare the costs associated with raising the height of the cofferdams to the costs associated with one or more overtopping events. In addition, the study suggests the updated Cofferdam Height Study was ruled out based on reasons not associated with an actual cost comparison.

Significance – Medium:

The decision to construct the cofferdams to an elevation of 329.0 feet would not directly affect the construction of Olmsted Dam; however, an exact comparison of construction costs would provide a quantitative basis for determining the top of cofferdam elevation.

Recommendations for Resolution:

1. Determine the estimated cost of raising the height of the cofferdams to reduce the probability of an overtopping event during construction.
2. Compare the economic impacts associated with a single overtopping event or multiple overtopping events to the cost of raising the height of the cofferdams.

Comment 7

Design conditions for the cells forming the cofferdam system may be affected by potential differences in the assumed top elevation of the McNairy I formation.

Basis for Comment:

Plates 7, 8, and 9 of Appendix A (Drawings) show the subsurface profile across the riverbed in the area of the Phase I and Phase II cofferdam systems. The information contained on these Plates indicates that the top of the McNairy I formation varies from El. 232.8 to El. 249.3; however, the geotechnical computations contained in Appendix B (Engineering Calculations) use only one typical cross-section with the top of the McNairy I formation at El. 240.0. This elevation is used for a variety of analyses provided in Appendix B, including sliding, bearing capacity, settlement, and other potential design conditions.

The use of El. 240.0 in the design analyses represents a reasonable assumption of “average” conditions, but the analyses and written summary do not account for any modifications in configuration or cost that would be required for cells found at other elevations. The Olmsted In-The-Dry (ITD) main report and the geotechnical computations contained in Appendix B do not include any information on the effect of variation in elevation of the McNairy I formation on the configuration and integrity of the cofferdam and berm.

Significance – Medium:

The configuration of the berm would likely change at various locations if a lower or higher elevation of the McNairy I formation were used in the analyses.

Recommendations for Resolution:

1. Conduct additional geotechnical analyses.
2. During the final design, analyze additional cross-sections that represent the variable top elevation of the McNairy I formation. This will likely result in the top elevation of the interior berm configuration varying from a constant elevation as predicted in Appendix A.

Comment 8

The planned use of the existing lock chamber to pass river flows during Stage 2 of the navigable pass construction may result in the deposition of gravel in the baffle system for the lock.

Basis for Comment:

As illustrated in Figure 5, Stage A Cofferdam, in the main report of the Olmsted In-The-Dry (ITD) Study, the plan is to use the existing lock chamber to pass river flows during Stage 1 of the Navigable Pass construction. Based on the Panel’s experience with the USACE St. Paul District and Upper St. Anthony Falls Project, this procedure could result in the deposition of gravel-sized material in the baffle system at the bottom of the lock chamber. During the 1977 dewatering of the Upper St. Anthony Falls Project, it was discovered that the use of the lock to pass flood flows during the 1965 flood had deposited gravel in the bottom of the lock. During the normal filling and emptying of the lock, a flow regime developed in the bottom of the lock that created a “milling operation” which scoured out a significant amount of the 10,000+ psi concrete in the bottom of the lock chamber. Subsequently, steel plating was installed in the bottom of the lock to repair this scour damage. This condition does not directly affect the feasibility of the ITD plan for construction, but it has the potential to create additional costs.

Significance – Medium:

Potential scouring of the lock chamber could result in unanticipated repair costs for the lock and unscheduled outages for navigation at the lock.

Recommendations for Resolution:

1. Conduct future studies and modeling to determine whether the use of the lock chambers to pass high river flows will result in the deposition of gravel material in the bottom of the lock chamber.
2. If there is a potential for the deposition of gravel-sized material, evaluate the hydraulics in the filling system to determine whether a long-term “milling operation” is possible.
3. If potential damage to the lock chamber is identified, consider protective means for the bottom of the lock, including steel plating of the baffle system. As an alternative to a steel plating system, a scheduled lock dewatering and cleaning regime after major flood events could be developed.

Comment 9

It cannot be determined if the linear interpolated values used to generate the elevation-frequency curve would be affected by a significant change in flood profile slope.

Basis for Comment:

The top of cofferdam elevation is key to construction economics and project safety. The elevation-frequency curve was one of many components used to select an adequate elevation for the top of the construction cofferdams. Appendix C (Hydraulics and Hydrology) describes the development of the elevation–frequency curve. As indicated in the study, since no elevation gage data were available at the Olmsted Dam to develop the elevation-frequency curve, the best available data from adjacent gages located upstream and downstream of the Olmsted Dam were used.

Flood profiles may vary in slope between two gage stations based on channel slope, channel geometry, tailwater conditions, or hydraulic structures. Linear interpolation can be reliable provided that the flood profile does not change significantly in slope between the two gage stations. The quantity of the significant change is relative to the results of the flood-frequency curve, which is used to determine the top elevation of the cofferdams. The In-The-Dry (ITD) Study gives no indication regarding the reliability of a direct linear interpolation.

Inaccurate interpolated values may result if the Ohio River flood profile should vary in slope between the gage stations. The interpolated values may affect the results of the elevation-frequency curve, which in turn may affect the decisions used to set the elevation of the top of the cofferdams in constructing the Olmsted Dam.

Significance – Medium:

The estimate for construction costs could be affected if the linear interpolation method used to generate the elevation-frequency curve is found to provide unreliable data.

Recommendations for Resolution:

1. Provide additional detail in the study highlighting the relative difference in elevation between the gage stations used to interpolate flood stages at the Olmsted Dam.
2. Provide various flood profile plots showing any changes in slope due to various channel conditions, flood stages, or hydraulic structures.
3. Discuss the validity of linear interpolation with further justification, or provide revised data based on considering any significant flood profile slope changes.

Comment 10

It could not be determined if the left boat abutment counterfort wall was designed according to EM 1110-2-2104.

Basis for Comment:

Proper design of the counterfort wall is important to the success of the overall project. The left boat abutment counterfort wall is designed as a 356 in. (29 ft. 8 in.) deep beam, but this structure is not explained in sufficient detail to determine the appropriateness of the design. The left boat abutment counterfort may respond to the applied loading as an axially loaded wall/shear wall with out-of-plane bending as opposed to a deep beam. Section 1.5 of EM 1110-2-2104 (USACE, 1992) states that “Reinforced-concrete hydraulic structures should be designed with the strength design method in accordance with the current American Concrete Institute (ACI) 318 except as hereinafter specified.” Wall designs are covered in Chapter 14 of ACI 318 (ACI, 2011), but it is unclear whether the left boat abutment counterfort wall was designed using this reference.

Significance – Medium:

The appropriateness of the design and function of the left boat abutment counterfort wall cannot be fully determined if the construction guidance is not referenced.

Recommendations for Resolution:

1. Provide the appropriate construction and engineering references for the design of the left boat abutment counterfort wall.
2. Discuss any deviations from EM 1110-2-2104 in the design of the left boat abutment counterfort wall.

Literature cited

ACI (2011). Building Code Requirements for Structural Concrete (ACI 318-11) and Commentary: Reported by ACI Committee 318. American Concrete Institute, Farmington Hills, MI.

USACE (1992). Strength Design for Reinforced Concrete Hydraulic Structures. Engineer Manual (EM) 1110-2-2104. Department of the Army, U.S. Army Corps of Engineers, Washington, D.C. 30 June.

Comment 11
The rationale for ignoring uplift pressures and assuming pumps will be effective has not been supported.
Basis for Comment:
In referring to the structural calculations for the cofferdam over the navigation pass monolith, the Olmsted In-The-Dry (ITD) main report states that “Uplift is conservatively ignored, assuming pumps are effective” (p. 109). EM 1110-2-2503 states that uplift and saturation of cofferdam cells is a potential failure mode (USACE, 1989; Section 5-2.a. (4)). It is unclear to the Panel whether ignoring uplift is a ‘conservative’ assumption since numerous factors can cause pumps to fail or become ineffective during construction operations. It would be more conservative to assume that the pumps are not effective, or have failed, and to design the cofferdam accordingly.
Significance – Medium:
Documentation or a discussion is required to understand the rationale for ignoring uplift pressures and cell saturation associated with potential pump failure.
Recommendations for Resolution:
<ol style="list-style-type: none"> 1. Evaluate the effect of full saturation of the cell fill in accordance with EM 1110-2-2503, Section 5-3(a). 2. Clarify the relationship among cell saturation, uplift pressures, and pumps and discuss negative effects and risks of pump failure.

Literature cited

USACE (1989). Engineering and Design - Design of Sheet Pile Cellular Structures and Retaining Structures. Engineer Manual (EM) 1110-2-2503. CECW-EP. Department of the Army, U.S. Army Corps of Engineers, Washington, D.C. 29 September 1989; Errata Sheet No. 1, 11 June 1990.

Comment 12

The procedures used in analyzing the stability of the sheet pile cells, as described in Appendix B, do not conform to the procedures stated in EM 1110-2-2503.

Basis for Comment:

The computations provided in Appendix B (Engineering Calculations) for the evaluation of the sliding of a sheet pile cell use a factor of safety (FS) defined as follows:

$$FS = \text{Resisting Forces/Driving Forces}$$

However, the procedure outlined in EM 1110-2-2503 (USACE, 1989) uses a different definition of the factor of safety and a mathematically different procedure to compute the factor of safety for sliding. Under the guidelines contained in EM 1110-2-2503, the factor of safety is defined as the factor by which the design shear strength needs to be reduced in order to place the sliding mass (the cell) in horizontal and vertical equilibrium. This definition of the factor of the safety and recommendations for its implementation are contained in the Engineer Manual (USACE, 1989).

