

Independent External Peer Review of the Wood River Levee System Limited Reevaluation Report for Design Deficiency Corrections Madison County, Illinois

IDIQ Contract No. W912HQ-11-R-0002
TO 0004

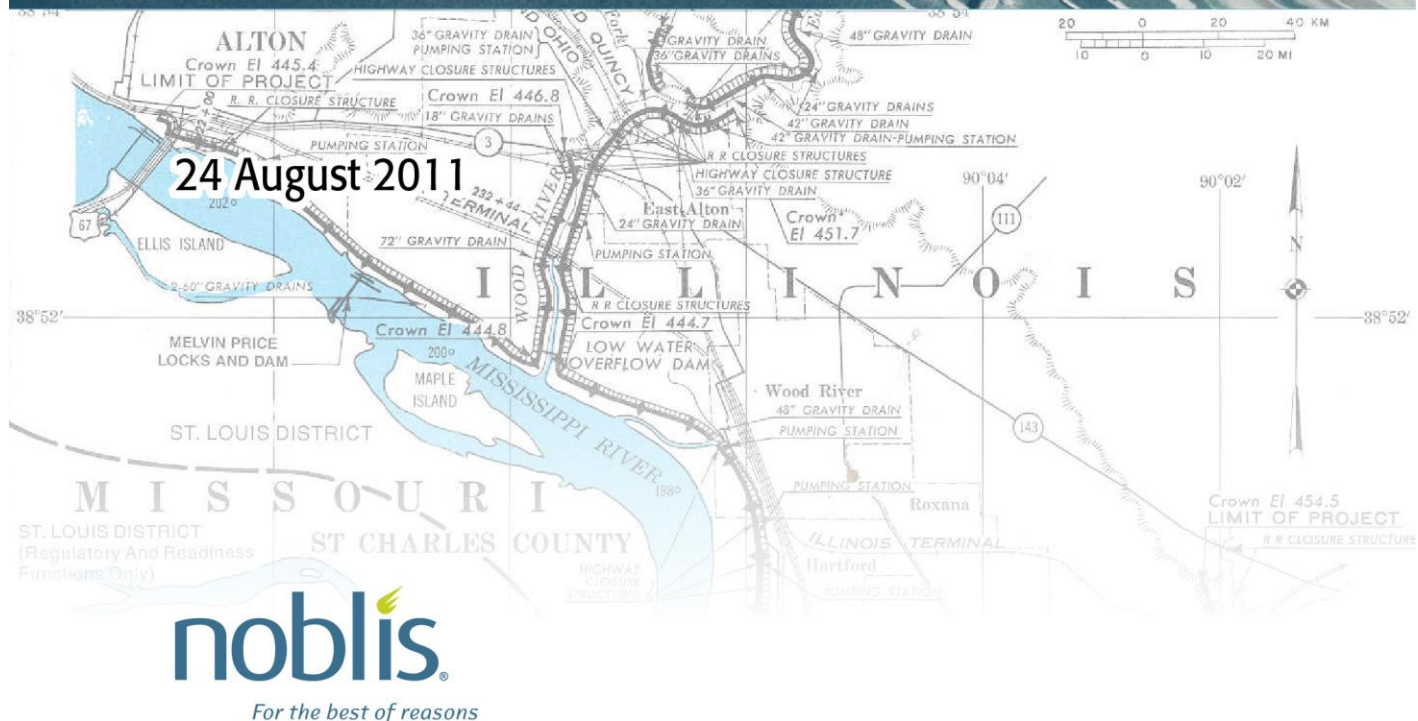


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List of Acronyms

COI	conflict of interest
EA	Environmental Assessment
EC	Engineer Circular
FEMA	Federal Emergency Management Agency
FONSI	Finding of No Significant Impact
ft	foot/feet
HEC-FDA	Hydrologic Engineering Center Flood Damage Reduction Analysis
HIS	Habitat Suitability Index
HTRW	Hazardous Toxic Radioactive Waste
IEPR	Independent External Peer Review
ISO	International Organization for Standardization
LIDAR	Light Detection And Ranging
LRR	Limited Reevaluation Report
NEPA	National Environmental Policy Act
O&M	operations and maintenance
OMB	Office of Management and Budget
PUP	Probability of Unsatisfactory Performance
SOW	Scope of Work
UC	University of California
SWILFPDC	Southwest Illinois Flood Prevention District Council
USACE	U.S. Army Corps of Engineers
yr	year(s)

Executive Summary

Noblis was tasked with conducting an Independent External Peer Review (IEPR) of the Limited Reevaluation Report (LRR) for Design Deficiency Corrections for the Wood River Levee System, Madison County, Illinois, for the U.S. Army Corps of Engineers (USACE). The purpose of the IEPR is to perform a technical assessment of the adequacy and acceptability of economic, engineering and environmental methods, models, data, and analyses performed for the LRR. The LRR investigates the existing condition of the Wood River levee system in order to determine what, if any, actions are required to return the levee, pump stations, and other appurtenant features to a condition that ensures they continue to provide their intended original degree of protection into the future. Noblis was tasked with conducting the IEPR of the LRR for Wood River in accordance with procedures described in the Department of the Army USACE Engineer Circular (EC) No. 1165-2-209, *Civil Works Review Policy*. The review was conducted by a panel of experts with extensive experience in economics, environmental, and engineering issues associated with flood protection feature design. The panel was “charged” with responding to specific technical questions as well as providing a broad technical evaluation of the overall report.

Since Noblis has no commercial interests to advance, no vendor alliances to protect, and no sponsors or shareholders to represent, it is fully independent. Noblis provides impartial, conflict of interest (COI)-free, independent assistance to organizations throughout the federal government and has extensive experience with conducting independent peer reviews. Noblis and the selected IEPR panel have not been involved in any capacity with the Wood River Levee System or the Wood River LRR. In addition, Noblis has not performed or advocated for or against any federal water resources projects. For these reasons, Noblis was suitable for upholding the principles of independence in all aspects of managing the IEPR.

Noblis performed the requirements of this contract in accordance with its Quality Management System, which is compliant with International Organization for Standardization 9000. Specifically, Noblis prepared a Work Plan to define and manage the process for conducting the IEPR, including the screening and selection of peer reviewers, communication and meetings with the USACE project team, project schedule and quality control, and compilation and dissemination of peer reviewers’ comments. The USACE required completing the IEPR as efficiently as possible, and Noblis developed an aggressive schedule that would meet this goal. Some aspects of the task were initiated before the task award date at no expense to the USACE, and certain phases of the project were carried out concurrently to enhance the project efficiency and meet the project schedule.

Reaching out to its various pools of experts, Noblis identified several potential peer reviewers, confirmed their availability, evaluated their technical expertise, and inquired about potential COI. Subsequently, Noblis selected four peer reviewers for the IEPR panel covering the three required areas of expertise: National Environmental Policy Act impact assessment, civil/geotechnical engineering, and economics. The panel represented a well-balanced mix of individuals from academia, large companies and small consulting firms, and individual consultants.

Noblis set up a secure online collaboration site to provide IEPR panel members with electronic copies of the charge and the documents to be reviewed. Noblis held a kickoff meeting with the panel members outlining the steps of the IEPR process and identifying the overall schedule and

deadlines. Noblis served as the conduit for information exchange between the panel and USACE in order to ensure a truly independent IEPR. Considering the compressed schedule for this task, Noblis conducted one meeting with the panel members midway through their review to discuss their progress and current observations/comments. The meeting ensured an exchange of technical information among the panel experts and reflected their diverse scientific backgrounds.

After the IEPR review period ended and comments were developed, Noblis consolidated and collated the panel comments and ensured they were complete and responsive to the charge. Noblis reviewed a draft of the consolidated IEPR panel comments with USACE and the IEPR panel for factual accuracy. Subsequent to this discussion, minor updates were made to the IEPR draft panel comments as necessary resulting in 20 final comments included in this report and submitted in a separate Comment Tracking Form for USACE to provide responses to comments. Of the final 20 comments, seven were identified as having high significance, 12 were identified as having medium significance, and one comment was identified as having a low level of significance. Table ES-1 summarizes the final comments by level of significance. Details on each comment and response are contained in Appendix A of this report. Minor editorial comments were also captured and are included in this report but were not submitted in the Comment Tracking Form.

The final IEPR comments were focused on recommended changes to the LRR to identify and clarify specific key design parameters and factors that should be considered in the selection of the preferred alternative. The St. Louis District Project Delivery Team reviewed the panel members' comments and provided responses in the Comment Tracking Form. The panel provided the concluding "backcheck" comments to indicate concurrence or non-concurrence on whether the USACE's responses addressed the stated concern. In accordance with USACE requirements, the formal record of USACE's responses to comments and the panel's backcheck comments are captured in a separate deliverable (Comment Tracking Form) and not included in this IEPR report.

Table ES-1. Overview of Final Comments Identified by IEPR Panel.

Significance – High	
1	There are several issues identified concerning the engineering analysis of the underseepage design.
2	There are several issues concerning the construction of the slurry trench cutoff walls that should be considered before proceeding with the design.
3	There are several issues concerning the overall design, particularly the slurry trench cutoff walls and relief wells.
4	There is no discussion of the seismic design/performance of the levees or proposed correction measures.
5	It is unclear whether the without-project condition should include the improvements planned for the levee system to meet Federal Emergency Management Agency (FEMA)-required 100-year (yr) flood protection levels, as planned for and described by the Southwest Illinois Flood Prevention District Council (SWILFPDC) in their Implementation Plan.

6	As presently written, the LRR does not effectively integrate the findings of the EA or Plan Formulation to provide a cogent explanation of how the tentatively selected plan was selected on the basis of effectiveness (safety, viability, reliability), costs, or environmental impacts.
7	The EA lacks sufficient detail and analysis of the environmental impacts of the tentatively selected plan, <i>relative to other potential project alternatives</i> , to allow clear and sufficient evaluation of project impacts.
Significance – Medium	
8	It is unclear what value was used in the analyses for the horizontal permeability of the pervious foundation.
9	The threat to future levee performance based on prior observations should be better explained.
10	It is unclear from the report what constitutes “failure” of the levee.
11	The net benefits are to a great degree dependent on the values used for the PUP, which are point estimates provided by District Engineers using professional judgment.
12	Section 7.0 Environmental Consequences provides a summary of impacts from the tentatively selected plan, as taken from the EA. Again, the summary of impacts does not demonstrate the preferred alternative’s impacts relative to the other alternatives, or how the effects will be mitigated.
13	The Draft EA concludes with an unsigned Finding of No Significant Impact (FONSI), which is not fully justified given missing information on potential Cultural Resources and HTRW impacts.
14	It is not clear from the report that all elevations cited in the report and used for design reference the same vertical datum (e.g., NAVD 88).
15	It is unclear how the 52-ft stage at the St. Louis Gage corresponds to the stages along the project site that have river elevations in the 400s.
16	The wetland mitigation plan presented in Appendix A-B requires additional detail in order to fully evaluate its effectiveness against the potential for future failure.
17	The Section 404(b)(1) analysis reads more like a description of the proposed project impacts to wetlands rather than a process by which wetlands impacts were avoided and minimized through careful consideration of alternatives.
18	With regard to the estimated berm quantities, it is not clear whether an allowance was made for site preparation (e.g., clearing and grubbing) beneath the scanned Light Detection And Ranging (LIDAR) surface.
19	There is some concern that the pump stations are designed for lower bound condition.

Significance – Low

20	A number of benefit categories are omitted and not mentioned, while other benefit categories are mentioned and various speculative damage estimates are stated, but they are not included in the HEC-FDA model or the expected annual damage reduction benefits.
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In general, the panel acknowledged that the LRR adequately identified the deficiencies in the underseepage designs and assembled viable alternatives for the design deficiency corrections. The LRR presented appropriate analyses, methods, and models used in evaluating each alternative and determining the tentatively selected plan. However, several assumptions underlying the methods and models were in question or not clearly identified or discussed in the LRR. The document lacked sufficient information in certain sections necessary to provide an adequate basis to fully assess impacts from the project. Additional analyses and assessments may be required for the conclusions presented in the LRR to be accurately supported, as current components of the LRR appear to be premature. The panel raised several key cost and technical issues that note the deficiencies and inconsistencies in the extent of detailed analyses for each alternative. These analyses are essential for the LRR to completely represent all factors considered in the selection of the tentatively selected plan.

Economics. The LRR included appropriate analysis for evaluating the cost benefits associated with each alternative being considered. The methodology and approach incorporated into the cost-benefit analysis were adequate for properly performing the analysis. Issues were noted that pertain to specific impacts and benefits not identified or thoroughly discussed. Also, certain information pertaining to cost-benefit analysis was mentioned but then not used in the detailed analysis, and the LRR could be improved by deleting unnecessary and extraneous information. While lack of detailed analysis for these impacts and benefits may not affect the selection of the preferred alternative, the project analysis would be more complete if the LRR provided justification as to why specific impacts and benefits were not considered or evaluated in detail. The panel understands that further revisions to the LRR are anticipated that will present cost-benefit information appropriately.

Engineering. Since the LRR included detailed drawings and information for the preferred alternative, the panel focused on the design of the tentatively selected plan. The overall engineering principles and methods used in conducting a design analysis and developing the conceptual design were sound. The panel's comments primarily relate to the need for more discussion of important considerations and justification for implementing specific design conditions to create a better understanding of the engineering parameters presented. The panel also identified other analyses missing in the LRR that are essential to the project design and should be discussed. The panel recognizes that this is not the final design and that additional detailed analyses are anticipated that will address many of the identified concerns.