The major uncertainty in the stability computations is the value of shear strength actually mobilized along a potential sliding surface. For this reason a definition of factor of safety, which applies directly to the shear strength, is considered to be theoretically more appropriate than a definition based on a ratio of forces. The Panel's experience with other structures has shown that the use of the force equilibrium definition will often result in somewhat higher computed values of factors of safety than when using a definition based on a ratio of forces. It is therefore likely that the computed factors of safety will increase if the appropriate procedures are used.

Significance – Low:

The computations contained in Appendix B do not use the recommended definition of factors of safety or the recommended computational procedures per EM 1110-2-2503.

Recommendations for Resolution:

1. Employ the procedures described in EM 1110-2-2503 for final design computations for the sheet pile cellular structure.

Literature cited

USACE (1989). Engineering and Design - Design of Sheet Pile Cellular Structures Cofferdams and Retaining Structures. Engineer Manual (EM) 1110-2-2503. CECW-EP. Department of the Army, U.S. Army Corps of Engineers, Washington, D.C. 29 September 1989; Errata Sheet No. 1, 11 June 1990.

Comment 13

The assumed shear strength of the McNairy I formation is an important element of the design of cellular sheet pile structure, but the basis for selecting the shear strength is not adequately described.

Basis for Comment:

The documented input for the slope stability computer codes contained in Appendix B (Engineering Calculations) indicates that the stability analyses of the cellular sheet pile structures were conducted using an anisotropic assumption related to the shear strength of the McNairy I formation. The documentation contained in Appendix B includes the results of several shear strength tests conducted in 1990, a tabulation showing the results of different direct shear (S test) or R triaxial tests (with pore pressure measurements), and Tables 16 and 17, which provide values for the design shear strength of the McNairy I formation. Although it appears that an anisotropic variation in the shear strength of the McNairy I formation was used for the stability analyses, there is no explanation or justification for the use of these procedures.

Significance – Low:

Providing the basis for incorporating an anisotropic assumption in the stability analysis and a justification of the anisotropic shear strength values would improve the understanding of the cellular sheet pile structure design.

Recommendations for Resolution:

1. Modify the Olmsted In-The-Dry (ITD) main report or Appendix B to include a justification for the anisotropic assumptions regarding the shear strength of the McNairy I formation, and the basis and procedures used to select and use the shear strength values assumed in the analysis.

Comment 14

The computations and references contained in Appendix B do not support the design of the structural sections of the piling system proposed for the navigable pass as shown in Appendix A.

Basis for Comment:

Various Plates in Appendix A (Drawings) illustrate the design configuration for the various structural elements forming the navigable pass structures. These drawings show that the permanent structures will be supported on pipe piles throughout the length of the navigable pass. However, Appendix B (Engineering Calculations) does not contain any information regarding the computations that were developed to support the foundation piling design shown in the Plates of Appendix A.

The Panel assumes that computations were developed during previous studies for the foundation piling system that supports the permanent navigable pass structures. However, neither the computations nor a reference to the computations are provided in the In-The-Dry (ITD) Study documents.

Significance – Low:

The procurement and placement of foundation pilings for the entire length of the navigable pass structures represent a significant portion of the project cost, and should be supported with documented computations.

Recommendations for Resolution:

1. Modify the Olmsted ITD main report to either include a specific reference to the computations previously developed for the pile foundation, or include the actual computations for the pile foundation shown in Appendix A.

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APPENDIX B

Final Charge to the Independent External Peer Review Panel

as

Submitted to USACE on November 29, 2012

on the

Olmsted ITD Study

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CHARGE FOR PEER REVIEW

Members of this IEPR Panel are asked to determine whether the technical approach and scientific rationale presented in the Olmsted ITD Study IEPR documents are credible and whether the conclusions are valid. The Panel is asked to determine whether the technical work is adequate, competently performed, 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 Olmsted ITD Study 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 Independent Technical Review.
2. Please contact the Battelle Project Manager (Julian DiGialleonardo, digialleonardoj@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 Project Manager, digialleonardoj@battelle.org, no later than December 11, 2012, 5 pm ET.

**Independent External Peer Review
of the
Olmsted Locks and Dam 52 and 53 Replacement Project Method of Construction
Alternative Analysis (Olmsted Dam In-The-Dry Study)**

1. Assess the adequacy and acceptability of the In-The-Dry (ITD) Study and analysis used.
2. Comment on whether the design and construction considerations outlined for the ITD plan are appropriate and adequate.
3. Offer opinions as to whether there are sufficient analyses upon which to base a recommendation for construction.
4. Identify, explain, and comment on assumptions that underlie engineering, cost engineering, and schedule development.
5. Evaluate whether the interpretations of analysis and conclusions are reasonable.
6. Please focus the review on scientific information, including factual inputs and data; the use and soundness of models, analyses, and assumptions; and other scientific and engineering matters that inform decision makers. Please comment on whether:
 - a. The assumptions that underlie the engineering analyses are sound.
 - b. The engineering methods, models, and analyses used are adequate and acceptable.
 - c. The planning and scheduling methods and analyses are sound.
7. Have the hazards that affect the successful completion of the Navigable Pass (NP) been adequately addressed?
8. Has anything significant been overlooked in the development of the study?
9. Please comment on the adequacy of the cost and schedule risk analysis (CSRA) in determining the 80-percent confidence level of the cost estimate.
 - a. In your opinion, considering the complexity of the project and the remaining schedule, are the proposed contingencies adequate?
10. Is the schedule for design, procurement, and construction of the NP ITD reasonable, and can the NP be completed as scheduled considering funding, river conditions, craft labor, etc.?

- a. Have risk factors and resulting impacts (e.g., cost or schedule) associated with schedule slippages at various times throughout the ITD plan been adequately identified, considered, and addressed in the ITD plan?
 - b. Based on your understanding of this project and the USACE's final National Environmental Policy Act (NEPA) assessment, in the event that an Environmental Impact Statement is required does the proposed timeline of 18 months provide an adequate time frame to complete this activity?
11. Is the \$109M cost difference and 2-year time difference within reason for the USACE to select which method of construction to use to complete the NP construction?
- a. Are there any additional analyses or information available or obtainable that would affect decisions regarding the method that should be chosen?
12. Are there other risk factors to consider that could impact the decision to proceed with the ITW or ITD method of construction?
- a. Are there any risk factors that may arise and should be considered due to switching from the ITW technique to the ITD technique?
 - b. Are there any other factors that the USACE should take into consideration when selecting which method of construction to use to complete the NP construction? If so, please describe.

**Final Compiled Comments and Responses
on the
Independent External Peer Review of the
Olmsted Locks and Dam 52 and 53 Replacement
Project Method of Construction Alternative Analysis
(Olmsted Dam In-The-Dry Study)**

Final Panel Comment 1

The study design relies heavily on data and procedures from the In-The-Wet (ITW) Study and lacks sufficient new analysis to validate the current study design and detect potential critical deficiencies.

Basis for Comment

The planning approach and design details contained in the In-The-Dry (ITD) Study are an extension of the planning and design procedures used in the development of the In-The-Wet (ITW) Study. The ITD Study, however, does not take into account the significant differences in the practicalities of constructing the two phased cofferdams in a heavily trafficked navigable waterway. Nor does it include a Value Engineering review during preliminary design, which would allow independent analysis of the entire process and help identify potential problems.

In its review of the ITD Study, the Panel identified issues associated with a cofferdam with no ready access to shore that require further analysis: hazards of moving personnel, equipment, and material daily over water, marine traffic maneuvering with obstructions in the way, and working 70 feet below the upper elevation of the cell walls, which is subject to periodic overtopping [at least one incident in five years (Olmsted Dam ITD Study main report, Sections 3a(1)(c)3 and 5, pp. 14 and 16]. Incidents of marine traffic striking obstructions in a navigable waterway occur all too frequently and should be anticipated for in the planning and development of the ITD design (USCG, 2012). The increase in river velocity at the pass between the cofferdams and the gates and the reduced navigable space increase the likelihood of marine accidents, including collisions with tow barges and the deflectors/cofferdam cells during storm events, and reduced visibility.

Several comments in the ITD Study [Olmsted Dam ITD Study main report, Section 3a(1)(c)4, p. 16; Sections 3d(3),(4), and (5), p. 99; and Section 5a(2)(a)1b, p. 109] suggest that, prior to construction, there is a need for a detailed hydraulic analysis other than the HEC-RAS model, study of scour and its impact on foundations, changes to river flow due to the placement of the deflectors, and further structural design review of the cast-in-place foundations for both boat abutments. In addition, the Panel believes that Value Engineering activities such as multiple pile driving rigs for Phases I and II to enhance the sequential nature of the pile driving operation (Activity IDs NPS1200 -1280) could shorten the construction time (reduce the 19 months difference between operation completion of the ITW and ITD studies). This would significantly improve the benefit/cost ratio and allow benefits to be realized at or before the ITW Study.

Significance – Medium

Relying on the existing ITW Study as the basis for the ITD Study can transfer undetected oversights in process and procedure from one study to the other.

Recommendations for Resolution

1. Consider conducting a constructability review of the ITD design. This could be accomplished by a team of independent engineers and consultants knowledgeable in riverine construction procedures.
2. Review and document the analysis (as appropriate) of all incidents of marine traffic striking

stationary objects occurring in the river systems of the U.S. in the last 20 years.