Environmental. The LRR identified the range of factors considered with potential environmental impacts. Particularly, it presented a sound process for monitoring and contingency planning for mitigation of wetlands impacts associated with the implementation of the tentatively selected plan. The panel acknowledged that the LRR recognizes the important consideration of involving different stakeholders including regulatory agencies and local communities as part of the planning process, particularly as the Hazardous Toxic Radioactive Waste (HTRW)

contamination investigations move forward. The primary issues raised by the panel pertained to the LRR not having sufficient discussion that provides justification for how the tentatively selected plan was selected relative to the other potential alternatives. The Environmental Assessment did not provide an adequate discussion of specific impacts of the tentatively selected plan and detailed impacts analysis compared with other potential alternatives. The panel recognizes that more detailed information to support the assessment of environmental impacts, particularly more detailed analysis of the HTRW issue, will be collected and carried forward as appropriate.

1 Introduction

1.1 Report Introduction and Overview

This Independent External Peer Review (IEPR) Report provides a description of the IEPR conducted of the Limited Reevaluation Report (LRR) for Design Deficiency Corrections of the Wood River Levee System, Madison County, Illinois, for the U.S. Army Corps of Engineers (USACE). This report includes a description of the IEPR objectives and process, overview of the Wood River LRR project, summary of the IEPR panel members' expertise, and discussion of observations and comments by the IEPR panel.

Section 1 of the IEPR Report provides a description of the objectives of this effort and general background information on the IEPR, as well as a brief introduction to Noblis, the contractor managing this effort. Section 2 provides an overview of the LRR project. Section 3 presents the overall process followed in performing the IEPR. Section 4 describes the panel composition and the panel members' expertise. Section 5 discusses the conclusions and observations of the IEPR, including a description of the IEPR comments. References are listed in Section 6. Appendix A of this Final IEPR Report lists the final IEPR comments, as well as editorial comments provided by the IEPR panel. Appendix B provides a description of the IEPR panel and the panel members' résumés. Appendix C includes the "charge" and list of documents provided to the panel for the IEPR of the LRR for Wood River.

1.2 IEPR Overview

The USACE lifecycle review strategy for Civil Works products provides for a review of all Civil Works projects from initial planning through design, construction, and Operation, Maintenance, Repair, Replacement and Rehabilitation (OMRR&R). It provides procedures for ensuring the quality and credibility of USACE decision, implementation, and operations and maintenance (O&M) documents and work products. Peer review is one of the important procedures used to ensure that the quality of published information meets the standards of the scientific and technical community. Peer review typically evaluates the clarity of hypotheses, the validity of the research design, the quality of data collection procedures, the robustness of the methods employed, the appropriateness of the methods for the hypotheses being tested, the extent to which the conclusions follow from the analysis, and the strengths and limitations of the overall product.

1.3 IEPR Objective

The objective of the work was to conduct an IEPR of the LRR for Wood River, in accordance with procedures described in the Department of the Army USACE Engineer Circular (EC) No. 1165-2-209, *Civil Works Review Policy*, dated 31 January 2010, and the Office of Management and Budget's (OMB's) *Final Information Quality Bulletin for Peer Review*, released 16 December 2004. The Wood River IEPR involved conducting an independent technical peer review to analyze the adequacy and acceptability of environmental and engineering methods, models, data, and analyses. The independent review was limited to a technical review of the LRR and was not involved in policy issues. The peer review was conducted by experts with extensive experience in National Environmental Policy Act (NEPA) impact assessment, civil/geotechnical engineering, and economics. The experts were "charged" with responding to specific technical questions as well as providing a broad technical evaluation of the LRR.

The independent expert reviewers identified, recommended, and commented upon assumptions underlying the analyses as well as evaluated the soundness of models and planning methods. They evaluated data, the use of models, analyses, assumptions, and other scientific and engineering methodologies. The reviewers offered opinions as to whether there are sufficient technical analyses upon which to base the ability to implement the project.

1.4 Noblis is Conflict-Free in Water Resources Projects

Noblis, the contractor leading this effort, is a nationally recognized leader in systems analysis and analytical support to the federal government. As a nonprofit science, technology, and strategy organization, Noblis solves complex systems, process, and infrastructure problems in ways that truly benefit the public. Noblis staff include accomplished engineers, scientists, analysts, researchers, technical specialists, and management experts with extensive multi-disciplinary and multi-sector experience. Since Noblis has no commercial interests to advance, no vendor alliances to protect, and no sponsors or shareholders to represent, it is fully independent. Noblis provides impartial, conflict of interest (COI)-free, independent assistance to organizations throughout the federal government. Noblis has documented experience with peer review oversight. Noblis and the selected IEPR panel have not been involved in any capacity with the Wood River Levee System or the Wood River LRR. In addition, Noblis has not performed or advocated for or against any federal water resources projects.

Noblis has been recognized as one of the 2011 World’s Most Ethical Companies by the Ethisphere Institute. This award honors companies that demonstrate “real and sustained ethical leadership in their industries.” Noblis was one of three companies worldwide to be listed in the Business Services category. The Ethisphere Institute, a think-tank dedicated to the creation, advancement, and sharing of best practices in business ethics, corporate social responsibility, anti-corruption, and sustainability, reviewed nominations from companies in more than 100 countries and 38 industries before naming 110 companies to their 2011 list.

Noblis clients and the public deserve nothing less than work that meets the highest standards of excellence, conducted in an environment where objectivity and integrity are the hallmarks. Noblis achieves this through the development, implementation, maintenance, and continual improvement of its International Organization for Standardization (ISO) 9001:2008 Compliant Quality Management System.

2 Wood River LRR Project Description

The purpose of the LRR is to investigate the existing condition of the Wood River levee system in order to determine what, if any, actions are required to return the levee, pump stations, and other appurtenant features to a condition that ensures they continue to provide their intended original degree of protection into the future. As a function of this investigation, current engineering standards were utilized, original design intent was compared to existing conditions, and problems identified were categorized as design deficiency, construction deficiency, maintenance deficiency, and/or advanced age. An investigation of project O&M requirements has been made to assign responsibilities in order to recommend cost sharing requirements. The goal of the study is to evaluate levee conditions and determine the federal interest in addressing problems in the Wood River levee system identified during and subsequent to the flood of 1993.

The Wood River Drainage and Levee District (Levee District) lies in southwestern Illinois, on the left bank of the Mississippi River flood plain, within Madison County, Illinois, between river

miles 195 and 203 above the Ohio River (see Figure 1). The Levee District is protected by an urban design levee, across the Mississippi River from St. Louis and St. Charles counties in Missouri. The Wood River levee system is part of a larger Metro East set of levee systems that includes the Metro East Sanitary District and Chain of Rocks levees and the Prairie du Pont and Fish Lake levee system to the south. The Wood River levee system includes approximately 21 miles of main line levee, 170 relief wells, 26 closure structures, 41 gravity drains, and seven pump stations. Only 163 wells are included in the design deficiency corrections project as seven wells are 8-inch diameter polyvinyl chloride (PVC) wells, installed in 1985 as a part of the Wood River Alterations, Design Memorandum No. 16, Lock and Dam No. 26 (Replacement) and are not included as part of the replacement/rehabilitation alternatives. The study area lies in the Mississippi River flood plain of Madison County, Illinois, just upstream of the city of East St. Louis. There are approximately 13,700 acres of bottomland within the District and 4,700 acres of hill land tributary to the levee units.

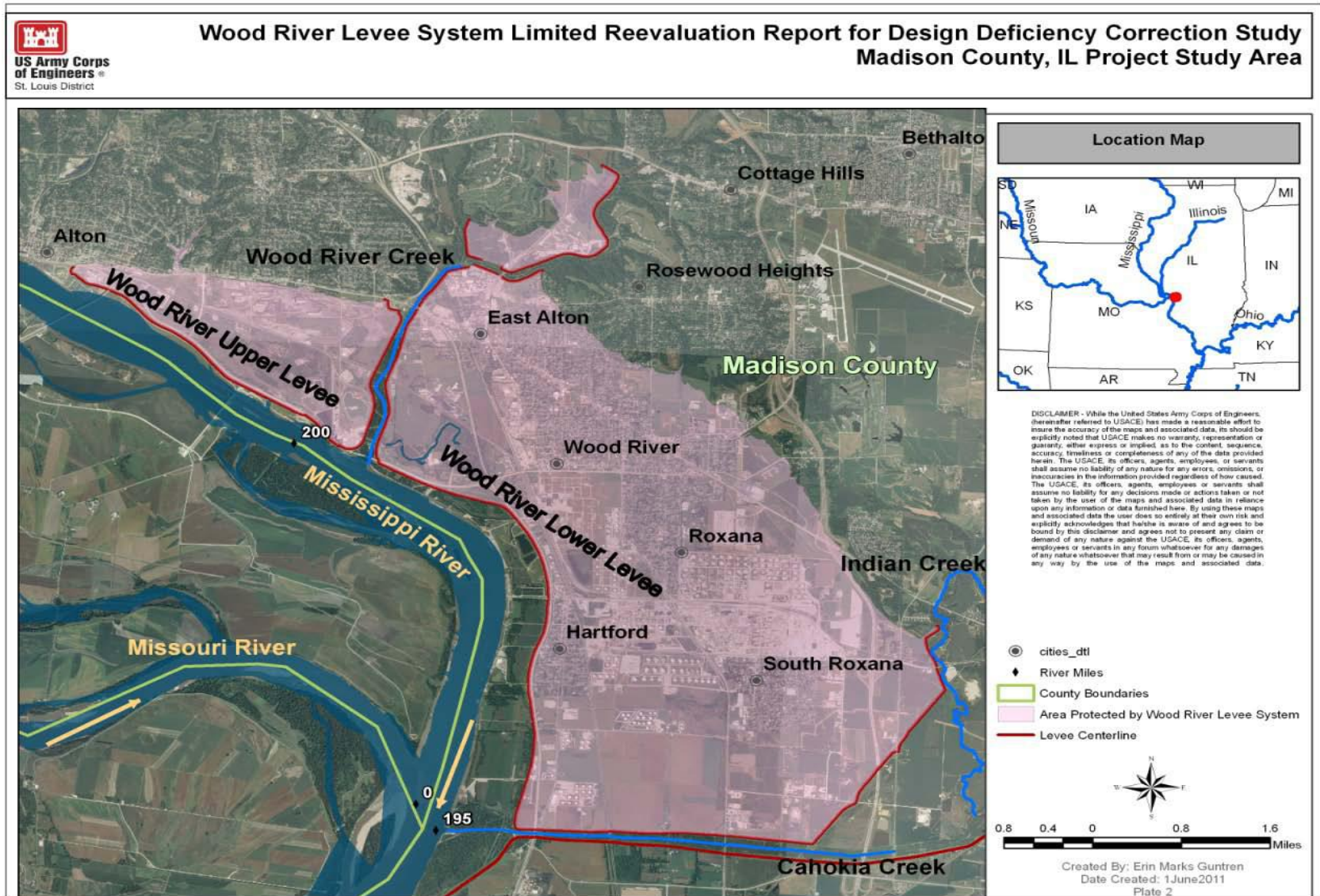


Figure 1. Map of Wood River Project Area

3 IEPR Process

3.1 Planning and Schedule

Noblis developed a schedule that would meet USACE’s goal of completing the task as efficiently as possible with a project duration considerably less than what USACE had set forth in the Scope of Work (SOW). Certain aspects of the task were initiated before the task award date at no expense to the USACE, and certain phases of the project were carried out concurrently to enhance the project efficiency. Figure 2 shows the overall process highlighting the major activities of the IEPR conducted of the LRR for Wood River.

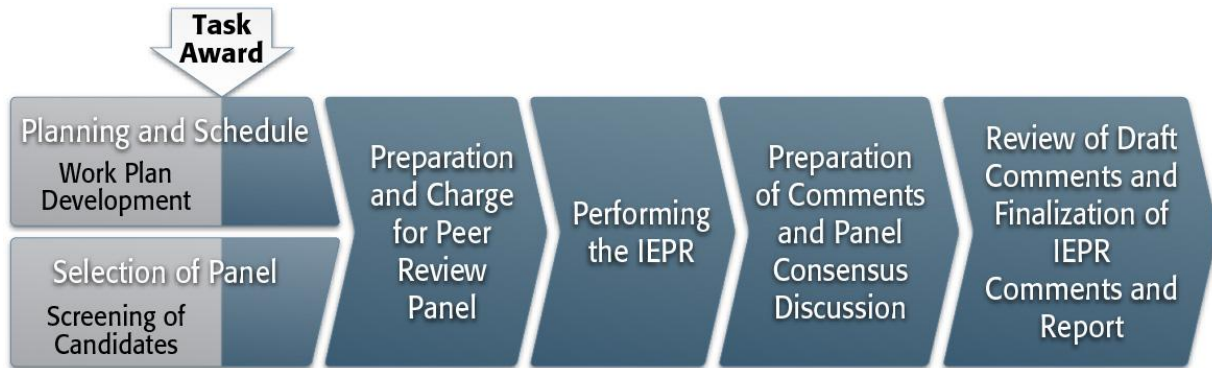


Figure 2. Wood River IEPR Process

Noblis prepared a Work Plan to define and manage the process for conducting the IEPR, including the screening and selection of peer reviewers, communication and meetings with the USACE project team, project schedule and quality control, and compilation and dissemination of peer reviewers’ comments. Upon review of the Draft Work Plan by USACE, the overall schedule was discussed considering the USACE’s aggressive deadline, which established a project completion date of 24 August 2011. The schedule was updated and submitted in the Final Work Plan. A summary table showing the final schedule is presented in Table 1.

Noblis provided USACE with Project Status Reports on a weekly basis to communicate the current status of the project. The Project Status Reports included details of each task and noted any schedule changes. Noblis performed the requirements of this contract in accordance with its Quality Management System, which is compliant with ISO 9000.

Table 1. Wood River IEPR Project Schedule

Activity and Output	Completion Date
Planning and Schedule (<i>Task Award Date: 19 July 2011</i>) Output: Final Work Plan	25 July 2011
Selection of Panel Output: Final Panel Members	25 July 2011
Preparation and Charge for Peer Review Panel Output: Final Charge	4 August 2011

Activity and Output	Completion Date
Performing the IEPR Output: Panel Member Comments	12 August 2011
Preparation of Comments and Panel Consensus Discussion Output: Draft IEPR Panel Comments	17 August 2011
Review of Draft Comments and Finalization of IEPR Comments and Report Output: Final IEPR Comments (including responses and concluding “backcheck” comments) and Final IEPR Report	24 August 2011
Total Time to Completion	27 working days

3.2 Selection of Panel

Reaching out to its various pools of experts, Noblis identified experts who met and exceeded the technical expertise and requirements of this IEPR. Noblis provided potential candidates with a copy of the SOW, including the required expertise and project schedule, and conducted informal and formal discussions to identify any technical competency concerns or potential COI issues. Consistent with the guidelines of the OMB, the following were considered in the screening of the candidates:

- Expertise: Ensuring the selected reviewer has the knowledge, experience, and skills necessary to perform the review.
- Independence: The reviewer was not involved in producing the documents to be reviewed.
- COI: Any financial or other interest that conflicts with the service of an individual on the review panel because it could impair the individual’s objectivity or could create an unfair competitive advantage for a person or organization.
- Availability: Candidates’ availability to meet the project schedule.

After screening candidates to exclude those with inadequate expertise or potential COI issues in accordance with the requirements and guidelines of the National Academy of Sciences and OMB, several candidates were selected for further screening and evaluation to ensure they met or exceeded the requirements of this task. Noblis provided the list of candidates along with their detailed résumés to USACE to identify any outliers who may have a potential COI based on USACE knowledge of the individual’s past involvement with the Wood River project. Also, USACE acknowledged the proposed panel members’ experience relative to the requirements of the IEPR. The list was then narrowed down to identify the most qualified candidates that would be available to serve on the Wood River IEPR panel. A description of the panel is provided in Section 4.

3.3 Preparation and Charge for Peer Review Panel

USACE made available necessary project documents (listed in Appendix C) to Noblis, which were placed on Noblis’ secure online collaboration site set up for this effort in order to provide IEPR panel members with electronic copies of relevant documents to be reviewed. Noblis communicated via email and held a kickoff meeting outlining the steps of the IEPR process,

identifying the overall schedule and deadlines, and instructing the IEPR panel members how to access the documentation and undertake the review. Noblis requested all panel members review the LRR for which USACE had requested comments, as well as additional supporting documents as background material for their reference.

Subsequent to a cursory review of the documents by the panel but prior to the actual detailed IEPR, a meeting was held with USACE via teleconference to familiarize the IEPR panel members with the technical aspects of the project and the specific objectives of the review. As part of this meeting, USACE provided a detailed project briefing, reviewed project features and requirements, and provided the opportunity for the exchange of technical information between the panel and USACE technical staff. Noblis met with the panel members following the meeting with USACE to refine roles and responsibilities of the IEPR panel members, including providing them with general instructions and guidance for preparing their comments, to ensure proper coverage of all important issues and consistency in the development of the IEPR comments. From this point on, Noblis was the conduit for information exchange between the panel and USACE in order to ensure a truly independent IEPR.

The final Charge Questions developed and approved by USACE established the general boundaries for the IEPR and are summarized in Table 2. The detailed Charge is included in Appendix C.

Table 2. Wood River IEPR General Charge Questions

Wood River IEPR General Charge Questions
1. Were all models used in the analyses used in an appropriate manner?
2. Are the models used sufficiently discriminatory to support the conclusions drawn from them (i.e. identify meaningful differences between alternatives)?
3. Were risk and uncertainty sufficiently considered?
4. Are potential life safety issues accurately and adequately described under existing, future without project, and future with project conditions?
5. In your opinion, are there sufficient analyses upon which to base the recommendation?

3.4 Performing the IEPR

After the panel was oriented with the general scope and background information of the project, the panel initiated a detailed review of the LRR and supporting documentation. The Wood River IEPR involved conducting an independent technical peer review to analyze the adequacy and acceptability of environmental and engineering methods, models, data, and analyses presented in the LRR. The review was limited to a technical review and was not involved with policy issues. The IEPR panel identified, recommended, and commented on the information presented in the LRR relative to the charge.

Considering the compressed schedule for this task, Noblis conducted one meeting with the panel members midway through their review to discuss their progress and current observations/comments. This meeting ensured an exchange of technical information among the panel experts and reflected their diverse scientific backgrounds. This information exchange

provided additional context to the reviewers, ensured that the scope of the review remained responsive to the charge, and was crucial in the development of the comprehensive peer review report. Schedule details were also discussed, and panel members were made aware of upcoming activities and deadlines. Any identified information or documents that the panel required to support its review were noted. Noblis facilitated discussions between the panel and USACE in order for the group to agree on reasonable solutions to address the major technical issues raised during the course of the effort.

Noblis used internal tools to track comments, issues, and information requests by the panel members during the evaluation process. This enabled Noblis to request additional information and documentation from USACE that closed out some of the comments during the review process to the satisfaction of the panel.

3.5 Preparation of Comments and Panel Consensus Discussion

After the IEPR review period ended and comments were submitted, Noblis collated the panel comments and ensured they were complete and responsive to the charge. Noblis ensured the panel focused on performing a technical review of the documents and avoided commenting on policy-related issues. Noblis convened a group consensus meeting via teleconference with the panel members to discuss the panel's comments. This meeting provided a forum for reviewers to reach consensus on the comments and to resolve any contradictions. Further refinement and consolidation of the comments occurred via email exchange following the meeting. The panel discussion resulted in draft comments that were sent to USACE for discussion.

Noblis identified overall themes that were presented by multiple peer reviewers or repeated by one reviewer, comments that indicated conflicting peer review opinions, and other noteworthy comments. Each comment was formatted into four parts: (1) a clear statement of the concern ("Comment"), (2) the basis for the concern ("Basis for Comment"), (3) the significance of the concern (the importance of the concern with regard to project implementability) ("Significance"), and (4) the recommended actions necessary to resolve the concern to include a description of any additional research that would appreciably influence the conclusions ("Recommendation[s] for Resolution"). Comments were rated as "high," "medium," or "low" to indicate the general significance the comment has to the sufficiency of the LRR.

3.6 Review of Draft Comments and Finalization of IEPR Comments and Report

Noblis provided a draft of the consolidated IEPR panel comments to USACE and held a teleconference with USACE and the IEPR panel to review the draft comments. The teleconference provided the forum to assess the factual accuracy of the panel comments, seek any needed clarification, and discuss specific technical positions. Based on verbal discussions with USACE, some comments were adjusted once USACE provided clarification and additional information. Subsequent to this discussion with USACE, updates were made to the IEPR draft panel comments as necessary resulting in 20 final comments included in this report and submitted in a separate Comment Tracking Form. The final IEPR panel comments are presented in Appendix A.

Noblis used the Comment Tracking Form to track the final comments of the IEPR panel, the development of USACE responses to those comments, and the panel's concluding "backcheck" comments. All responses in the Form provided by USACE and panel are labeled as

“concurrence” or “non-concurrence” to indicate agreement or non-agreement, respectively, on whether the concerns identified by the panel needed to be addressed in the LRR. The formal record of the USACE’s responses to comments and panel’s backcheck comments are captured in the Comment Tracking Form.

After the USACE submitted the responses to the IEPR comments, Noblis met with the panel to discuss the responses and the approach for preparing the concluding backcheck comments, which were to provide concurrence or non-concurrence with the USACE responses on whether the identified concerns were adequately addressed. After Noblis input the panel backcheck comments to the USACE responses to comments, the issue was closed out. Once all issues were closed out, Noblis provided USACE with a Portable Document Format (PDF) printout of the project file.

Minor editorial changes were not included in the final set of comments unless they affected the technical understanding of the document. A listing of the editorial comments is included in Table A-2 of Appendix A.

4 Panel Organization

Noblis assembled a panel of experts to conduct the IEPR, responsible for reviewing and providing comments on the LRR for Design Deficiency Corrections for the Wood River Levee System. Noblis guided communications between the panel and USACE to complete the IEPR project.

4.1 Panel Description

Noblis selected four panel members providing expertise in the required areas of NEPA impact assessment, civil/geotechnical engineering, and economics. All panel members met and exceeded the minimum requirements for each of the specified areas of expertise. The panel represented a well-balanced mix of individuals from academia, large companies and small consulting firms, and individual consultants.

Figure 3 outlines the members of the IEPR Team. Table 3 presents the list of IEPR panel members and associated qualifications to participate in this IEPR. Panel member résumés are included in Appendix B.

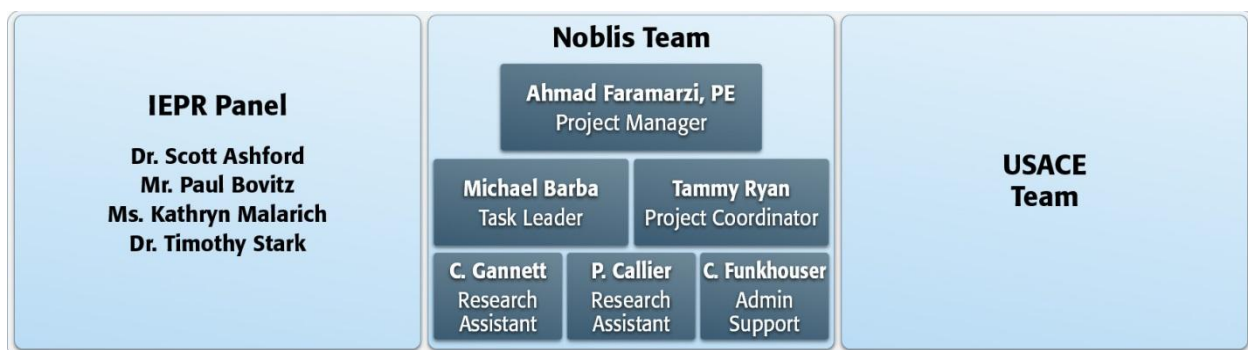


Figure 3. IEPR Team

4.2 IEPR Panel Members

Scott A Ashford, PhD, PE

Role: Civil/Geotechnical Engineer

Affiliation: Oregon State University

Dr. Scott A. Ashford has over 25 years' experience in geotechnical engineering. He spent seven years in private industry before earning his PhD from University of California (UC) Berkeley in 1994. He then served on the faculty at the Asian Institute of Technology in Bangkok, 1994–1996, and at UC San Diego, 1996–2007. He is currently Professor and Head of the School of Civil and Construction Engineering at Oregon State University. Dr. Ashford's research works to enhance public safety and reduce potential economic loss worldwide from earthquake and coastal hazards through cross-disciplinary research. His specialty is geotechnical earthquake engineering, in particular liquefaction, lateral spreading, seismic slope stability, and the performance of deep foundations.

Paul Bovitz, PWS, LSRP, CEM, LEED AP

Role: NEPA Impact Assessment

Affiliation: WESTON

Mr. Paul Bovitz has more than 20 years of technical experience in ecological assessment and natural resources management in public, private, and academic sectors, engaging in both theoretical and applied aspects of ecological research and encompassing a variety of geographic regions and habitats. He has managed and participated as principal investigator for Environmental Assessments (EAs) under NEPA; water quality and stormwater studies; wetlands delineation, assessment, mitigation, and permitting; and essential fish habitat investigation. His experience includes project management, field supervisory experience, expert testimony, proposal preparation, client negotiation, and budget management, as well as international experience in ecological assessment. He is a Leadership in Energy and Environmental Design (LEED) Accredited Professional and a Certified Professional Wetland Scientist. Mr. Bovitz has a Master's degree in ecology from Rutgers University.

Kathryn R. Malarich

Role: Economist

Affiliation: Gannett Fleming

Ms. Kathryn Malarich has served as lead economist on a wide variety of projects in her 22 years with Gannett Fleming. Her economics expertise and experience includes cost-benefit analysis, economic impact assessment, financial analysis, rate studies, and economic development planning. With a Master's degree in natural resources management from the University of Michigan, her experience specific to cost-benefit analysis includes projects with the Ohio Department of Transportation (Portsmouth Transportation Study), Natural Resources Conservation Service (Various Watershed Plans), Natural Resources Conservation Service, West Virginia (North Fork Hughes River Reservoir and Randolph County Reservoir studies), USACE Pennsylvania, (Lower Beaver River Sedimentation Study), the U.S. Environmental Protection Agency (Critical Review of Cost-Benefit Analysis Procedures for Coastal Projects in Light of Sea Level Rise), and the USACE Pittsburgh District (Evaluation of Social and Economic Effects of Unreliable Lock Service).

Timothy D. Stark, PhD, PE, D.GE

Role: Civil/Geotechnical Engineer

Affiliation: University of Illinois at Urbana-Champaign (UIUC)

Dr. Timothy Stark has been a licensed professional engineer for 17 years and in academia for close to 25 years. His experience has involved the design of flood control works including levee and underseepage control features. He has been involved (since 1988) in a variety of geoenvironmental projects including waste containment design, excavation and re-disposal of contaminated materials, and liner and cover system designs for contaminated soils. Dr. Stark has lived in Illinois for 21 years and is familiar with the Mississippi River Floodplain and geotechnical practices in the floodplain. He spent two summers working at Waterways Experiment Station in Vicksburg, Mississippi, working on dam- and levee-related projects. He has demonstrated experience in performing cost engineering/construction management for all phases of flood risk management-related projects and is familiar with geotechnical practices associated with floodwall design and construction. Dr. Stark received his PhD in geotechnical engineering from the Virginia Polytechnic Institute and State University.