3. Develop preventive measures (lighting, signage, public notices, etc.) to raise awareness of the hazards of the temporary structures in the navigable spaces of the river associated with the project.
4. Conduct further modeling analysis (including ship modeling) of the impacts of the marine structures in the navigable spaces of the river. Analyze the actions to be taken in the event a river incident occurs and document them in the study.
5. Incorporate the related additional studies identified in the ITD Study (scour, structural, etc.) and add a Value Engineering review to the design process.

PDT Final Evaluator Response (FPC#1):

The PDT Non-concurs with the comment statement in the first box.

Explanation: The level of analysis performed is deemed adequate based upon existing guidance for a feasibility level study such as this, and equivalent to the level of analysis of the PACR to which it is compared. The isolated cofferdam issues mentioned under Basis for Comment were processed extensively by the ITD PDT and as part of QC were "checked" by the Olmsted Dam Resident Engineer (RE) and ATR reviewed by a RE from LRP experienced with in-river construction. These issues were weighed into the cost, schedule and design. Also, additional 2D numerical modeling and tow simulator studies were conducted subsequent to the completion of this report to validate the assumption that safe navigation could occur around the cofferdams even during unusual flow conditions. Should an ITD course of action be selected, additional analysis would be performed during final design.

Recommendation #1: Adopt in future

Explanation: Constructability reviews are always part of the LRL design process and must be certified complete by the end of the final design. If the ITD design is moved forward, a group of independent and knowledgeable engineers and construction representatives will be assigned to conduct review of constructability. However, as mentioned above, constructability was processed extensively as part of the ITD study including review by RE staff at Olmsted and an experienced RE from LRP. Also, it is noted that this is the 3rd iteration (Original Project Design Memorandum, 1997 Method of Construction Study) of an ITD concept design which helps validate the feasibility. Therefore, further review at this time is not considered necessary.

Recommendation #2: Not adopt

Explanation: Marine accidents occur regularly on the inland navigation system involving a wide range of structures, causes, and conditions. Review of this information is not expected to provide significant additional insight into site specific conditions associated with the cofferdam construction. In the base estimate, costs to repair 2 cofferdam cells twice per year were included as recognition of the risk to damage from barge accidents. Additionally, see the explanation to Recommendation 4.

Recommendation #3: Adopt in future

Explanation: See also explanation to Recommendation 4. In addition to expected construction lighting, USACE would follow normal procedures for notifying navigation interests with regards

to conditions around the construction and any restrictions.

Recommendation #4: Adopt in future

Explanation: If the ITD design is moved forward, additional model studies would be completed. In particular, 2D numerical models would probably be refined to assess scour potential at the cofferdams and a physical model would be used to assess navigation conditions in and out of the locks. For the ITD study, expert elicitation involving subject matter experts from LRL, ERDC and LRP were used to develop an opinion on probable navigation conditions and possible resulting problems. As an off shoot of this effort, the cost and schedule included response and repair associated with two barge collision events per year. This level of refinement is considered appropriate and acceptable for a near Feasibility level study such as the ITD study.

As proposed in Section 3, paragraph b(6) (Page 43), and subsequent to the conclusion of the report, ERDC conducted a 2D numerical model and ship simulator investigation to analyze the proposed cofferdam configurations. These configurations included the conceptual deflector and guard cells as shown in Appendix A (Drawings) and the simulator modeled anticipated construction lighting during night-time conditions. The testing program utilized a total of 5 commercial pilots with varying levels of experience to evaluate navigation conditions through the dam construction area. Two flow conditions were analyzed, a moderate flow condition and a high flow condition when the locks would no longer be in service. Both conditions assumed low tailwater conditions on the Mississippi River, creating high slope (thus higher than average velocities and therefore conservative) conditions based upon the historical observations at the site. Helper boats were available to the pilots in the simulator and were used to varying degrees by the different pilots. Preliminary results from the draft report indicate that navigation traffic can maneuver through the restricted navigation pass with fewer complications than expected. There were no issues with downbound traffic through the navigable pass for both flow conditions. Navigation upbound was more challenging for both flow conditions, but use of helper boats and some experimentation by pilots enabled them to accomplish passage. Some allisions with the fender system or guard cells did occur as the pilots first gaged the changing flow directions, but this was attributed to the fact that the test pilots were not allowed to communicate experiences to each other; in reality, pilots would actively communicate with each other about the flow conditions experienced and successful experiences. The pilots commented on the fact that, in general, there is always enough light from the stars, moon, and bank lights to see the structure and pass. The final report for this work is being developed.

Recommendation #5: Adopt in future

Explanation: See the explanation to Recommendation 4. Additionally, a Value Engineering review would be included in subsequent design work as required by Corps guidance..

Panel Final BackCheck Response (FPC#1):

The Panel Non-concurs with the PDT's response.

Explanation: The Panel suggests the addition of the details contained in the Explanations of Non-Concur by the PDT to the ITD report. These details would have aided in the Panel's

understanding of the project planning and significantly resolved the concerns expressed in FPC #1

PDT Follow-on Final Evaluator Response (FPC#1):

Concur.

Explanation: The PDT concurs that it would be prudent to document, as part of the report, the details contained in the comment evaluation. Each Panel comment and subsequent comment resolution dialogue contained in DrChecks will become an official part of the ITD Study report and will be forward up through the same COE chain of command as the original report. It is suggested that this DrCheck record serve as the documentation of details requested versus editing the report text.

Panel Follow-on Final BackCheck Response (FPC#1):

The Panel Concurs with the PDT's response.

USCG (2012). Proceedings of the Marine Safety & Security Council, the Coast Guard Journal of Safety & Security at Sea. Fall 2012 Report, Volume 69, Number 3.
<http://www.uscg.mil/proceedings/>

Final Panel Comment 2

Components of the cost and schedule risk analysis (CSRA), including labor costs, equipment costs, design costs, and contracts, are not sufficiently discussed to determine the 80% confidence level of the cost estimate.

Basis for Comment

The Panel identified major components of the Olmsted In-The-Dry (ITD) Study CSRA that appear to require further analysis to determine the 80% confidence level of the cost estimate required by USACE.

Labor costs have been adjusted to current Davis-Bacon wage rates. Specific provisions for future increases of these wage rates are not apparent in the estimate. Inasmuch as the Olmsted project is the largest project in the wage determination area, it is in effect setting these wage rates. It is not apparent in the ITD Study main report or appendices whether a project labor agreement (PLA) was ever considered as a means to control or predict rising labor costs over the life of the project (Appendix D [Cost Estimate], Schedule, and Risk, p. 25, paragraphs 4.2.2 and Table 5).

Equipment fuel costs were based on 2009 data adjusted for current local costs. There is no discussion of fuel rate adjustment clauses in the CSRA for equipment lease agreements. Future increases or decreases of diesel fuel costs that power most construction equipment have not been examined (Appendix D, p. 25, paragraph 4.2.2.4).

Equipment and tools will be procured to operate and maintain the dam. It is not clear if this is a capital expense chargeable to the job, or an operating expense of Louisville District Operations personnel chargeable to another budget center (Appendix D, p. 12, paragraph 3.2.4.3).

Engineering during construction (EDC) costs of \$1.75 M per year are based on historical data from the last 2 to 5 years and are projected from FY2012 until the end of the Tainter Gate Contract (FY2016). If the work is fully designed in the Planning, Engineering, and Design (PED) effort, it would seem EDC design efforts should fall into the Contractor Means and Methods category and be borne by the contractor. In addition, it would seem the EDC design needs would be less in the later stages of the 4-year work period after the initial engineering challenges have been met. Inasmuch as the cofferdam design is relatively simple and repetitive, \$7M (4 years x \$1.75M) for EDC seems high (Appendix D, p. 23, paragraph 4.1.2.3 and p. 27, paragraph 4.2.2.6).

Contract claims during ITD construction has been raised as a possibility. There are no apparent provisions in the estimate, other than the overall contingency, to service future claims. Due to the higher risk of marine construction methods, future claims could play a large role in meeting, or not meeting, project budgets (Olmsted ITD Study main report, p. g, Key Project Risk Items).

Closer analysis of the above listed components will contribute to the 80% confidence level by providing greater accuracy in the estimated amounts.

Significance – Medium

To determine the monetary impact on the overall project budget it is important to provide details

or estimates for common, yet sometimes less apparent, costs that have the potential for significant increase.

Recommendations for Resolution

1. Project labor cost increases over the entire project duration and investigate the use of a PLA to control labor costs.
2. Review project contracts that use heavy equipment for provisions for adjusting fuel rates. Include fuel rate adjustment clauses in equipment lease agreements for both government- and contractor-owned equipment.
3. Estimate and detail design costs for each type of ITD construction rather than apply a fixed percentage or monetary value.

PDT Final Evaluator Response (FPC#2):

The PDT Non-concurs with the comment statement in the first box.

Explanation: The CSRA includes an exhaustive Risk Register (see Appendix D-4, Section B) that includes all potential risk items identified by the PDT. Each risk item is given a short title, a summary concern, and full PDT discussion during the 2 day risk meeting workshop. These risks were first qualified by likelihood of occurrence and impacts to cost and schedule. These qualitative selections by the PDT result in a risk level of High, Medium, and Low. Per current USACE guidance, only High and Medium risks were carried forward for quantification and contribute to the overall contingency.