Table 3. Wood River IEPR Panel

		Dr. Scott Ashford	Mr. Paul Bovitz	Ms. Kathryn Malarich	Dr. Timothy Stark
	Highest Degree	Ph.D	M.S.	M.S.	Ph.D
	Years of Experience	25	27	22	25
	Past Experience with COE Projects	•	•	•	•
	Affiliation (e.g., academia, consulting firm, government, etc)	Academia	Private	Private	Academia
Civil/Geotechnical Engineer	≥10 years experience in civil/geotechnical studies and design of flood control works including levee and underseepage control features, access to work sites, disposition of excavated contaminated soil material, and design and construction of relief wells and slurry walls.	•			•
	Registered Professional Engineer from academia, a public agency whose mission includes flood damage prevention, or an Architect–Engineer or consulting firm	•			•
	Familiar with geotechnical practices used in the Mississippi River Floodplain and have demonstrated experience related to levee design and construction.				•
	Experience with hazardous waste and aquifer protection	•			•
	Active participation in related professional engineering and scientific societies	•			•
NEPA Impact Assessment	≥10 years demonstrated experience in evaluation and conducting NEPA impact assessments, including cumulative effects analyses, for complex multi-objective public works projects with competing trade-offs		•		
	Scientist from academia, a public agency, a non-governmental entity, or an Architect–Engineer or Consulting Firm		•		
	Experience encompasses determining the scope and appropriate methodologies for impact assessment and analyses for a variety of projects and programs with high public and interagency interests and having project impacts to nearby sensitive habitats		•		
	Active participation in related professional societies		•		
Economist	≥ 10 years economics work experience including benefit cost analysis			•	

4.3 Noblis Team

The Noblis Project Management Team (as outlined in Figure 3) included the following members:

Mr. Ahmad Faramarzi, PE, Project Manager, supervised project personnel and communicated policies, procedures, and goals to these employees, and maintained regular contact with the USACE. Mr. Faramarzi was responsible for the overall project plan, project performance, and client satisfaction on project tasks.

Mr. Michael Barba, Task Leader, developed the Work Plan and Report and provided technical leadership in managing the IEPR activities.

Ms. Tammy Ryan, Project Coordinator, supported the Project Manager on all IEPR tasks, including the identification and recruitment of candidates for the expert panel. Ms. Ryan also supported Mr. Barba in coordinating Wood River IEPR activities.

Ms. M.R. “Peaches” Callier, Ms. Christina Gannett, and Mr. Hooman Rouhi served as Research Assistants and supported the IEPR activities on an as-needed basis.

Ms. Carolina Funkhouser provided Administrative Support for the project.

5 Conclusions and Observations

The Wood River IEPR resulted in several comments on the adequacy of the information presented in the LRR, as well as the information that was not found and recommended to be included. In general, the comments identify shortcomings and offer considerations that would improve the technical adequacy and overall quality of the LRR. The comments also include a number of issues that should be addressed so the LRR can be comprehensive in its representation of all factors that should be considered in determining the preferred alternative.

The general themes of the technical comments cover issues that are instrumental in being able to fully understand the technical information and rationale for the tentatively selected plan discussed in the LRR. There are a few comments regarding key design considerations in the tentatively selected plan that were not clearly identified in the LRR. Other comments pertain to the need for better organization and discussion of analysis that incorporates important considerations and justifies the selection of the preferred alternative. Many of the comments relate to the clarifications of environmental and engineering factors that were considered in the evaluation of alternatives and the tentatively selected plan. Some issues presented in the IEPR comments pertain to including more detailed discussion of specific geotechnical analyses, refining discussion to explain the necessary level of detail when identifying cost-benefit considerations, and performing a more thorough environmental assessment such that the project impacts can be adequately discussed. These issues primarily identify that the LRR did not include adequate discussion justifying why specific issues and information are not presented but should be in order to provide a more complete understanding of the project.

In general, the panel acknowledged that the LRR adequately identified the deficiencies in the underseepage designs and assembled viable alternatives for the design deficiency corrections. The LRR presented appropriate analyses, methods, and models used in evaluating each alternative and determining the tentatively selected plan. However, several assumptions underlying the methods and models were in question or not clearly identified or discussed in the LRR. The document lacked sufficient information in certain sections necessary to provide an adequate basis to fully assess impacts from the project. Additional analyses and assessments may

be required for the conclusions presented in the LRR to be accurately supported, as current components of the LRR appear to be premature. The panel raised several key cost and technical issues that note the deficiencies and inconsistencies in the extent of detailed analyses for each alternative. These analyses are essential for the LRR to completely represent all factors considered in the selection of the tentatively selected plan.

Economics. The LRR included appropriate analysis for evaluating the cost benefits associated with each alternative being considered. The methodology and approach incorporated into the cost-benefit analysis were adequate for properly performing the analysis. Issues were noted that pertain to specific impacts and benefits not identified or thoroughly discussed. Also, certain information pertaining to cost-benefit analysis was mentioned but then not used in the detailed analysis, and the LRR could be improved by deleting unnecessary and extraneous information. While lack of detailed analysis for these impacts and benefits may not affect the selection of the preferred alternative, the project analysis would be more complete if the LRR provided justification as to why specific impacts and benefits were not considered or evaluated in detail. The panel understands that further revisions to the LRR are anticipated that will present cost-benefit information appropriately.

Engineering. Since the LRR included detailed drawings and information for the preferred alternative, the panel focused on the design of the tentatively selected plan. The overall engineering principles and methods used in conducting a design analysis and developing the conceptual design were sound. The panel's comments primarily relate to the need for more discussion of important considerations and justification for implementing specific design conditions to create a better understanding of the engineering parameters presented. The panel also identified other analyses missing in the LRR that are essential to the project design and should be discussed. The panel recognizes that this is not the final design and that additional detailed analyses are anticipated that will address many of the identified concerns.

Environmental. The LRR identified the range of factors considered with potential environmental impacts. Particularly, it presented a sound process for monitoring and contingency planning for mitigation of wetlands impacts associated with the implementation of the tentatively selected plan. The panel acknowledged that the LRR recognizes the important consideration of involving different stakeholders including regulatory agencies and local communities as part of the planning process, particularly as the Hazardous Toxic Radioactive Waste (HTRW) contamination investigations move forward. The primary issues raised by the panel pertained to the LRR not having sufficient discussion that provides justification for how the tentatively selected plan was selected relative to the other potential alternatives. The Environmental Assessment did not provide an adequate discussion of specific impacts of the tentatively selected plan and detailed impacts analysis compared with other potential alternatives. The panel recognizes that more detailed information to support the assessment of environmental impacts, particularly more detailed analysis of the HTRW issue, will be collected and carried forward as appropriate.

A number of editorial comments were also provided. Although they should be addressed to improve the overall quality of the LRR, they are not included in the final list of IEPR comments submitted into the Comment Tracking Form. These editorial comments are provided in Appendix A.3 of the report.

6 References

- Agency Technical Review Comments and Responses. Provided by USACE St. Louis District. Department of the Army. 2010. USACE Engineer Circular (EC) No. 1165-2-209, *Civil Works Review Policy*. 31 January.
- Design Memorandum No. 16 Wood River Drainage and Levee District Alteration, March 1985.
- Limited Reevaluation Report, Wood River Levee System, Design Deficiency Corrections, Madison County, Illinois.
- Office of Management and Budget (OMB). 2004. *Final Information Quality Bulletin for Peer Review*, released 16 December.

Appendix A – IEPR Comments

A.1 Final IEPR Comments

This Appendix provides the Wood River IEPR comments on the LRR for Wood River, Illinois. The comments cover a range of issues that pertain to the technical aspects of the LRR. Each comment is formatted into four parts that include the following: (1) a clear statement of the concern (“Comment”), (2) the basis for the concern (“Basis for Comment”), (3) the significance of the concern (the importance of the concern with regard to project implementability) (“Significance”), and (4) the recommended actions necessary to resolve the concern to include a description of any additional research that would appreciably influence the conclusions (“Recommendation[s] for Resolution”). Comments were rated as “high,” “medium,” or “low” to indicate the general significance the comment has to the sufficiency of the LRR. The significance ratings are applied using the following criteria:

- High = Comment describes a fundamental problem with the project that could affect the recommendation or justification of the project
- Medium = Comment affects the completeness or understanding of the recommendation or justification of the project
- Low = Comment affects the technical quality of the reports but will not affect the recommendation or justification of the project

A.2 Summary of Comments

Following is a listing of the final comments submitted in the Comment Tracking Form.

Table A-1. Overview of Final Comments Identified by IEPR Panel

Significance – High	
1	There are several issues identified concerning the engineering analysis of the underseepage design.
2	There are several issues concerning the construction of the slurry trench cutoff walls that should be considered before proceeding with the design.
3	There are several issues concerning the overall design, particularly the slurry trench cutoff walls and relief wells.
4	There is no discussion of the seismic design/performance of the levees or proposed correction measures.
5	It is unclear whether the without-project condition should include the improvements planned for the levee system to meet Federal Emergency Management Agency (FEMA)-required 100-year (yr) flood protection levels, as planned for and described by the Southwest Illinois Flood Prevention District Council (SWILFPDC) in their Implementation Plan.
6	As presently written, the LRR does not effectively integrate the findings of the EA or Plan Formulation to provide a cogent explanation of how the tentatively selected plan was selected on the basis of effectiveness (safety, viability, reliability), costs, or environmental

	impacts.
7	The EA lacks sufficient detail and analysis of the environmental impacts of the tentatively selected plan, <i>relative to other potential project alternatives</i> , to allow clear and sufficient evaluation of project impacts.
Significance – Medium	
8	It is unclear what value was used in the analyses for the horizontal permeability of the pervious foundation.
9	The threat to future levee performance based on prior observations should be better explained.
10	It is unclear from the report what constitutes “failure” of the levee.
11	The net benefits are to a great degree dependent on the values used for the PUP, which are point estimates provided by District Engineers using professional judgment.
12	Section 7.0 Environmental Consequences provides a summary of impacts from the tentatively selected plan, as taken from the EA. Again, the summary of impacts does not demonstrate the preferred alternative’s impacts relative to the other alternatives, or how the effects will be mitigated.
13	The Draft EA concludes with an unsigned Finding of No Significant Impact (FONSI), which is not fully justified given missing information on potential Cultural Resources and HTRW impacts.
14	It is not clear from the report that all elevations cited in the report and used for design reference the same vertical datum (e.g., NAVD 88).
15	It is unclear how the 52-ft stage at the St. Louis Gage corresponds to the stages along the project site that have river elevations in the 400s.
16	The wetland mitigation plan presented in Appendix A-B requires additional detail in order to fully evaluate its effectiveness against the potential for future failure.
17	The Section 404(b)(1) analysis reads more like a description of the proposed project impacts to wetlands rather than a process by which wetlands impacts were avoided and minimized through careful consideration of alternatives.
18	With regard to the estimated berm quantities, it is not clear whether an allowance was made for site preparation (e.g., clearing and grubbing) beneath the scanned Light Detection And Ranging (LIDAR) surface.
19	There is some concern that the pump stations are designed for lower bound condition.
Significance – Low	
20	A number of benefit categories are omitted and not mentioned, while other benefit categories are mentioned and various speculative damage estimates are stated, but they are not included in the HEC-FDA model or the expected annual damage reduction benefits.

The following pages outline the IEPR comments in detail (as submitted in the Comment Tracking Form), including the four-part analysis for each. The comments are sorted based on their designated significance (High, Medium, or Low) in regards to the sufficiency of the LRR.

Comment #1:

There are several issues identified concerning the engineering analysis of the underseepage design.

Basis for Comment:

The LRR appears to use conservative assumptions in the underseepage analysis, which seems to result in the recommendation of significant seepage control measures, and does not clearly provide justification or references in the use of such specific design details. Some of the conservative assumptions include:

- A factor of safety of 1.6, even though it is common professional practice to use a lower factor of safety for temporary conditions, such as flood stage.
- A maximum allowable hydraulic gradient of 0.5 between adjacent relief wells, even though TM-3-424 calls for design gradients of 0.5–0.6 (from p. 23 of the LRR).
- The design water level of 54-foot (ft) elevation at the St. Louis Gage, rather than 52 ft as noted on p. 21 of the LRR.
- None of the existing relief wells are operational, including those installed in 1985. Page 15 of the LRR does not even note whether or not the 1985 wells are functioning.
- The new wells will operate at 80% efficiency, as noted on p. 27 of the LRR.

Without providing specific justification or basis for using such design parameters, the use of these assumptions is not fully understood and is in question. These conservative assumptions may be adding multiple “layers” of conservatism to the design and may be resulting in the need for extensive remedial measures. For example, it seems conservative to install a 140-ft-deep slurry wall to bedrock to control underseepage due to a short-term (less than 9 months) flood event. A full cutoff wall, i.e., cutoff wall to bedrock, has not been installed for some dams that impound a permanent reservoir, so a full cutoff for a levee should be explained. It is not clear what the precedence is for a levee with a full cutoff. In the LRR, a full cutoff is recommended for Decision Segment 151+50 to 185+50 over a length of 2,910 ft to a depth of 140 ft. In this same Decision Segment, 3,970 lineal ft of 100-ft-deep cutoff wall is recommended. In addition, a relief well spacing of as little as 83 ft is recommended.