Labor and fuel rates in the ITD cost estimate are commensurate with the rates researched and applied as current to the FY12 PACR estimate. Labor rates including base wage rates, fringe benefits, payroll taxes and insurance, worker's compensation, and longshoremen's insurance are based on the existing PLA for the Dam Contract. Future price increases to labor and fuel are considered through both the Total Project Cost Summary Sheet calculation for future inflation (CWCCIS method) and the risk of variation from these forecasted inflation rates in the CSRA.

Equipment and tools will be planned to be procured through the out-year contract "Operations Equipment and Machinery". The scope of these items includes mostly small tools and everyday items that will be needed to do repair work on the locks and dam. The initial purchase of such items is required to turnover a fully functioning facility from the Construction General business line to the Operations business line. This is a typical use of the Construction General funds due to the limited nature of O&M funding that is shared and prioritized among the several District projects in operation and is not suited to absorb such a large capital initial investment. Finally, the scope and cost of these purchases are verbatim to those included in the FY12 PACR.

Engineering During Construction rates have an established track record level of PDT involvement. This involvement has, if anything, increased in intensity presumably due to the political interest of the project and the new USACE project controls initiatives for "mega-projects".

Contract Claims have been considered by the PDT through much discussion with the Resident

Engineer, Contracting Officer, Project Manager and supporting staff. Risk Item DAM-023 of the CSRA adequately captures these discussions and the associated range of cost impacts.

Recommendation #1: Adopt in the future

Explanation: The labor rates in the ITD cost estimate are commensurate with the rates researched and applied as current to the FY12 PACR estimate. Those rates are based on the existing PLA in place for the current Dam Contract. As this ITD Study estimate is intended to serve as a comparison to the ITW costs of the FY12 PACR these rates should remain consistent. In addition, the USACE method of developing the “Total Project Cost” (shown on the Total Project Cost Summary Sheet (TPCS) in Appendix D-1) considers future price increases for labor, materials, and equipment according to the cost escalation factors presented in EM_1110-2-1304 (CWCCIS). Finally, the CSRA considers potential variation (increase/decrease) from the CWCCIS estimated escalation through Risk Items DAM-036, NP-033, and OYC-001. Finally, should the ITD Alternative be carried forward, an updated PLA would be explored during the advertisement period for those contracts.

Recommendation #2: Adopt in the future

Explanation: The fuel rates in the ITD cost estimate are commensurate with the rates researched and applied as current to the FY12 PACR estimate. As this ITD Study estimate is intended to serve as a comparison to the ITW costs of the FY12 PACR these rates should remain consistent. In addition, the USACE method of developing the “Total Project Cost” (shown in the Total Project Cost Summary Sheet (TPCS) in Appendix D-1) considers future price increases for labor, materials, and equipment (including the fuel operating expense) according to the cost escalation factors presented in EM_1110-2-1304 (CWCCIS). Finally, the CSRA considers potential variation (increase/decrease) from the CWCCIS estimated equipment cost and fuel escalation through Risk Items DAM-036, NP-033, NP-038, and OYC-001. Finally, should the ITD Alternative be carried forward, fuel price adjustment clauses would be explored during the advertisement period for those contracts.

Recommendation #3: Not adopt

Explanation: ITD design costs are either based on historical experience and judgment from the PDT or in many cases used verbatim from the FY12 PACR (particularly with the OYC’s). The resulting design costs have been reviewed and agreed upon among the PDT. This method of development in the alternative study is consistent with the detail collected for the FY12 PACR and surpasses protocol for Class 4 Alternative Level estimates. At this level of consideration, it is often the tendency for design cost detail precision to outrun accuracy. For this reason, a top down approach, such has been employed, is typically favored in lieu of bottoms up design cost development.

Panel Final BackCheck Response (FPC#2):

The Panel Concurs with the PDT’s response.

Final Panel Comment 3

Contingencies discussed in the In-The-Dry (ITD) Study and shown in the project schedule are broad in nature and scope and do not accurately account for difficulties that may affect project construction.

Basis for Comment

Contingencies account for risks through rough estimates of time and budget when there are too many unknowns to accurately plan for different scenarios and unforeseen conditions. For example, a contingency discussed in the ITD Study that is broad in scope involves adverse river conditions that may be encountered at critical times during the seven plus years of construction for Phase I and II cofferdams. The ITD Study projects one overtopping event to occur during the project's life (Olmsted Dam ITD Study main report, Section 3a(1)(c)3, p. 14). To rely on a contingency activity to capture all of the effects of the overtopping event to the project personnel, equipment, costs, and schedule is very optimistic. The Panel feels the potential impact of the overtopping is not being considered with sufficient detail in the ITD Study.

Furthermore, it is important that contingency activities be uniformly incorporated into the logical link within activities of the Critical Path Network (Network), or hammocked (grouped) with other activities. Normal construction contingencies are very different from those unique to a marine project where there is construction over the water and its associated increased risk. For example, the reliance on Locks and Dam 52 and 53 continuing to perform without requiring a major repair (full closure) during the construction of the new replacement dam is a large risk. That risk has not been incorporated into the schedule with a sufficient level of detail to account for the impact that a major repair would have on the new project.

Significance – Medium

Differentiating between normal construction contingencies and those unique to a project of this type would assist in clarifying potential adverse conditions and the corresponding response activities.

Recommendations for Resolution

1. Provide additional rationale and detail that support the contingencies in the ITD Study. This information will help ensure that adverse river conditions (i.e., overtopping events) are more accurately reflected.
2. Incorporate contingency activities into the logic of the Network.
3. Provide further explanation as to the sequence of events and impact should Locks and Dam 52 and 53 require major repairs during the construction of the new navigation pass.

PDT Final Evaluator Response (FPC#3):

The PDT Non-concurs with the comment statement in the first box.

Explanation: The In-The Dry Study implements risk-based contingency development as required by current USACE guidance for development of Total Project Cost Estimates supporting budgetary and decisional documents. The same CSRA methodology has been employed for the

In-The Dry Study as was performed for the FY12 PACR. This process includes an exhaustive Risk Register (see Appendix D-4, Section B) that includes all potential risk items identified by the PDT. The Risk Register for In-The Dry Study was developed from intense PDT collaboration and identified 216 total risk items of which 107 cost risks and 45 schedule risks were considered Medium to High Level and therefore quantified and included in either or both of the cost and schedule risk models (and therefore contributing to the resulting project contingency).

With respect to overtopping event see response to Recommendation #1.

With respect to the linking of contingency activities to the critical path network see response to Recommendation #2.

Lock and Dam 52/53 are funded through the separate operations business line. Impacts to the Olmsted project due to failure of Lock and Dam 52/53 is discussed in response to Recommendation #3.

Recommendation #1: Not adopt

Explanation: The base estimate and schedule include direct allowances for a single overtopping event of cofferdam height of El. 329' (river El. 327.5' allowing for 1.5' swell head to overtop). In other words, the estimate and schedule does not solely rely on a contingency activity to capture the effects of an overtopping event. Main Report Table 3, page 15 presents the statistical analysis of river level history indicating a 45% likelihood of occurrence sometime during the approx. 3 year exposure period of in-the dry construction. Further, the CSRA considers the statistical likelihood (8%) and impact of a second occurrence (NP-007) as well as anticipated near-miss events that impose false prep work and schedule inefficiency (NP-039). Within the schedule the overtopping event is treated with a blackout period within the work calendar and a subsequent task to recover. The blackout period was specifically placed to ensure maximum effect on the networks critical path. The impact of an overtopping event is based on what is seen as a worst case scenario of occurring during monolith construction in the interior. A very similar event was experienced during the lock construction. Cost and schedule impacts are based on that real event.

Recommendation #2: Not adopt

Explanation: Risk items affecting the project schedule have been quantified such to ensure that they are linked to the project's critical path network logic. Individual work calendars for land based construction and marine based work exist and are applied to tasks to specifically address elements of work that are impacted by either or both high water and high flow levels.

Recommendation #3: Not adopt

Explanation: The worst case scenario for a failure at Lock and Dam 52/53 would result in the inability to maintain a controlled pool elevation, resulting in similar to a low water event at the Olmsted site. The likelihood and impact of such an event is addressed within Risk Items DAM-001 and NP-003 for River Conditions. Major repair costs to Lock and Dam 52/53 would be funded through the separate Operations business line rather than divert funding to the Olmsted project.

Panel Final BackCheck Response (FPC#3):

The Panel Non-concurs with the PDT's response.

Explanation: The incorporation of the additional details contained in the PDT's Explanations of their Non-Concurrence into the ITD Report would aid in the Panel's understanding of the planning methodology used for the project. Specifically, Risk Items DAM-008 states that Barge Impacts would be very unlikely to occur. This seems to be in conflict with the PDT's explanation on Non-Concurrence.

The addition of more background documentation concerning schedule constraints would assist the Panel in understanding the logic used for the Project planning.

As to funding for any repairs to LD 52/53, the Panel was referring to the impact to funding for the Olmsted Project should extensive repairs be required. Documenting the impacts would assist the Panel in understanding the PDT's rationale.

PDT Follow-on Final Evaluator Response (FPC#3):

Concur.

Explanation: The PDT concurs that it would be prudent to document, as part of the report, the details contained in the comment evaluation. Each Panel comment and subsequent comment resolution dialogue contained in DrChecks will become an official part of the ITD Study report and will be forward up through the same COE chain of command as the original report. It is suggested that this DrCheck record serve as the documentation of details requested versus editing the report text. Additionally, based on the PDT/Panel comment resolution teleconference of 1/11/13, it is understood that the explanations contained in the comment evaluation "1" above adequately address the issues presented in the comment.

Panel Follow-on Final BackCheck Response (FPC#3):

The Panel Concurs with the PDT's response.

Final Panel Comment 4

Project activities such as Value Engineering, contingencies, and the development of the Second Supplemental Environmental Impact Statement (S2EIS) are not tied logically in the Critical Path Network.

Basis for Comment

The goal of the Critical Path Network (Network) described in Appendix D-3 (Primavera P6® Schedule) is to graphically depict the sequential nature of project events through the completion of interrelated tasks or activities. This process simulates the procedures that are followed to accomplish a project by logically linking tasks through successor/ predecessor constraints on the path in the project schedule. The dependence of one task starting prior to the initiation of a follow-on activity is fundamental to planning how the project will be constructed. However, the Panel identified numerous critical activities that are not tied logically to successor activities in the Network. Without logical ties, the activities have not constrained the critical path (simulated the construction sequencing), nor are they aiding in the time management of the In-The-Dry (ITD) Study.

For example, activities for Demolition of Locks and Dam 52 and 53 (DEMO 52 and DEMO 53) are not being constrained by the completion of the new navigation pass. This is important since Locks and Dam 52 and 53 must remain operational until the new dam is complete. Furthermore, the 18-month term for development and approval of the S2EIS (Olmsted ITD Study main report, Section 7, p. 115) would normally constrain any of the construction activities that are dependent on the S2EIS and the Record of Decision for approval. There is an activity, ENV1000, with a duration of 300 days, but it does not include the scope of work required for the S2EIS.

Including Value Engineering/Constructability Review in the Network could help identify shortcuts in the design/construction requirements and reduce the 19-month construction delay imposed under the ITD Study. These internal and external reviews by knowledgeable engineers and consultants could replace the large contingencies currently in the schedule, which act as place holders to cover future unknowns. Adding Value Engineering activities to the Network could also save costs by shortening the construction time and thereby significantly improving the benefit/cost ratio by allowing benefits to be realized at or before the ITW Study (e.g., use multiple pile driving rigs for Phase I and II cofferdams, thus enhancing the sequential nature of the pile driving operation; Activity IDs NPS1200-1280).

Significance – Medium

The project schedule requires that activities be linked logically so that the Critical Path Network can identify changes and help manage the design and construction tasks.

Recommendations for Resolution

1. Consider including a dedicated constructability review to the ITD design process before preparing final bid documents.
2. Ensure all activities in the Network are logically linked with predecessors/successors, as appropriate.

3. Consider including a Value Engineering/Constructability review by knowledgeable contractors/consultants to the Network to help identify improvements that would shorten the construction duration of the ITD Study and allow benefits to be realized earlier than currently projected.

PDT Draft Evaluator Response (FPC#4):

The PDT Non-concurs with the comment statement in the first box.

Explanation: Given unconstrained funding, the study period leading up to the advertisement of the Cofferdam Contract 1 considers two float paths (1) cofferdam design, plans, and specifications, and (2) the S2EIS environmental compliance process. The two paths are concurrent resulting in the environmental compliance anticipated to be the driver of contract award. However the most likely scenario is not unconstrained funding rather, it is based on a \$150M/year funding limit. This delays award of Cofferdam Contract 1 and Nav Pass & Cofferdam Contract 2 until funds are available, dropping the environmental impact from the network's true critical path.

Demolition of Lock and Dam 52 & 53 are indirectly connected to the Dam Operational milestone. The NTP for this contract is not allowed to proceed until Olmsted Dam is operational. This logic is likely more conservative than is necessary but supports balancing the budgetary constraints of the job as well as maintains a functional limit on how early this work can start. Work shown in parallel would be the engineering to prepare the design, bid package, advertisement, and award.

The durations for the activities were derived from collaborative and intense PDT discussion and agreement. The level of confidence for these durations was adequately communicated and variance thereto considered in the CSRA. The base schedule duration of 15 months for environmental compliance process was agreed and is reflected in activity ENV1000. The report text mentions on page 115 that a "typical EIS" would take 18 months as referenced by the Panel Comment, however, this specific EIS is an amendment to an existing document which the PDT felt could be accomplished in the 15 months used in the schedule analysis.

The crewing plan for cell construction actually does consider three pile driving rigs. Two working in opposing sections and a third rig filling completed cells by driving piles for the arc cells. These multiple rigs are indicated by sections working in parallel in the detailed schedule. This crewing plan was drawn from the construction methodology employed for the lock cofferdam contract completed in prior years.

Recommendation #1: Adopt in the Future

Explanation: Should the ITD Alternative be carried further, a Biddability, Constructability and Operability, and Environmental (BCOE) review would be required per USACE policy. However, for the purpose of this effort, sufficient duration has been included in the schedule to allow for constructability reviews. Further, funding constraints introduce opportunities for additional float prior to bid and award activities by releasing engineering effort earlier than shown in the schedule (01 Oct 2014).

Recommendation #2: Adopt in the Future

Explanation: It may be worth noting that the schedule has 1341 logical relationships and a critical path that was reviewed and agreed with the team and both sets of reviewers leading up to certification. It can also be noted that there are only four tasks beyond the start and finish milestones for the project that have open ends and they are all associated with the site restoration contract. Two of these tasks are Level of Effort (Hammock type) tasks that should be tied to the final physical task for this contract. The final two items should be tied to the project complete milestone. If this were done they would have nearly nine months of float. Therefore these errors could be fixed, however, will have no significance to the planned completion dates or outcome of the analysis. Those tasks actually lacking successors are listed here:

Activity: SCRAP EDC Site Restoration EDC

Activity: SCRAP S&A Site Restoration S&A

Activity: SCRAP760 Upper Staging Area - Tree Watering after Install

Activity: SCRAP840 Wetland - Site Restoration Complete

For the purposes of this alternative study the existing schedule is sufficient in communicating the critical path to completion. All activities have undergone rigorous quality control and agency technical review. Should the ITD Alternative be selected to move forward, the project schedule could be progressed commensurate with the advanced level of detail and analysis required for implementation.

Recommendation #3: Adopt in the Future

Explanation: Should the USACE merit further evaluation of the ITD Alternative the design would progress through Value Engineering and BCOE review as required by USACE policy. However, the PDT, quality control, and ATR teams were manned with experienced construction and design technical specialists from across the USACE. Much input was solicited and provided in the formulation of the ITD Study design, construction methodology, cost, schedule and risk.

Panel Final BackCheck Response (FPC#4):

The Panel Non-concurs with the PDT's response.

Explanation: Further documentation added to the Report as discussed in the PDT's explanation will clarify and should resolve the many concerns expressed by the Panel members.

Namely, an indirect linkage of elements does not directly tie activities logically together. Therefore, a 'conservative approach' should be documented to fully explain the rationale used in the development of the schedule. For example, ENV 1000 has a duration of 300 days. This is far shorter than the 15 months (18 months in the Report) stated in the PDT's Explanation. Outlining the rationale for the activities, durations and logical connections more fully explains the PDT's reasoning and aids future team members during the more detailed phases of the project.

Further, project schedules of this type should have only two activities (start and finish) that do not have successor/predecessor. Any other configuration is in disagreement with standard protocols used by USACE.

Finally, all known activities (ex. BCOE/Value Engineering Reviews) especially those mandated by USACE policy should be incorporated into the schedule to the level of detail appropriate whenever possible. This aids in analyzing impacts when events don't occur as planned. The Panel agrees that there is a great deal of float available; however, unforeseen circumstances not yet identified can have major impacts that would consume that available float. The best level of detail should be planned into the project at this stage to aid in the design/construction phases in the future.

PDT Follow-on Final Evaluator Response (FPC#4):

Concur.

Explanation: The PDT concurs that it would be prudent to document, as part of the report, the details contained in the comment evaluation. Each Panel comment and subsequent comment resolution dialogue contained in DrChecks will become an official part of the ITD Study report and will be forward up through the same COE chain of command as the original report. It is suggested that this DrCheck record serve as the documentation of details requested versus editing the report text. Additionally, based on the PDT/Panel comment resolution telecon of 1/11/13, it is understood that the explanations contained in the comment evaluation "1" above adequately address the issues presented in the comment.

Panel Follow-on Final BackCheck Response (FPC#4):

The Panel Concur with the PDT's response.

Final Panel Comment 5

There may be opportunities to compress the project schedule that do not appear to have been considered.

Basis for Comment

Currently the design efforts for Cofferdams #1 and #2 are staggered (Olmsted In-The-Dry (ITD) Study main report, Executive Summary, Figure E-1, p. d), with each effort taking more than two years. Due to their similar nature, these design efforts could be done concurrently by one designer. The Panel identified several scheduling items that could expedite project completion:

- Completing the building and grounds work is not on the Critical Path, and three years to complete that scope of work seems excessive.
- A period of 2.5 years to complete the Resident engineer (RE) office conversion appears to be longer than required to convert an existing building; six to 12 months would be more appropriate. This work could be moved back to coincide with the lock startup.
- Unless limited by fiscal year budget constraints, site restoration and county road paving could be started sooner to more closely coincide with the RE office conversion. Additional explanation of this work activity will provide task durations for closer analysis.
- Demolition of existing Locks and Dam 52 and 53 does not appear to be critical to the on-line operation of the new lock and dam. These locks are at a separate upstream site, and this work will be let as a separate contract without affecting the project close-out.
- Potential repair closure durations for Locks and Dam 52 and 53 have not been quantified or factored into the schedule.
- Schedule activities do not reflect needed resources for issues associated with annual budget limitations and seasonal issues with the river wet season.
- The two-year delay associated with the proposed ITD method of construction could potentially be recovered with proper Value Engineering efforts and by providing incentive contract opportunities to the construction bidders.