Significance: HIGH

The LRR appears to use conservative assumptions in the underseepage analysis, and the justification for using such significant seepage control measures is not fully understood.

Recommendation(s) for Resolution:

The underseepage analysis should be revised to understand the effect of these assumptions on the design and should include the following:

- A. Parametric study to understand the sensitivity of the recommended control measures to the design criterion of a safety factor of 1.6, as well as a lower factor of safety for the temporary condition of a flood stage.
- B. Parametric study to understand the sensitivity of the recommended control measures to the design criterion of a maximum hydraulic gradient of 0.5 between relief wells.

- C. Parametric study to understand the sensitivity of the recommended control measures to the design criterion of assuming no effect of existing relief wells during the flood event due to reduced efficiency, as well as the 80% efficiency assumption for the new wells.
- D. Alternatively, specific reference to USACE policy should be cited in the LRR as justification for these key parameters.

Comment #2:

There are several issues concerning the construction of the slurry trench cutoff walls that should be considered before proceeding with the design.

Basis for Comment:

The LRR does not thoroughly discuss some of the potential problems with constructing deep cutoff walls via slurry trenches. These problems can impact the cost and performance of the completed cutoff wall. Some examples of the potential problems are listed below and the problems can lead to cost increases.

- Wall verticality varies with depth of wall with a well-constructed wall, showing a vertical deviation of at least 1%. Therefore, a well-constructed 140-ft-deep wall would have a deviation of at least 1.4 ft. Adjacent panels of the wall could also deviate 1%, so a gap could exist in the wall with depth due to verticality.
- Gaps or windows in the cutoff wall could also occur due to failure to remove some in-situ soil.
- Anchoring or sealing a cutoff wall into bedrock can be problematic because of difficulties excavating the rock or the rock being jointed, and a depth of embedment of about 5 ft—not 1 ft—is required.
- Developing a suitable self-hardening slurry mix can be problematic in achieving the desired long-term cutoff wall properties such as ductility so cracking does not occur during seismic events.
- Slope stability issues may occur while excavating at the levee toe to construct the cutoff wall.

Significance: HIGH

The LRR does not thoroughly discuss the potential problems and cost overruns usually associated with deep cutoff wall construction. These considerations may change the design in some reaches.

Recommendation(s) for Resolution:

The underseepage analysis should provide a more thorough discussion of the consideration of these construction issues and investigate possibly more cost effective alternatives to deep (≥ 100 ft) cutoff walls such as:

- A. Flood side blanket or buried geomembrane
- B. Protected side relief wells and/or seepage berms

Comment #3:
There are several issues concerning the overall design, particularly the slurry trench cutoff walls and relief wells.
Basis for Comment:
<p>Some examples of the potential design issues not thoroughly presented in the LRR are listed below:</p> <ul style="list-style-type: none">• The slurry mix for the cutoff walls must provide enough ductility so that the cutoff wall does not crack and allow greater seepage.• Generally, the top of slurry cutoff walls settle with time due to slurry bleed and/or consolidation. This settlement can result in a gap forming at the top of the wall that can act as a seepage path, which can reduce the effectiveness of the wall.• Recent data on the long-term performance of cutoff walls suggests decreased effectiveness with time due to high gradients developing at wall joints, cracks, transitions, windows/gaps, and soil and bedrock connections. Thus, the effectiveness of the walls may decrease with time. This is true with relief wells, too, but relief wells are less expensive and can be augmented more easily than cutoff walls.• Special attention should be given during design to interfaces between deficiency correction alternatives, as well as the levee section. On p. 29 of the LRR, overlap areas are noted in the design of the slurry cutoff walls that are adjacent to other correction measures. This is a good approach.• Pages D-10 and D-11 note observations of seepage occurring through the embankments on the Upper Wood River (e.g., 22+50 to 30+50) observed in the prior 1993 flood. It is not clear how the design deficiency correction measures proposed would affect seepage through the embankments. Discussion of whether the levees need to be retrofitted is not apparent.
Significance: HIGH
The LRR does not thoroughly discuss these design issues, which are critical considerations in implementing the project.
Recommendation(s) for Resolution:
<ul style="list-style-type: none">A. The underseepage and cost-benefit analyses should consider the design issues discussed above for cutoff walls and relief wells.B. In the design phase, procedures should be implemented to ensure that levee/deficiency correction alternative interfaces are appropriately detailed.C. The LRR should clearly indicate why seepage through the levee is acceptable, or provide alternative correction measures that would be effective for this case.

Comment #4:
There is no discussion of the seismic design/performance of the levees or proposed correction measures.
Basis for Comment:
The LRR subject area is located in a region that will likely be affected by local faults and/or the New Madrid Fault system, yet there is no mention of this seismic risk in the LRR. After construction, the cutoff walls and relief wells will be subjected to seismic forces. The resulting seismic deformations can cause cracks in the completed walls and/or bending of the relief well casing, which can impact the performance of these seepage control measures. It is anticipated that the seepage berms will be less impacted by seismic forces. Seismic deformation analyses should be performed to assess the performance of the seepage control structures during the design seismic event.
Significance: HIGH
The LRR does not discuss seismic design/performance of the levees essential to understanding the key design details.
Recommendation(s) for Resolution:
The anticipated seismic performance of the levee and mitigation measures should be included in the LRR. If deficiencies are noted in the analysis resulting from strong shaking or liquefaction, then they should be addressed.

Comment #5:

It is unclear whether the without-project condition should include the improvements planned for the levee system to meet Federal Emergency Management Agency (FEMA)-required 100-year (yr) flood protection levels, as planned for and described by the Southwest Illinois Flood Prevention District Council (SWILFPCD) in their Implementation Plan.

Basis for Comment:

The SWILFPCD has commissioned engineering studies and has recently (July 2011) released a Project Implementation Plan that outlines the basic components of the design, cost estimate, schedule, and financial plan for the project to improve the region's flood protection system. <http://www.floodpreventiondistrict.org/wp-content/uploads/2011/07/Project-Implementation-Plan-report-ver.-1.7.pdf>

The stated goal of the project design *“is to achieve improvements to the flood protection system that, once constructed, will fully address the requirements of 44 CFR 65.10, the criteria that determine the eligibility for FEMA to accredit the system and designate the American Bottom as protected from flooding”* (p. 9). Appendix L to the LRR contains a letter from SWILFPCD regarding the design deficiency correction in which the SWILFPCD states that they anticipate that *“some of the features of the design deficiency correction project may help achieve FEMA accreditation and that some or all of the features of the FPDC and WRLD project to achieve FEMA accreditation will contribute to addressing the design deficiency.”* However, the interaction and degree of overlap of these projects does not seem to be clarified in any of the LRR documents or elsewhere.

Significance: HIGH

Proper specification of the alternatives is critical to the cost-benefit analysis and other project impacts analysis.

Recommendation(s) for Resolution:

Clarify the relationship of the Wood River Levee System portions of the SWILFPCD Plan to the Plan evaluated in the LRR. If the design deficiency correction measures are in addition to those planned by the SWILFPCD, then the without-project condition appears to over-estimate the Probability of Unsatisfactory Performance (PUP) of the without-project condition and the associated flood damage reduction benefits.

If the improvements evaluated in the LRR include the measures planned by the SWILFPCD, then the without-project conditions applied in the LRR (i.e., no levee improvements) and estimated flood reduction benefits are appropriate. If this is the case, then the LRR Cost-Benefit Analysis should evaluate three alternatives: the No Action, the SWILFPCD plan, and the USACE design deficiency correction plan, because in this case the operative federal decision is whether to undertake a project to provide the incremental protection from 100-yr to >500-yr flooding, and a cost-benefit analysis should be available to support this decision.

Besides clarifying and possibly revising the alternatives in the main LRR report and the Economic Appendix, statements in the EA (specifically in Section 1.4, p. A-A-9 and Section 4.1, p. A-A-33) should be verified or revised to be consistent with the clarified determination of what constitutes the various alternatives.

Comment #6:

As presently written, the LRR does not effectively integrate the findings of the EA or Plan Formulation to provide a cogent explanation of how the tentatively selected plan was selected on the basis of effectiveness (safety, viability, reliability), costs, or environmental impacts.

Basis for Comment:

As a standalone public document, the LRR should clearly show why the tentatively selected plan best addresses the issues of effectiveness, cost, and environmental impacts to produce a project that best meets the public interest. The majority of the discussion of environmental consequences of the plan is in relation to the No-Action alternative, but there is little written discussion of how the tentatively selected plan (preferred alternative) was selected to begin with. Such discussion is critical to evaluating the extent to which the proposed alternative impacts the environment relative to other potential alternatives that were not carried forward. Table 5.6.1 provides a summary matrix of the plan formulation process and the justification of the selected alternative by reach, but there is no discussion of environmental impacts, and the table is more of a summary of the tentative plan than alternatives.

Significance: HIGH

The LRR does not adequately discuss the process and evidence for how the tentatively selected plan was selected providing justification for the selection over the other potential alternatives.

Recommendation(s) for Resolution:

- A. Information provided in Appendix B, Plan Formulation should be described and distilled to explain how the tentative proposed plan was developed.
- B. The EA in Appendix A should be revised to reflect this discussion as well, from the perspective of environmental impacts.
- C. Section 5.5.4 should be greatly expanded to include a discussion of the various alternatives considered and their environmental effects. Each alternative considered does not need a full environmental analysis, but rather an initial discussion of how the alternatives were winnowed down on the basis of cost and effectiveness, followed by a discussion of environmental impacts of the major alternatives considered.
- D. Then the section on Environmental Consequences in the LRR should be revised to summarize the results of both, to allow the reader a transparent understanding of the process.

Comment #7:

The EA lacks sufficient detail and analysis of the environmental impacts of the tentatively selected plan, *relative to other potential project alternatives*, to allow clear and sufficient evaluation of project impacts.

Basis for Comment:

The discussion of impacts in the EA is generic and does not allow the reader to come away with a clear understanding of impacts within each reach as a result of the proposed alternative, or impacts relative to the other potential design alternatives that could be employed to minimize them. Specific examples are listed below.

- A. Project Purpose and Need statement does not seem totally accurate and lacks sufficient detail to document the need for the project. While the need for the project is described adequately, albeit indirectly, elsewhere in the EA and LRR, it should be pulled forward into the EA into the Project Purpose and Need statement concisely to allow evaluation of the preferred alternative against others considered, including the No-Action alternative. The project purpose given in the EA is “*The purpose of this study is to evaluate design deficiency correction alternatives and choose a tentatively selected plan that will allow the Wood River Levee System to function as initially intended by the designer in a safe, viable and reliable manner.*” That purpose statement seems to address the purpose of the study and not the project itself. The purpose of the project itself would be “To correct deficiencies in the design of underseepage and through seepage controls necessary to return the Wood River Levee System to its original design condition.” Also, the project need is dictated by the need to ensure that not only does the system operate safely and effectively, but to prevent residents and communities from experiencing the fiscal impacts from increased insurance rates associated with being in the 100-yr floodplain. This is important, since it provides the basis for which alternatives need to be considered versus others that do not, and establishes the point that the No-Action alternative is not viable.
- B. The character and scope of the study area have not been adequately described sufficient to undertake a systems/watershed/ecosystem-based investigation, or to allow sufficient evaluation of impacts. In general, there are insufficient graphics in the EA to allow the reader to evaluate the text discussion on existing conditions or project impacts. Examples are: wetlands impacts relative to different design alternatives, location of potential hazardous, toxic, and radioactive waste (HTRW) impacts, location of cultural resources, bald eagles nests, etc. within the project area. As a result, while the text discussion regarding the extent of environmental impacts sounds reasonable, there is no way to confirm the impacts of the proposed alternative relative to No-Action conditions or other potential alternatives. Specifically:
 - i. Section 3.2 would benefit from having a graphic that shows geologic cross-sections of the area as a basis for understanding the need for the proposed plan (e.g., cutoff walls not feasible in some areas).
 - ii. Section 3.5 states that “*in the vicinity of the East Alton community water supply, there is a plume of groundwater contamination coming from two sites that consist of leaking underground storage tanks, and the contaminants include various*

- volatile organic compounds (IEPA, 2010b)."* A graphic would be helpful showing the location of this plume relative to any project activities. If it will not be impacted, then the impacts section should state so clearly.
- iii. Section 3.9 discusses prime farmland; a graphic of Natural Resources Conservation Service soil types would be helpful in interpreting the text.
 - iv. Section 3.14 states "*Within the proposed project construction footprint, six archaeological sites have been previously recorded: 11MS67 (further testing required), 11MS108 (ineligible), 11MS178 (further testing required), 11MS1584 (ineligible), 11MS1600 (further testing required), and 11MS2025 (eligible). As noted for each site, two have been determined to be ineligible for nomination to the National Register of Historic Places (NRHP), therefore the project will have no adverse impact on these sites. Of the remaining four, additional research will be required for three sites in order to assess the potential effects of this undertaking upon the sites, while one site has been determined to be eligible.*" Again, a graphic would be helpful to show where these sites are in relation to the proposed alternative and to evaluate whether there are any alternatives that could avoid these sites.
 - v. Section 4.7 would benefit from a simple graphic showing how the proposed relief wells, cutoff wall, and seepage walls will act to intercept groundwater flow and lower water levels while relieving hydrostatic pressure on the levees. Perhaps the graphics in Appendix D and E could be brought forward into the EA or LRR to explain. A cross-sectional view, similar to a site conceptual model used in remedial investigation reports, would be helpful in understanding the proposed project.
- C. A description of the screening process used to develop the tentatively selected plan should be provided along with those alternatives considered. Table A-A-1 summarizes the alternative selected, but there is no discussion of the environmental consequences of other alternatives considered and rejected. The text of the EA should also describe the reaches that do not have more than one feasible alternative.
- D. Section 3.3 Air Quality mentions a Conformity Determination that was conducted; this should be appended to the EA.
- E. Section 4.1 compares project impacts from a 500-yr flood event. The EA should be revised to be consistent with the Project Purpose of restoring the levees to be protective of the 100-yr flood, unless it will be designed to withstand the 500-yr flood. In the latter case, the Project Purpose statement should be revised as well. This same comment applies to other sections of the EA where impacts from the 500-yr flood are discussed.
- F. Section 4.1 also mentions but does not attempt to quantify job creation. At a minimum, some discussion should be added to the EA to indicate whether the jobs created would be temporary construction jobs or permanent ones, along with an estimate of the number created, with justification for the estimate.
- G. Section 4.7 Hydrologic Conditions begins by stating "*No significant climatological changes are expected to occur over the next 50 years.*" This statement is unsubstantiated.