Significance – Medium

A closer examination of the many schedule related expenses that impact the total project cost (e.g., overhead, escalation, wages, contingency, etc.) could decrease the total project time line.

Recommendations for Resolution

1. Re-examine the project schedule for work items that may be consolidated through Value Engineering/Constructability analysis.
2. Identify work segments that are not on the critical path to lock and dam completion and operation, and reschedule them to an earlier start; finish whenever possible.
3. Consider providing contract incentives for contractors to finish earlier.

PDT Final Evaluator Response (FPC#5):

The PDT Non-concurs with the comment statement in the first box.

Explanation: While we concur with this literal statement (as all schedules at any stage have opportunities to compress) we do not concur with the spirit of the comment. We agree that the USACE working with a prudent construction contractor have many opportunities to realize efficiencies in the ITD schedule. However, much effort has gone into the base assumptions and CSRA to ensure that the PDT communicates cost and schedule at an 80% level of confidence for comparison to the FY12 PACR.

The critical measurement point for the comparison for ITW and ITD is not project completion but in fact lock and dam operational. Elements such as Building and Grounds, RE Office Conversion, and County Road Paving were not optimized beyond the PACR estimate they were carried forward as is in order to avoid biasing the comparison. Of further note, the durations described appear to be referenced from Figure E-1 of the Executive Summary (page d of Volume 1). The durations depicted include design and construction. Therefore the period of 2.5 years for the RE Office Conversion (Resident Engineers Office) includes the time to prepare the design, reviews, and bid package as well as advertise, award, and construct. For contract sequencing see response to Recommendation #2.

See response to Comment #5 regarding the sequencing of Locks and Dam 52 and 53 with the operational milestone. Potential 52 and 53 lock and dam closures were considered consistently with the FY12 PACR in order to avoid biasing the ITD result. It is also important to note that the operation, maintenance and repair of 52/53 prior to decommissioning are separately budgeted for and executed through the USACE's O&M business line.

The schedule plan reviewed resources and cost in an analysis external to the master Primavera schedule that were then incorporated back into the schedule network. This was accomplished by conducting iterative analysis of the schedule and cost model until all work fit under the funding limitations. The results are clear that it is not the schedules logical sequence that makes the schedule late but in fact the cost limiter of \$150M per year. River construction work is specifically assigned to river calendars developed to address seasonal river issues. This was accomplished for resources by each critical sequence of work being evaluated for crewing/equipment requirements in external fragnets sketched out in discussion with construction representatives, the responsible cost estimator and the scheduler. These fragnets were vetted by peer review and used in the schedule's network logic and the cost estimate to establish concurrency of working tasks and appropriate shifting to meet our 80% confidence level.

Recommendation #1: Adopt in the Future

Explanation: Should the USACE merit further evaluation of the ITD Alternative the design would progress through design optimization, value engineering, and BCOE review.

Recommendation #2: Not adopt

Explanation: As a general rule, the team worked with the understanding that the sooner work is

completed the less it costs and sooner benefits are realized. In the case of prioritizing contracts, the team first developed a contract sequence based on physical predecessor/successor requirements of the projects (e.g. wicket lifter barge completed and delivered just before it is needed once the wicket dam is in place). Some contracts resulted in having tight constraints while others could happen at any time prior to overall completion. The next step was to review the resulting annual funding levels with the projected annual contract obligations in order to “cost level” the schedule. Tough decisions had to be made to ensure the physical and fiscal requirements were met. This pushed out contracts with little or no physical successors until sufficient funds were in place. In this way, the constrained funding assumption increases total project cost by delaying purchases until later years and the associated inflation.

Recommendation #3: Adopt in the Future

Explanation: Potential changes to the Dam Contract fee structure are being actively considered, however, they were not included in this analysis, to avoid biasing the comparison. Should the USACE merit further evaluation of the ITD Alternative these same considerations for performance incentive fee structure would be evaluated for the cofferdam and nav pass contracts.

Panel Final BackCheck Response (FPC#5):

The Panel Concurs with the PDT’s response.

Final Panel Comment 6

The assumption that the cost to raise the height of the cofferdam would be greater than the cost associated with one overtopping event is not supported by a cost estimate.

Basis for Comment

The purpose of the study is to develop the design basis for constructing the Olmsted Dam Navigable Pass In-The-Dry (ITD), which includes evaluating the feasibility of such a construction method and preparing a cost estimate for the ITD construction. The Olmsted Dam ITD Study indicates that the height of the cofferdams to be constructed was determined from the elevation-frequency analysis, elevation-duration analysis, the available cofferdam materials, and the previously constructed lock cofferdam. The study suggests that the cofferdam be constructed to an elevation of 329.0 feet based on time constraints, past studies, including one overtopping event in the cost estimate, and the relatively low probability of multiple overtopping events. It concludes that it is reasonable to select a top of cofferdam elevation of 329.0 feet and not perform an updated Cofferdam Height Study (Memorandum, “2012 Olmsted Elevation-Duration Curve Development,” 17 April 2012, under the section titled, “Risk of Cofferdam Overtopping”).

The concluding assumption may be valid and additional considerations may have been evaluated to understand the increased costs associated with raising the height of the cofferdam; however, the study does not compare the costs associated with raising the height of the cofferdams to the costs associated with one or more overtopping events. In addition, the study suggests the updated Cofferdam Height Study was ruled out based on reasons not associated with an actual cost comparison.

Significance – Medium

The decision to construct the cofferdams to an elevation of 329.0 feet would not directly affect the construction of Olmsted Dam; however, an exact comparison of construction costs would provide a quantitative basis for determining the top of cofferdam elevation.

Recommendations for Resolution

1. Determine the estimated cost of raising the height of the cofferdams to reduce the probability of an overtopping event during construction.
2. Compare the economic impacts associated with a single overtopping event or multiple overtopping events to the cost of raising the height of the cofferdams.

PDT Final Evaluator Response (FPC #6):

The PDT Concurs with the comment statement in the first box.

Explanation: There is existing Corps guidance (See EM 1110-2-1605) on how to set the final height of an in-river cofferdam including the need to determine the costs of incremental increases in cofferdam height. This guidance was not followed, due principally to the lower level of cost accuracy considered necessary for the ITD study and the amount of time allotted for the study.

Recommendation #1: Adopt in future

Explanation: See explanation for Recommendation #2 below.

Recommendation #2: Adopt in future.

Explanation: If the ITD concept is moved forward toward final design, a cofferdam height study, as required and defined by guidance, and as has been completed on past Olmsted Cofferdam designs, will be completed. The process as defined by guidance includes the suggested steps in Recommendations 1 and 2. The process was not followed in the ITD study, partly because of time constraints, but more importantly because it could be seen through the work completed that the project costs (either in cofferdam construction costs and/or flood out costs) were reasonably accurate and close enough for the study goals. It is felt that the past Olmsted cofferdam studies and past Corps precedence/experience on overtopping probabilities used on cofferdam designs set the ITD cofferdam height close to what is needed or possibly a little low. While it is correct that there may be some over all savings to be had by raising the cofferdam height, the cost change would not be relatively large because the cost of a flood out was determined to be only about \$25 million with a two month delay (i.e. you wouldn't spend \$100 million dollars more on the cofferdam to avoid the \$25 million for an additional overtopping). Therefore, the approach taken was considered acceptable.

Panel Final BackCheck Response (FPC#6):

The Panel Concurs with the PDT's response.

Final Panel Comment 7

Design conditions for the cells forming the cofferdam system may be affected by potential differences in the assumed top elevation of the McNairy I formation.

Basis for Comment

Plates 7, 8, and 9 of Appendix A (Drawings) show the subsurface profile across the riverbed in the area of the Phase I and Phase II cofferdam systems. The information contained on these Plates indicates that the top of the McNairy I formation varies from El. 232.8 to El. 249.3; however, the geotechnical computations contained in Appendix B (Engineering Calculations) use only one typical cross-section with the top of the McNairy I formation at El. 240.0. This elevation is used for a variety of analyses provided in Appendix B, including sliding, bearing capacity, settlement, and other potential design conditions.

The use of El. 240.0 in the design analyses represents a reasonable assumption of “average” conditions, but the analyses and written summary do not account for any modifications in configuration or cost that would be required for cells found at other elevations. The Olmsted In-The-Dry (ITD) main report and the geotechnical computations contained in Appendix B do not include any information on the effect of variation in elevation of the McNairy I formation on the configuration and integrity of the cofferdam and berm.

Significance – Medium

The configuration of the berm would likely change at various locations if a lower or higher elevation of the McNairy I formation were used in the analyses.

Recommendations for Resolution

1. Conduct additional geotechnical analysis.
2. During the final design, analyze additional cross-sections that represent the variable top elevation of the McNairy I formation. This will likely result in the top elevation of the interior berm configuration varying from a constant elevation as predicted in Appendix A.

PDT Final Evaluator Response (FPC#7):

The PDT Concurs with the comment statement in the first box.