- H. Section 4.8 should indicate how temporary noise impacts to residents would be mitigated (e.g., by limiting construction activity to daytime hours).
- I. Section 4.10 discusses impacts to biological resources, and describes Habitat Suitability Indices (HSIs) for various wildlife species potentially affected by the project. It is difficult to ascertain whether the species chosen are appropriate indicators without a better description of the natural communities present and their extent within the study area. For example, Section 3.10 states “*Groundcover is related to site wetness, and may not be present at all, may be discontinuous and consists of various sedges, forbs, and grasses, or may be dense and support a diversity of herbaceous plant species.*” The description does not provide dominant species, or the specific vegetation community present. Wildlife habitats affected by the proposed action are described as “*2.6 acres of emergent wetlands, 0.3 acres of forested wetlands, and 2.1 acres of bottomland hardwood forest (nonwetland floodplain forest).*” Without sufficiently detailed description, it is difficult to confirm or corroborate the conclusion of the EA that habitats impacted would be of low quality. For example, if the emergent wetland is dominated by common reed (*Phragmites australis*), a common invasive species, the conclusion can be easily corroborated. This is important, not simply as a basis of documenting potential impacts to existing conditions, but in determining and evaluating mitigation requirements for the project.
- J. Related to the sub-comment #9 above, the individuals who conducted the HSI analyses should be identified. Appendix A-B and A-D refer to representatives of an interagency team, but this is not mentioned in the EA.
- K. The following discussion presented in the EA should be expanded to summarize alternatives and impacts evaluated at each individual reach, and used as a basis for the Section 404(b)(1) analysis: “*Mitigation for unavoidable adverse impacts to wetlands and bottomland hardwoods is part of the tentatively selected plan. Avoidance of impacts to wetlands and bottomland hardwoods was considered during the development of the proposed action. For example, at design reach 5 (151+50 – 185+50), the seepage berm option considered there would directly impact about 70 acres of various wetland habitats. Instead the proposed cutoff wall would avoid these direct impacts. Avoidance or minimization of impacts is possible at design reaches 4, 5, and 12 (see Table A-A-12). Where relief wells are proposed within small areas of bottomland hardwoods, individual wells can be sited in the future during the plans and specifications stage to minimize any required tree clearing. Similarly, the construction easement for the cutoff wall proposed at design reach 5 (151+50 – 185+50) can be narrowed in width to avoid the loss of about 0.2 acre of forested wetland. Table A-A-12 reflects future efforts at design reaches 4, 5, and 12 to avoid and minimize habitat losses. At design reach 14, habitat losses are unavoidable because the proposed seepage berm (or fill) was the only feasible solution to solve the underseepage problem at this location. At design reaches 13 and 15, relief wells would avoid about 1.5 acres of impacts to low-quality bottomland hardwoods (Table A-A-12), but this option was not the least cost alternative at these locations.*”
- L. Currently the Draft EA proposes no mitigation for reduced hydrology within the extensive wetland within Design Reach 5, associated with implementation of measures to reduce or eliminate underseepage from the levees. The EA states: “*As a result of less wet*

conditions in the ponding area, shifts in the abundance and spatial extent of several wetland plant communities are expected. The currently extensive mud flats are expected to diminish in area and be replaced shallow marshes and wet meadows.”

- M. The project planning period encompassed by the EA should be established early in the document as the basis for Future No-Action conditions. The mitigation calculations are based on a 50-yr project life, and the cumulative impacts section states that the project is based on a 50-yr planning horizon.

Significance: HIGH

The EA lacks sufficient information to adequately assess environmental impacts.

Recommendation(s) for Resolution:

- A. Revise Project Purpose and Need statement to address the purpose of the project itself and also the need to ensure that not only does the system operate safely and effectively, but to prevent residents and communities from experiencing the fiscal impacts.
- B. Include graphics to provide a better visual understanding of existing conditions or project impacts.
- C. Provide a description of the screening process used to develop the tentatively selected plan and that describes the reaches that do not have more than one feasible alternative.
- D. Append the Conformity Determination to the EA.
- E. Revise the EA to be consistent with the Project Purpose of the design life (i.e., 100-yr flood vs. 500-yr flood).
- F. Include discussion to indicate whether the jobs created would be temporary construction jobs or permanent ones along with an estimate of the number created.
- G. Provide justification for the claim that no climatological changes are expected or eliminate the statement from the EA.
- H. Indicate how temporary noise impacts to residents would be mitigated.
- I. Provide sufficient description to ascertain whether the species chosen are appropriate indicators of the dominant species or the specific vegetation community present.
- J. Identify the individuals who conducted the HSI analyses.
- K. Summarize alternatives and impacts evaluated at each individual reach and used as a basis for the Section 404(b)(1) analysis.
- L. Consider whether the anticipated habitat conversion would result in significant biological impacts to species such as migratory shorebirds. Given the importance of this habitat within the region, consider mitigation measures including reestablishment of some of the mudflats eliminated.
- M. Establish the project planning period encompassed by the EA early in the document as the basis for Future No-Action conditions.

Comment #8:
It is unclear what value was used in the analyses for the horizontal permeability of the pervious foundation.
Basis for Comment:
On p. D-15, the procedure for analyzing the underseepage is presented, but the reference to indicate how the “k-value” was determined (e.g., assumed or via lab testing) is not clear. Under the soil laboratory testing carried out, no indication of hydraulic conductivity testing was mentioned. Page D-16 indicates that commercially available sands will be used, but it appears that the properties are assumed.
Significance: MEDIUM
Understanding the use of any appropriate k-value is critical for performing adequate underseepage analysis.
Recommendation(s) for Resolution:
Add the procedure for determining k in the report. Once a borrow source is identified, confirmation should be made that it meets the design requirements.

Comment #9:

The threat to future levee performance based on prior observations should be better explained.

Basis for Comment:

Page 24 of the LRR describes some of the observations during prior flood events that resulted in this design deficiency report. The LRR does not elaborate on what specific deficiencies were noted that led to the particular recommended correction measures. Some examples of the prior observations and suggestions for clarifying the observations are listed below:

- *“In some reaches along the Alton to Gale system, when the gathered piezometric data is extrapolated to design flood levels, a level of system performance is predicted to be well below acceptable limits.”* What was “well below acceptable limits”? Gradient? Seepage quantity? Did any levee fail? How much will the design event exceed this event?
- *“Observations made during the 1973, 1993 and 2008 flood fights show development of high uplift gradients, sand boils, and heavy seepage along reaches with no in-place seepage control measures as well as reaches that do contain seepage control measures.”* From a geotechnical point of view, high uplift gradients are not in themselves problematic unless the factor of safety against uplift is below the design criterion and a critical structure will become unstable. If this is the case, the LRR should give specifics of this deficiency.
- From a geotechnical point of view, the presence of sand boils is not problematic but they can be if there is sufficient flow to erode a significant amount of foundation material from under the levee. If this is the case, the LRR should state sand boils and high flow were observed. If the sand boil occurs with low flow, a substantial amount of soil will not be eroded in the short duration of the flood and the sand boil can be remediated during and after the flood.
- From a geotechnical point of view, the “heavy seepage” is not problematic unless the seepage contains soil particles that are being eroded from the levee or underlying foundation. If this is the case, the LRR should state heavy seepage and accompanying erosion was observed.
- *“It has been concluded that this unsatisfactory performance stems from the unconservative assumptions made in TM 3-430 and limited observations of levee underseepage performance made at that time.”* A number of USACE Districts are using a lower maximum hydraulic gradient between adjacent relief wells than the St. Louis District. As a result, the St. Louis District should clarify why it is using a higher maximum hydraulic gradient and the initial design assumptions are unconservative. Have there been any levee failures with the TM 3-430 criteria?

Significance: MEDIUM

The LRR should better explain why prior observations do not meet design criteria to provide a better understanding of the project.

Recommendation(s) for Resolution:

Revise the LRR and/or analyses to properly utilize prior observation during flood events.

Comment #10:
It is unclear from the report what constitutes “failure” of the levee.
Basis for Comment:
On p. 17 of the LRR, the discussion includes terms such as “failure as a result of underseepage,” “catastrophe failure,” and “actual levee failure.” It appears that these terms are used loosely and it is unclear the specific concerns of USACE. Later in the report, the first paragraph under Section 5.3.1 is useful, but in the second sentence it is unclear whether both types of seepage are considered “underseepage” and whether both are problems. It should be clarified if underseepage alone can be a failure or if the slopes of the levee need to fail.
Significance: MEDIUM
Use of the term “failure” is unclear and is necessary to understand proper design conditions.
Recommendation(s) for Resolution:
A short paragraph should be included in the LRR that defines the range of failures USACE is concerned about, and then consistently use those definitions through the report.

Comment #11:
The net benefits are to a great degree dependent on the values used for the PUP, which are point estimates provided by District Engineers using professional judgment.
Basis for Comment:
<p>The Hydrologic Engineering Center Flood Damage Reduction Analysis (HEC-FDA) model is a risk-analysis-based approach to estimating the expected annual flood reduction benefits of alternatives, recognizing flood risk as well as uncertainty in the measurement and specification of various values. However, the current version of the model treats the PUP's deterministically; there is no uncertainty band (e.g., standard deviation) provided for these probabilities. The concern is that differences in the values for the PUP, which are estimated using engineering judgment, can possibly result in substantial differences in the expected annual flood reduction benefits.</p> <p>The uncertainty behind these PUP values is a general concern. Some specific aspects to this concern with the selection of PUP values include: (1) have seismic risks and their implications for levee performance been considered? (2) are the without-project PUP's based on the design basis assumption of zero performance from the existing relief wells?</p>
Significance: MEDIUM
The expected annual net benefit is dependent on the selected values for the PUP.
Recommendation(s) for Resolution:
Conduct an analysis of the sensitivity of the expected annual flood reduction benefits to variations in the PUP's within a reasonable range. Clarify the assumptions that were made regarding seismic risk and regarding the performance of existing relief wells in developing the PUPs for the without-project condition.

Comment #12:
Section 7.0 Environmental Consequences provides a summary of impacts from the tentatively selected plan, as taken from the EA. Again, the summary of impacts does not demonstrate the preferred alternative's impacts relative to the other alternatives, or how the effects will be mitigated.
Basis for Comment:
As a standalone document the LRR should integrate the results of the studies and analyses upon which the plan is based, rather than incorporating them largely by reference to Appendices A (including A-D), H, and K, and so that the reviewing agencies and public can ascertain compliance with NEPA, USACE ERs, and follow the decision-making logic behind the selected plan.
Significance: MEDIUM
The LRR does not effectively integrate and organize information that supports the assessment of impacts.
Recommendation(s) for Resolution:
Section 7 should be revised to reflect the issues identified above and in Comment #6 so that the reader can ascertain the project impacts relative to other alternatives considered.

Comment #13:
The Draft EA concludes with an unsigned Finding of No Significant Impact (FONSI), which is not fully justified given missing information on potential Cultural Resources and HTRW impacts.
Basis for Comment:
The EA discussion in Appendix A notes that a Phase II EA is required to further evaluate HTRW concerns and that further Cultural Resources investigation is required before a final design of the project can be developed. The EA recommends this additional study and is followed by an unsigned FONSI. However, usually an EA has one of two outcomes: either the review indicates there is little likelihood of significant impacts, in which case a FONSI may be issued, or there is a potential for a significant impact to be addressed by further information collection as part of an EIS. Another alternative is to collect more information before the EA is released. At any rate, the cultural resources impacts remain inconclusive.
Significance: MEDIUM
A FONSI is not supported given that the LRR presents potential environmental concerns.
Recommendation(s) for Resolution:
Delete the FONSI until such time as the necessary studies have been completed.

Comment #14:
It is not clear from the report that all elevations cited in the report and used for design reference the same vertical datum (e.g., NAVD 88).
Basis for Comment:
On p. D-5, the LRR indicates that the boring locations were surveyed using the NAD 83 horizontal datum, and on p. D-6, the LRR notes that NGS survey control was used. However, the vertical datum is not mentioned. The datum for the hydrosurveys was also not indicated. With data from a variety of sources and spanning several decades, it is critical that all elevations use the same vertical datum.
Significance: MEDIUM
Ensuring all elevations use the same datum is critical for the design.
Recommendation(s) for Resolution:
All elevations noted in the LRR should have the datum used noted. If different data are used, then the elevations must be corrected.

Comment #15:
It is unclear how the 52-ft stage at the St. Louis Gage corresponds to the stages along the project site that have river elevations in the 400s.
Basis for Comment:
Pages 18 and 19 discuss the PUP at various stages, as noted on Charts 2 and 3.
Significance: MEDIUM
An explanation of how the 52-ft stage correlates to stages at various project locations is important to adequately understand the project design.
Recommendation(s) for Resolution:
Clearly indicate in the LRR the correlation between the St. Louis Gage and the stages at the project locations.

Comment #16:

The wetland mitigation plan presented in Appendix A-B requires additional detail in order to fully evaluate its effectiveness against the potential for future failure.

Basis for Comment:

The plan provides solid documentation for the derivation of mitigation credits, as well as a credible process for monitoring and contingency planning. However, the mitigation credits derived provide no allowance for future failure. In short, 5.6 acres of wetlands are proposed for mitigation to offset approximately 5 acres of impacts. The appropriateness of this recommendation cannot be verified without better information on the plant species composition of existing vegetation communities. Table A-B-3 gives detailed information on the representative herbaceous species at the mitigation site, but there is little information on the wetlands impacted. From review of the EA (Appendix A-D, p. AD-5) it appears that the wetlands themselves were not delineated, but that impacts were ascertained from reviewing remote sensing data. If that is the case, there is additional uncertainty regarding the existing resource to be mitigated.

Based on the panel's experience, other USACE districts require 2:1 acreage for mitigation to ensure against the likelihood of failure and as acknowledgement that human engineered systems do not completely match the functions provided by natural ones.

Tables A-B-4 and A-B-5 appear generic and numbers provided do not provide for any cost escalation over the 10-yr monitoring period. The \$1000 annual planting costs appears assumed and not estimated based on number of plants or a given percent mortality. The same is true for invasive species management and related costs.

Significance: MEDIUM

The wetland mitigation plan does not provide a clear understanding of whether potential impacts are effectively addressed.

Recommendation(s) for Resolution:

The District should revisit the likelihood of success of the proposed mitigation site and allow for a margin of error in the calculations to address uncertainties inherent in offsetting impacts. The mitigation plan should be revised to address the comments raised.

Comment #17:
The Section 404(b)(1) analysis reads more like a description of the proposed project impacts to wetlands rather than a process by which wetlands impacts were avoided and minimized through careful consideration of alternatives.
Basis for Comment:
Section 404(b)(1) guidelines, under § 230.5 General procedures to be followed, part C, state: <i>“Examine practicable alternatives to the proposed discharge, that is, not discharging into the waters of the U.S. or discharging into an alternative aquatic site with potentially less damaging consequences (§230.10(a)).”</i> This should be done for any reach for which wetland impacts are proposed, and should encompass alternative methods for addressing underseepage, alternative locations where possible (e.g., relief wells), and alternative construction methods, including any necessary access roads or other improvements required for implementing the project.
Significance: MEDIUM
Section 404(b)(1) does not appropriately discuss wetlands impacts minimization through the consideration of alternatives.
Recommendation(s) for Resolution:
The Section 404(b)(1) analysis should be revised to incorporate appropriate discussion that examines wetlands impacts minimization through consideration of alternatives as prescribed by the Section 404(b)(1) guidelines.

Comment #18:
With regard to the estimated berm quantities, it is not clear whether an allowance was made for site preparation (e.g., clearing and grubbing) beneath the scanned Light Detection And Ranging (LIDAR) surface.
Basis for Comment:
On the second page of Appendix E, the text indicates that the berm surface was superimposed on the LIDAR surface to calculate quantities. Depending on the condition of the existing ground surface (e.g., vegetation), it seems that this would result in a lower bound sand quantity estimate.
Significance: MEDIUM
Berm quantities and associated costs are not clearly understood.
Recommendation(s) for Resolution:
Modify LRR to either explain why this procedure is appropriate, or increase estimated sand quantities to account for site preparation.

Comment #19:
There is some concern that the pump stations are designed for lower bound condition.
Basis for Comment:
On the third page of Appendix E, the LRR indicates that the pump stations were sized to match the anticipated flows from the wells. If additional flows are observed (e.g., surface run-off, more efficient relief well performance), there is some concern that the pumps could not handle the total flow at peak periods.
Significance: MEDIUM
The discussion of the pump station design poses some concern with the current interpretation.
Recommendation(s) for Resolution:
Further discuss the size selection of the pumps to ensure that they are sized properly, or briefly explain why excess flow to the pumps would not have an adverse effect on levee performance.

Comment #20:

A number of benefit categories are omitted and not mentioned, while other benefit categories are mentioned and various speculative damage estimates are stated, but they are not included in the HEC-FDA model or the expected annual damage reduction benefits.

Basis for Comment:

The LRR and its appendices do not include estimates of flood damages to agriculture and to infrastructure (except the Mel Price Locks and Dam) and do not note the absence of these estimates. Their omission lowers the expected annual net benefits and cost-benefit ratio from what it would be if they were included.

For other damage categories, there are some catastrophic scenarios that are described in the LRR (in the EA and the Economics Appendix), sometimes with attempts made to quantify the damages that might result in the event of such a scenario. These damages are not in any way comparable to the expected annual damages output from the HEC-FDA model, as they are not subject to the entire uncertainty and flood and failure probability risk analysis. For example, Appendix J contains a discussion of the environmental cleanup benefits of the design deficiency correction. The discussion includes highly speculative cleanup cost estimates from other oil spill events that may or may not be applicable to the situation under study. These quoted damage values are never used in the analysis and a definitive statement regarding their applicability is not given. The Appendix also discusses the possibility of refineries being forced to close and hints at a serious military impairment from this closure, but does not estimate the actual lost fuel production nationwide (the potential extent of shifting production to other refineries is not explored) nor states its significance in the context of total military grade jet fuel production.

Significance: LOW

The omitted benefits that are not named in the LRR (agriculture and infrastructure damage reduction) would not be expected to have a large value in comparison to the benefits that are estimated. Also, the cost-benefit ratio is already over 1.1 (a threshold established in P&G, over which estimation of omitted benefits is not required).

As for the damages that are described but not included, their omission from the cost-benefit analysis is not significant in the sense that including these damages would only have increased the cost-benefit ratio. Although the statements regarding possible catastrophic scenarios may possibly be overly alarming, the conclusion of a positive net annual benefit would not be altered, and this result is the critical one in the decision-making calculus.

Recommendation(s) for Resolution:

The various types of damages that would be reduced but could not be estimated in the net benefits analysis should be enumerated, but the report should avoid vague and unsupported but alarming statements about possible damages and should avoid highly speculative estimates of possible damage. To avoid possible misinterpretation, any damage estimates that are given should come with the caveat that the damages are not expressed in comparable terms to the expected annual damages, and therefore cannot be simply added to the expected annual damages.

A.3 Editorial Comments on the LRR

Editorial comments are provided below as a reference for USACE. Some of the comments listed do have some significance to the technical understanding of the project; however, the actions necessary to address the comments only involve editorial changes.

Table A-2. Editorial Comments

No.	Comment	Notes
1	There are various typographical errors throughout the LRR.	<p>Page ii: Last paragraph, Line 8, should be “(\$16.2 Million).”</p> <p>Page ii: “Rehabilitation” missing from OMRR&R definition.</p> <p>Page 2: Plate 2 is not referred to, other plates missing.</p> <p>Page 15: Table headings are missing.</p> <p>Page 16 and others: Consider changing from “Charts” to “Tables” for clarity. There appears to be no difference.</p> <p>Page 16: Define “n/ a/”</p> <p>Appendix E: No page numbers given.</p>
2	The discussion of gradients is noted with and without “z.”	On pages 22 and 23, old reports are quoted and discussed in relation to acceptable design gradients. The term “z” is used loosely in the old materials, as well as in the report.
3	The \$838.02 listed under “Expected Annual Cost” in Table 7 of Appendix J for both alternatives is not identified.	This should be clarified in the table or possibly left out since it is netted out when computing Annualized Average Benefit.
4	The “Structure Inventory by Area” in Table 1 of Appendix J and a similar table A-A-7 in Appendix A would benefit from an additional column.	The column should give the total structure value (average value x number of buildings).
5	The text of Appendix J is not clear on the distinctions between “Probability of Failure” and “Probability of Unsatisfactory Performance.”	Statements on page J-10 suggest a difference in meaning, and then the footnote to Table 3 states the PUP is “a probability of failure at that return period/water surface elevation.”

No.	Comment	Notes
6	Page 18 of Appendix J states: “The Expected Value and Probabilistic Values of Net Benefits for all project Alternatives are presented in Table 8.” This is incorrect.	Table 8 shows costs. Actually, there is no such table as described in this statement. There are expected inundation reduction benefits in Table 6, but these are not all the estimated benefits. There is no table that shows the component benefits (inundation damage reduction and reduction in expected annual closure cost) together; but such a presentation would make a good addition to the Appendix.

Appendix B – IEPR Panel Members

Noblis selected four panel members to conduct an IEPR of the LRR for Design Deficiency Corrections for the Wood River Levee System, Illinois. Consistent with the requirements of the USACE SOW, the panel members provided expertise in three areas: NEPA impact assessment, civil/geotechnical engineering, and economics. All panel members met and exceeded the minimum requirements for each specified areas of expertise, as outlined in Table 3 of this IEPR Report. The panel represented a well-balanced mix of individuals from academia, large companies and small consulting firms, and individual consultants.

B.1 **Résumés of panel members**

The résumés of the panel members follow.

Scott A. Ashford, P.E., Ph.D.

Qualifications Summary

- 28 years of experience with a Ph.D. in geotechnical engineering.
- Geotechnical engineering working to enhance public safety and reduce potential economic loss worldwide from earthquake and coastal hazards through cross-disciplinary research in earthquake and coastal engineering, focusing on seismic site response, modeling of soil-foundation-structure interaction, liquefaction and lateral spreading, design of bridges and port facilities, sea cliff erosion, and slope stability.
- Dam safety experience through participation in dam safety expert panels, risk evaluation/mitigation studies or similar experience with hydraulic retaining structures.
- Several years of direct experience with hydraulic retaining structure rehabilitation projects as either designer or construction project engineer.
- Adroit with risk informed approach to dam risk decision making.
- Design or construction experience evaluating slope sufficiency under a seismic load using geological analysis provided.
- Education and design or construction management experience with embankment dams and foundations and underground concrete structures including necessary worksite earthwork preparation and workflow management.
- Familiar with USACE application of risk and uncertainty analysis in flood damage reduction studies.

Education

- Ph.D., Geotechnical Engineering, University of California at Berkeley, 1994
- M.S., Geotechnical Engineering, University of California at Berkeley, 1986
- B.S., Civil Engineering, Oregon State University, 1983

Certifications and Licenses

- Licensed Professional Engineer, State of California, (No. C41723, 1987)
- Licensed Professional Engineer, State of Oregon (applying for reciprocity)

Summary of Professional Experience

Ashford Engineering, Corvallis — *Co-Founder, CFO, Geotechnical Engineer*

Oregon State University, Corvallis — *Professor and Head*

University of California, San Diego — *Professor, Associate Professor, Assistant Professor*

Ashford Engineering Inc., Encinitas, Calif. — *CFO and Geotechnical Engineer*

Asian Institute of Technology, Bangkok, Thailand — *Assistant Professor*

University of California at Berkeley — *Graduate Student Researcher*

CH2M HILL, Emeryville, Calif. — *Project Engineer*

McClelland Engineers, Houston, Tex. — *Geotechnical Engineer*

- Technical Advisor, Seismic Hazards Evaluation for Kaeng Sua Ten Dam Project, Thailand, for Woodward-Clyde

Federal Services, Oakland, California

- Technical Advisor, Sri Lanka Landslide Hazard Mitigation Project, Colombo, for Asian Disaster Preparedness Center, Bangkok, Thailand
- Peer Reviewer, Preliminary Design of I5/I805 Improvement Project, for California Department of Transportation
- Peer Reviewer, Del Mar Bluff Geotechnical Study, for North County Transit District, Oceanside, Calif.
- Technical Advisory Panel Member, Seismic Design of Route 30 Improvement Project, San Bernardino Associated Governments
- Consultant, Port of Long Beach Expansion, Diaz-Yourman & Associates, Long Beach
- Consultant, West City Center School Project, Geotechnics, San Diego, Calif.
- Member, Expert Review Panel, Columbia River Crossing Project, Portland, Ore.
- “Amplification of Earthquake Ground Motions in Bangkok,” Royal Thai Government, 1995–1997.
- “Kobe Earthquake Reconnaissance,” Pathum Thani Concrete Company, 1995.
- “Solid Waste Management for Environmental Sustainability,” The Netherlands Government, 1996–1999, (Co-PI with C. Visvanathan).
- “Earthquake Induced Loss of Lifeline Facilities in Southeast Asia Risks, Socio-Economic Impacts, and Mitigation,” UC Pacific Rim Project, 1997–1998.
- “Effect of Pile Diameter on Modulus of Subgrade Reaction,” California Department of Transportation (Co-PI with M.J.N. Priestley and F. Seible), 1997–2001.
- “Shake Table Testing of Pile-supported Twin-Column Bents,” California Department of Transportation (Co-PI with M.J.N. Priestley and F. Seible), 1997–2001.
- “Pilot Liquefaction Study,” California Department of Transportation, 1998.
- “Supplemental Field Laboratory Development,” Alaska Department of Transportation and Public Resources, 1998.
- “Effect of Large Velocity Pulses on Bridge Columns,” Pacific Earthquake Engineering Research Center/National Science Foundation, 1998–1999.
- “Behavior of Laterally Loaded Deep Foundations in Liquefied Sand,” Federal Highways Administration Pooled Funds (Caltrans-Lead Agency, Missouri DOT, New York DOT, Oregon DOT, Utah DOT, and Washington State DOT) 1998–2001.
- Royal Thai Government for General Support of Research on Dynamic Response of Soft Bangkok Clay. 1998.
- Hayward Baker, Inc., General Support of the Treasure Island Liquefaction Test, 1999.
- “Performance of Bridge Components Subjected to a Large Velocity Pulse,” PEER/NSF, 1999–2001.
- “Substation Equipment Interaction – Rigid and Flexible Conductor Studies,” 1998–1999, (Co-PI with A. Filiatrault, A. Elgamal, and F. Seible).
- “Characterization of Ground Motions from Special Source Zones,” PEER/NSF, 1998, (Co-PI with A. Elgamal).
- “Ravenel Bridge Load Testing Program,” South Carolina DOT, 2000.
- “Powell Faculty Fellowship,” Powell Foundation, 2000–2002.
- “Mitigation of Coastal Bluff Instability in San Diego County,” California Sea Grant, 2001–2004.
- Royal Thai Government for General Support of Research on Dynamic Response of Soft Bangkok Clay, 2001.
- “Assessment/Completion of the NEES Experimental Infrastructure,” NSF, 2001, (Co-PI with F. Seible, A. Filiatrault, and A. Elgamal).
- “Performance of Lifelines Subjected to Lateral Spreading: Full-Scale Field Experiment,” California Energy Commission, Caltrans, and Pacific Gas & Electric through PEER Lifelines Program, 2001–2002.
- “Axial and Lateral Behavior of Full-Scale CIDH Piles in Soft Clay and Liquefied Sand,” Caltrans, 2001–2003.