Recommendation #1: Adopt in the future;

Explanation: Additional geotechnical analysis was expected and will be a part of the Final Design Phase.

Recommendation #2: Adopt in the future;

Explanation: Additional geotechnical analysis was expected to occur during the Final Design to incorporate all possible cross-sectional geometries due to the varying elevations of the McNairy I formation. Additional borings will also be performed along the alignment of the cofferdam cells and this information used to determine the top of McNairy I for final design.

Panel Final BackCheck Response (FPC#7):

The Panel Concurs with the PDT's response.

Final Panel Comment 8

The planned use of the existing lock chamber to pass river flows during Stage 2 of the navigable pass construction may result in the deposition of gravel in the baffle system for the lock.

Basis for Comment

As illustrated in Figure 5, Stage A Cofferdam, in the main report of the Olmsted In-The-Dry (ITD) Study, the plan is to use the existing lock chamber to pass river flows during Stage 1 of the Navigable Pass construction. Based on the Panel's experience with the USACE St. Paul District and Upper St. Anthony Falls Project, this procedure could result in the deposition of gravel-sized material in the baffle system at the bottom of the lock chamber. During the 1977 dewatering of the Upper St. Anthony Falls Project, it was discovered that the use of the lock to pass flood flows during the 1965 flood had deposited gravel in the bottom of the lock. During the normal filling and emptying of the lock, a flow regime developed in the bottom of the lock that created a "milling operation" which scoured out a significant amount of the 10,000+ psi concrete in the bottom of the lock chamber. Subsequently, steel plating was installed in the bottom of the lock to repair this scour damage. This condition does not directly affect the feasibility of the ITD plan for construction, but it has the potential to create additional costs.

Significance – Medium

Potential scouring of the lock chamber could result in unanticipated repair costs for the lock and unscheduled outages for navigation at the lock.

Recommendations for Resolution

1. Conduct future studies and modeling to determine whether the use of the lock chambers to pass high river flows will result in the deposition of gravel material in the bottom of the lock chamber.
2. If there is a potential for the deposition of gravel-sized material, evaluate the hydraulics in the filling system to determine whether a long-term "milling operation" is possible.
3. If potential damage to the lock chamber is identified, consider protective means for the bottom of the lock, including steel plating of the baffle system. As an alternative to a steel plating system, a scheduled lock dewatering and cleaning regime after major flood events could be developed.

PDT Final Evaluator Response (FPC#8):

The PDT Non-concurs with the comment statement in the first box.

Explanation: Damage to the lock as a result of gravel deposition and "milling" of chamber concrete surfaces, if actual, is expected would be a long term issue, and the difference in operations during construction by the ITW or ITD methodologies is not expected to be significant in the long term.

Recommendation #1: Not adopt

Explanation: Use of the lock chambers to pass flood flows is a normally planned operation for the dam, regardless of the construction methodology (ITW or ITD). The District is familiar with the potential for gravel movement into the locks, as gravel materials are routinely removed from the lock walls at L&D 53 upstream. Because this concern is a long term issue relative to the operation of the locks, it is not believed that the difference between the number of lock cycles experienced for the ITW vs. ITD would be significantly different to create a quantifiable difference in damage.

Recommendation #2: Not adopt;

Explanation: The Louisville District is familiar with the scenario of gravel/cobbles becoming trapped in stilling basins below tainter gates or the discharge pipes at reservoirs, where the velocities are known to be high and turbulent, and causing significant damage over time. District personnel were not familiar with the Upper St. Anthony Falls lock scour. As stated in response to Recommendation #1, gravel is experienced at L&D 53 and would thus be expected to occur at the Olmsted locks. Potential for damage is a long term issue not related to the method of dam construction. Investigation into the similarities and differences between the two projects is recommended external to this study, as well as further research to determine what extent this was previously considered in the design of the lock projects.

Recommendation #3: Not adopt

Explanation: If potential for damage is identified as a result of the investigation per Recommendation #2, all alternatives will be considered. As the damage is expected as a result of long term operation, it is not considered to be a factor in the ITW vs. ITD comparison.

Panel Final BackCheck Response (FPC#8):

The Panel Concurs with the PDT's response.

Final Panel Comment 9

It cannot be determined if the linear interpolated values used to generate the elevation-frequency curve would be affected by a significant change in flood profile slope

Basis for Comment

The top of cofferdam elevation is key to construction economics and project safety. The elevation-frequency curve was one of many components used to select an adequate elevation for the top of the construction cofferdams. Appendix C (Hydraulics and Hydrology) describes the development of the elevation–frequency curve. As indicated in the study, since no elevation gage data were available at the Olmsted Dam to develop the elevation-frequency curve, the best available data from adjacent gages located upstream and downstream of the Olmsted Dam were used.

Flood profiles may vary in slope between two gage stations based on channel slope, channel geometry, tailwater conditions, or hydraulic structures. Linear interpolation can be reliable provided that the flood profile does not change significantly in slope between the two gage stations. The quantity of the significant change is relative to the results of the flood-frequency curve, which is used to determine the top elevation of the cofferdams. The In-The-Dry (ITD) Study gives no indication regarding the reliability of a direct linear interpolation.

Inaccurate interpolated values may result if the Ohio River flood profile should vary in slope between the gage stations. The interpolated values may affect the results of the elevation-frequency curve, which in turn may affect the decisions used to set the elevation of the top of the cofferdams in constructing the Olmsted Dam.

Significance – Medium

The estimate for construction costs could be affected if the linear interpolation method used to generate the elevation-frequency curve is found to provide unreliable data.

Recommendations for Resolution

1. Provide additional detail in the study highlighting the relative difference in elevation between the gage stations used to interpolate flood stages at the Olmsted Dam.
2. Provide various flood profile plots showing any changes in slope due to various channel conditions, flood stages, or hydraulic structures.
3. Discuss the validity of linear interpolation with further justification, or provide revised data based on considering any significant flood profile slope changes.

PDT Final Evaluator Response (FPC#9):

The PDT Non-concurs with the comment statement in the first box.

Explanation: The proximity of the Olmsted project to the upstream gage used in the linear interpolation minimizes the likelihood of significant error through interpolation. Prior to 2006 (approximately), elevations for design of the Olmsted project were interpolated between the gage at L&D 53 (aka the Grand Chain gage) located 1.8 miles upstream of the Olmsted project, and

the Cairo gage located 15.1 miles downstream of the Olmsted project. (A gage was installed at Olmsted Locks and data is available for that gage since 2006.) Due to the close proximity to the L&D 53 gage and the nature of the valley in this reach, there is not a significant change in valley storage over the short 1.8 mile distance that would result in a significant difference in water surface elevations. Progression of flood waves is also not a significant consideration for the same reason. Use of linear interpolation to estimate the historical elevations at Olmsted is therefore deemed adequate for these purposes, particularly when focusing on high flows.

Recommendation #1: Not adopt

Explanation: See explanation in response to main comment.

Recommendation #2: Not adopt

Explanation: See explanation in response to main comment.

Recommendation #3: Not adopt

Explanation: See explanation in response to main comment.

Panel Final BackCheck Response (FPC#9):

The Panel Concurs with the PDT's response.

Final Panel Comment 10

It could not be determined if the left boat abutment counterfort wall was designed according to EM 1110-2-2104.

Basis for Comment

Proper design of the counterfort wall is important to the success of the overall project. The left boat abutment counterfort wall is designed as a 356 in. (29 ft. 8 in.) deep beam, but this structure is not explained in sufficient detail to determine the appropriateness of the design. The left boat abutment counterfort may respond to the applied loading as an axially loaded wall/shear wall with out-of-plane bending as opposed to a deep beam. Section 1.5 of EM 1110-2-2104 (USACE, 1992) states that “Reinforced-concrete hydraulic structures should be designed with the strength design method in accordance with the current American Concrete Institute (ACI) 318 except as hereinafter specified.” Wall designs are covered in Chapter 14 of ACI 318 (ACI, 2011), but it is unclear whether the left boat abutment counterfort wall was designed using this reference.

Significance – Medium

The appropriateness of the design and function of the left boat abutment counterfort wall cannot be fully determined if the construction guidance is not referenced.

Recommendations for Resolution

1. Provide the appropriate construction and engineering references for the design of the left boat abutment counterfort wall.
2. Discuss any deviations from EM 1110-2-2104 in the design of the left boat abutment counterfort wall.

PDT Final Evaluator Response (FPC#10):

The PDT Concurs with the comment statement in the first box.

Explanation: The LBA was designed according to EM 1110-2-2104. However, this is not explicitly stated in the report text or the calculations in Appendix B such that a reader can readily surmise what design guidance was followed.

Recommendation #1: Adopt in future

Explanation: If the ITD design of the Olmsted Dam, including the LBA, is taken to the next level of detail, the supporting text and calculations will be revised to thoroughly explain what design guidance and analysis models/approaches were used in the design of the LBA. Additionally, given its unique nature, the counterfort portion of the LBA will be checked as both a deep beam and a laterally loaded wall to insure its long term adequacy.

Recommendation #2: Not adopt

Explanation: There were no deviations from EM 1110-2-2104 in the current design and none

are anticipated if the ITD design is developed further.

Panel Final BackCheck Response (FPC#10):

The Panel Concurs with the PDT's response.

Literature cited

ACI (2011). Building Code Requirements for Structural Concrete (ACI 318-11) and Commentary: Reported by ACI Committee 318. American Concrete Institute, Farmington Hills, MI.

USACE (1992). Strength Design for Reinforced Concrete Hydraulic Structures. Engineer Manual (EM) 1110-2-2104. Department of the Army, U.S. Army Corps of Engineers, Washington, D.C. 30 June.

Final Panel Comment 11

The rationale for ignoring uplift pressures and assuming pumps will be effective has not been supported.

Basis for Comment

In referring to the structural calculations for the cofferdam over the navigation pass monolith, the Olmsted In-The-Dry (ITD) main report states that “Uplift is conservatively ignored, assuming pumps are effective” (p. 109). EM 1110-2-2503 states that uplift and saturation of cofferdam cells is a potential failure mode (USACE, 1989; Section 5-2.a.(4)). It is unclear to the Panel whether ignoring uplift is a ‘conservative’ assumption since numerous factors can cause pumps to fail or become ineffective during construction operations. It would be more conservative to assume that the pumps are not effective, or have failed, and to design the cofferdam accordingly.

Significance – Medium

Documentation or a discussion is required to understand the rationale for ignoring uplift pressures and cell saturation associated with potential pump failure.

Recommendations for Resolution

1. Evaluate the effect of full saturation of the cell fill in accordance with EM 1110-2-2503, Section 5-3(a).
2. Clarify the relationship among cell saturation, uplift pressures, and pumps and discuss negative effects and risks of pump failure.

PDT Final Evaluator Response (FPC#11):

The PDT Non-concurs with the comment statement in the first box.

Explanation: Uplift was not necessarily ignored but was actually accounted for by designing a dewatering system that would eliminate foundation pressures and also reduce the saturation levels in the cells. A discussion of the rationale for incorporating a dewatering system is included in the main report under Section 7. The second paragraph on page 66 of the Main Report includes a discussion on dewatering system maintenance and back-up that ensures the integrity of the system and safety of the cofferdam. A similar system was employed for the Olmsted and McAlpine lock cofferdams and is currently being used by the Nashville District for the Kentucky Lock project.

Recommendation #1: Not adopt

Explanation: The analysis of the initial filling of the cells shows that they will develop excessive interlock tension if allowed to become fully saturated. Analyses of long term sliding and overturning shows that adequate safety factors are not achieved if the cells are fully saturated. Therefore, a dewatering system designed to lower the saturation in the cells and relieve uplift pressures is a requirement of this cofferdam. The background and basis for incorporating a dewatering system for the Olmsted Dam Cofferdams is explained in the Main Report, under Section 7. Cofferdam Unwatering, Cell Dewatering and Instrumentation Requirements.

Recommendation #2: Not adopt

Explanation: The cofferdam would not be able to meet the required safety factors set forth in EM 1110-2-2503 if the cells are allowed to be either fully saturated or saturated at flood level as described in the EM. The use of a dewatering system to reduce saturation in the cells and relieve uplift pressure incorporated into previous LRL projects. Section 7 of the Main Report documents the justification for relying on this feature of the project. Past project have successfully relied on these systems and they have proven to be durable with proper maintenance and specifications.

Panel Final BackCheck Response (FPC#11):

The Panel Concurs with the PDT's response.

Literature cited

USACE (1989). Engineering and Design - Design of Sheet Pile Cellular Structures and Retaining Structures. Engineer Manual (EM) 1110-2-2503. CECW-EP. Department of the Army, U.S. Army Corps of Engineers, Washington, D.C. 29 September 1989; Errata Sheet No. 1, 11 June 1990.

Final Panel Comment 12

The procedures used in analyzing the stability of the sheet pile cells, as described in Appendix B, do not conform to the procedures stated in EM 1110-2-2503.

Basis for Comment

The computations provided in Appendix B (Engineering Calculations) for the evaluation of the sliding of a sheet pile cell use a factor of safety (FS) defined as follows:

$$FS = \text{Resisting Forces/Driving Forces}$$

However, the procedure outlined in EM 1110-2-2503 (USACE, 1989) uses a different definition of the factor of safety and a mathematically different procedure to compute the factor of safety for sliding. Under the guidelines contained in EM 1110-2-2503, the factor of safety is defined as the factor by which the design shear strength needs to be reduced in order to place the sliding mass (the cell) in horizontal and vertical equilibrium. This definition of the factor of the safety and recommendations for its implementation are contained in the Engineer Manual (USACE, 1989).

The major uncertainty in the stability computations is the value of shear strength actually mobilized along a potential sliding surface. For this reason a definition of factor of safety, which applies directly to the shear strength, is considered to be theoretically more appropriate than a definition based on a ratio of forces. The Panel's experience with other structures has shown that the use of the force equilibrium definition will often result in somewhat higher computed values of factors of safety than when using a definition based on a ratio of forces. It is therefore likely that the computed factors of safety will increase if the appropriate procedures are used.

Significance – Low

The computations contained in Appendix B do not use the recommended definition of factors of safety or the recommended computational procedures per EM 1110-2-2503.

Recommendations for Resolution

1. Employ the procedures described in EM 1110-2-2503 for final design computations for the sheet pile cellular structure.

PDT Final Evaluator Response (FPC#12):

The PDT Concurs with the comment statement in the first box.

Explanation: The method used in Appendix B was the more conservative method, as stated.

Recommendation #1: Adopt in future

Explanation: The method for analyzing sliding on the base that is described in the EM will be included in the Final Design Calculations. It is noted that the CCELL results for sliding on the base are considerable higher than in the report. It is postulated that CCELL uses the EM method

and this will also be investigated and reported in the Final Design Report.

Panel Final BackCheck Response (FPC#12):

The Panel Concurs with the PDT's response.

Literature cited

USACE (1989). Engineering and Design - Design of Sheet Pile Cellular Structures Cofferdams and Retaining Structures. Engineer Manual (EM) 1110-2-2503. CECW-EP. Department of the Army, U.S. Army Corps of Engineers, Washington, D.C. 29 September 1989; Errata Sheet No. 1, 11 June 1990.

Final Panel Comment 13

The assumed shear strength of the McNairy I formation is an important element of the design of cellular sheet pile structure, but the basis for selecting the shear strength is not adequately described.

Basis for Comment

The documented input for the slope stability computer codes contained in Appendix B (Engineering Calculations) indicates that the stability analyses of the cellular sheet pile structures were conducted using an anisotropic assumption related to the shear strength of the McNairy I formation. The documentation contained in Appendix B includes the results of several shear strength tests conducted in 1990, a tabulation showing the results of different direct shear (S test) or R triaxial tests (with pore pressure measurements), and Tables 16 and 17, which provide values for the design shear strength of the McNairy I formation. Although it appears that an anisotropic variation in the shear strength of the McNairy I formation was used for the stability analyses, there is no explanation or justification for the use of these procedures.

Significance – Low

Providing the basis for incorporating an anisotropic assumption in the stability analysis and a justification of the anisotropic shear strength values would improve the understanding of the cellular sheet pile structure design.

Recommendations for Resolution

1. Modify the Olmsted In-The-Dry (ITD) main report or Appendix B to include a justification for the anisotropic assumptions regarding the shear strength of the McNairy I formation, and the basis and procedures used to select and use the shear strength values assumed in the analysis.

PDT Final Evaluator Response (FPC#13):

The PDT Concurs with the comment statement in the first box.

Explanation: This discussion is included in the main report, see below.

Recommendation #1: Not adopt

Explanation: Table 8 on page 48 illustrates the shear strength values used for the McNairy I formation. This information was obtained from the Olmsted Dam Construction Design Memorandum #8. On the following page (page 49), is a discussion of the three cases analyzed. The three cases varied the shear strength in the McNairy I in both the horizontal and vertical direction. The results of the analysis are included in Table 10. The initial soil testing and shear strength testing was conducted for design of the lock and lock cofferdam and are contained in DM #3, Foundation Design and DM #, Lock DM.

Panel Final BackCheck Response (FPC#13):

The Panel Concurs with the PDT's response.

Final Panel Comment 14

The computations and references contained in Appendix B do not support the design of the structural sections of the piling system proposed for the navigable pass as shown in Appendix A.

Basis for Comment

Various Plates in Appendix A (Drawings) illustrate the design configuration for the various structural elements forming the navigable pass structures. These drawings show that the permanent structures will be supported on pipe piles throughout the length of the navigable pass. However, Appendix B (Engineering Calculations) does not contain any information regarding the computations that were developed to support the foundation piling design shown in the Plates of Appendix A.

The Panel assumes that computations were developed during previous studies for the foundation piling system that supports the permanent navigable pass structures. However, neither the computations nor a reference to the computations are provided in the In-The-Dry (ITD) Study documents.

Significance – Low

The procurement and placement of foundation pilings for the entire length of the navigable pass structures represent a significant portion of the project cost, and should be supported with documented computations.

Recommendations for Resolution

1. Modify the Olmsted ITD main report to either include a specific reference to the computations previously developed for the pile foundation, or include the actual computations for the pile foundation shown in Appendix A.

PDT Final Evaluator Response (FPC#14):

The PDT Concurs with the comment statement in the first box.

Explanation: The pipe pile foundation was designed under a previous study.

Recommendation #1: Adopt in the future

Explanation: The Final Design Phase will incorporate a reference to the pipe pile design that can be found in the Olmsted Dam Construction, Design Memorandum #8, Volume 1, Main Report, on pages 3-28 through 3-41. This is the document that contains the overall foundation design for the dam.

Panel Final BackCheck Response (FPC#14):

The Panel Concurs with the PDT's response.