- “Full-Scale Testing at Port of Long Beach,” National Sea Grant, 2001–2003.
- General Support of Research on Dynamic Response of Soft Bangkok Clay, Donation from Royal Thai Government, 2001.
- Seismic Performance of Port Facilities: Full-Scale Testing at Port of Long Beach, Calif., 2002–2003
- Rapidly Deployable Composite Bridge Project, Office of Naval Research, 2002–2003 (Co-PI with John Kosmatka).
- NEES: Large High Performance Outdoor Shake Table, NSF, 2002–2004, Co-investigator (PI - Jose Restrepo)
- Response Assessment of Bridge Systems, Caltrans, 2002–2005
- Large Diameter Piles and Pile Systems, Caltrans, 2002–2005
- Performance of Lifelines Subjected to Lateral Spreading, PEER, 2002–2005
- Performance of PierG Seismic Fuse, Port of Long Beach, 2004–2005
- Load Capacity, Failure Mode, and Design Criteria of Sand Jacks, Caltrans, 2004–2005
- Data Acquisition System and Instrumentation for NEES LHPOST, NSF, 2004–2005, Co-Principal Investigator (PI - Jose Restrepo)
- Coastal Bluff Erosion: Causes, Mechanisms, and Implications for Coastal Protection and Restoration, UC Office of the President, 2004–2006
- Development of Reliable Methods to Analyze Batter Piles and Piles in Sloping Ground, Caltrans, 2006–2009
- Relationship between Bluff Erosion and Beach Sand Supply in the Oceanside Littoral Cell, California Sea Grant, 2006–2008
- Structural Capacity Confirmation Testing of the Modular Hybrid Pier Test Bed, BERGER/ABAM and US Navy, 2006

Related Publications

- Ashford, S.A., Roth, L.H., Madsen, S.L., and Anderson, D.G., “FS=1.5: Is it Appropriate for Embankment Design?” Proceedings, Stability and Performance of Slopes and Embankments – II, ASCE, Berkeley, California, June 1992, pp. 1112-1125
- Ashford, S.A., Sitar, N., Lysmer, J., and Deng, N., “Topographic Effects on the Seismic Response of Steep Slopes,” Bulletin of the Seismological Society of America, 87(3), 1997, pp.701-709.
- Ashford, S.A., Rollins, K.M., Bradford V, S.C., Weaver, T.J., Baez, J.I., “Liquefaction Mitigation Using Stone Columns Around Deep Foundations: Full Scale Test Results,” Transportation Research Record No. 1736, Journal of the Transportation Research Board, 2001, pp. 110-118.
- Ashford, S.A., Juirnarongrit, T., "Evaluation of Force Based and Displacement Based Analysis for Responses of Single Piles to Lateral Spreading", Proceedings, 11th International Conference on Soil Dynamics and Earthquake Engineering and the 3rd International Conference on Earthquake Geotechnical Engineering, 2004, pp.752-759.
- Ashford S.A., Rollins, K.M., Lane, D., “Blast-Induced Liquefaction for Full-Scale Foundation Testing,” Journal of Geotechnical and Geoenvironmental Engineering, ASCE, August 2004, pp. 798-806.
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Spreading. I: Field Test,” Journal of Geotechnical and Geoenvironmental Engineering, ASCE, 132(2), 2006, pp.152-162.

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Professional Associations

- American Society of Civil Engineers (ASCE), Geo-Institute; Coasts, Oceans, Ports, and Rivers Institute
- Earthquake Engineering Research Institute (EERI)
- Network for Earthquake Engineering Simulation (NEES)
- Seismological Society of America (SSA)
- American Society of Civil Engineers, Continuing Education Committee, 1986–1989
- Earthquake Engineering Research Institute, Traditional Education Committee, 1992–1996
- Engineering Institute of Thailand, Committee on Wind and Earthquake Effects, 1995–1996
- Pacific Earthquake Engineering Research Center, Education Committee, 1998–Present
- Chair, K-12 Outreach Subcommittee, 1998–1999
- Chair, Special Projects Subcommittee, 1999–2000
- Session Chair, Planning Committee, EERI Annual Meeting, 1999
- Transportation Research Board, University Representative, 2000–Present
- Planning Committee, American Seismological Society Annual Meeting, 2000
- American Society of Civil Engineering/TCLEE, Ports and Harbors Lifeline Committee, 2004–Present
- International Society for Soil Mechanics and Geotechnical Engineering TC-4, Earthquake Geotechnical Engineering, 2004–Present
- Earthquake Engineering Research Institute, Learning from Earthquakes Advisory Committee, 2005–Present
- American Society of Civil Engineers, Standards Committee on Seismic Design of Piers and Wharves, 2005–Present
- American Society of Civil Engineers/COPRI, Ports and Harbors Committee, 2005–Present

Awards

- Faculty Representative, Transportation Research Board, 2000-2007
- Outstanding Early Career Engineer, College of Engineering, OSU, 1998
- Oliver Merwin Memorial Scholarship, University of California at Berkeley, 1985
- Otto Herman Memorial Scholarship, Oregon State University, 1982
- Tau Beta Pi National Engineering Honor Society, Oregon State University, 1981

Paul Bovitz, PWS, LSRP, CEM, LEED AP

Qualifications Summary

- Over 27 years experience in the environmental field, including assessment of environmental impacts under NEPA. Project experience includes complex multi-objective public works projects such as evaluating the feasibility of different dredging alternatives under the Baltimore Dredged Material Management Plan, the San Francisco Dredged Material Management Plan, New Jersey Intracoastal Waterway EA and FS, as well as other projects requiring evaluation of different alternatives with trade-offs (i.e., the Fresh Kills Landfill EIS, Kensico Reservoir EIS and EAs for multiple projects).
- More than 28 years technical experience in ecological assessment and natural resources management in public, private, and academic sectors, engaging in both theoretical and applied aspects of ecological research and encompassing a variety of geographic regions and habitats.
- Managed and participated as principal investigator for the following types of work:
 - Environmental assessments under NEPA
 - Water quality and stormwater studies
 - Wetlands delineation, assessment, mitigation and permitting
 - Essential fish habitat investigation
- MS degree in ecology from Rutgers University
- Experience includes evaluation of impacts to different habitats, and performing complex impact assessments for high profile USACE projects, such as the Meadowlands Mills EIS in New Jersey, and multiple EAs. Experienced in wetland functional assessment, HEP, and other habitat equivalency analysis used to evaluate the effectiveness of mitigation in offsetting different alternatives.
- Project management, field supervisory experience, expert testimony, proposal preparation, client negotiation, and budget management.
- International experience in ecological assessment.
- Certified Professional Wetland Scientist, Society of Wetland Scientists, SAME New Jersey Chapter, Hudson-Raritan Chapter of SETAC

Education

- M.S., Ecology, Rutgers University, 1992
- B.S., Wildlife Biology, Colorado State University, 1982
- Habitat Evaluation Procedures – Virginia Tech, 2005

Certifications and Licenses

- Certified Professional Wetland Scientist #0023, Society of Wetland Scientists (1995)
- Licensed Site Remediation Professional, New Jersey
- Certified Energy Manager, American Association of Energy Engineers (2009)
- LEED® Accredited Professional, U.S. Green Building Council (2009)

Summary of Professional Experience

WESTON**The Hudson Partnership, Inc.**

Rutgers University

Digital Equipment Corp., Inc.

Mariah Associates, Inc.

Colorado State University

Various state and federal agencies in Colorado and Wyoming

KEY PROJECTS

- **Environmental Assessment (EA) for Wind Turbine Development, Cape May, NJ, U.S. Coast Guard (USCG), Project Manager.** Project Manager and primary author of the National Environmental Policy Act (NEPA) EA for placement of two 2-MW wind turbines at the USCG TRACEN installation in Cape May. Assessed environmental impacts including potential impacts on birds and bats within a major migratory corridor of national significance. Worked with USCG in evaluating alternatives and selecting the preferred design, and with reviewing agencies to develop mitigation strategies for projected impacts. The EA was well received by the public and reviewing agencies, and the project is progressing to the construction stage.
- **NEPA Environmental Impact Assessment, Meadowlands Mills Development, USACE, New York District, Project Manager.** Directed preparation of draft and final environmental impact statements (EISs) on behalf of the USACE, New York District, evaluating impacts of a proposed 206-acre wetland fill project in the Hackensack Meadowlands District as part of a larger proposal to build a mixed-use regional retail/office/entertainment center (“megamall”). Critical technical issues evaluated by WESTON included compliance with Section 404(b)1 guidelines and NEPA; the accuracy of the Indicator Value Assessment method as a means of functional assessment of wetlands on the site; assessment of contamination present within site wetlands, the derivation of appropriate mitigation ratios for the site; the potential success of the applicant’s mitigation plan in offsetting potential development impacts; and the evaluation of wildlife habitat, including threatened and endangered species, avian studies, water quality, flood storage and hydrological and hydraulic modeling, management of contaminated sediment, and other wetland values under existing and proposed alternative conditions.
- **Wetland Restoration, Wall Township, NJ, Confidential Client, Project Manager.** Project manager for site cleanup of a forested wetland contaminated with polychlorinated biphenyls (PCBs). Directed clean up and restoration of the 6.5 acre forested wetland, which was approved by NJDEP after five years of monitoring. The NJDEP Inland Regulation reviewer indicated that this project should be considered an example by which other restoration projects should be measured. Responsible for delineation of the extent of contamination, assisting with development and negotiation of a remedial action work plan acceptable to the New Jersey Department of Environmental Protection (NJDEP), and preparation of wetland restoration plans and permit application documents for the excavation and restoration of 6.5 acres of forested wetlands impacted by PCB contamination. The site has been successfully restored and is now owned and managed by the Monmouth County Parks Department.
- **Wetland Restoration, Woodbridge, NJ, Hatco Remedial Project, Project Manager.** Delineated and characterized wetlands, designed wetland restoration plan and obtained necessary permits from NJDEP for remediation and restoration of a 3.61 acre area of emergent and forested wetlands and three branches of Crows Mill Creek, a tributary of the Raritan River. Work is in progress at this site. Also negotiated the natural resource damage assessment based on an evaluation of habitat quality and historical impacts from contamination at the site.
- **Dredged Material Management Plan, San Francisco District, USACE, San Francisco District, Principal Scientist.** As part of an interdisciplinary team, prepared sections of the proposed project pertinent to dredged material management impacts on water quality and endangered species within the San Francisco bay region. Reviewed existing regional sediment management plans, assessed dredging needs relative to environmental impacts, projected future conditions with and without the project within a NEPA framework. Project is entering its final stage.
- **Ecological Assessment, Paulsboro, NJ, Gloucester County Improvement Authority (GCIA), Paulsboro Marine Terminal.** Conducted environmental assessment evaluating the existing quality of wetland and aquatic

habitats potentially impacted by different port redevelopment alternatives for inclusion in the NEPA Environmental Impact Statement (EIS) document, and calculation of state and federal wetland mitigation requirements. Reviewed the existing wetland delineation and negotiated remapping of the area to save GCIA over \$4M in wetland mitigation costs by having over 9 acres of area mapped as freshwater wetland reclassified as upland. Also assisted GCIA in negotiations with the New Jersey Department of Environmental Protection (NJDEP) to reduce requirements for sampling under Section 106 requirements for a historical/ archaeological resources survey, resulting in significant reduction in the sampling required over what the agency was requesting.

- **Categorical Exclusions, City of Newark, Newark, NJ, Project Manager.** Was project manager evaluating proposed housing redevelopment projects from the perspective of NEPA in order to justify categorical exclusions from the Bureau of Housing and Urban Development (HUD). Obtained categorical exclusions for over 20 different housing projects in support of grant applications from HUD.
- **NEPA Environmental Assessment and Feasibility Study, Dredged Material Management Plan, Baltimore Harbor and Approach Channels, Maryland and Virginia, USACE, Baltimore and Norfolk Districts, Principal Scientist.** Assisted with identification and analysis of dredge material placement alternatives, habitat restoration sites, and beneficial reuse options for the Port of Baltimore, Maryland. Coauthored sections of the Dredged Material Management Plan (DMMP), with specific focus on the Virginia Approach Channels. Major project tasks included communication and coordination with federal, state, and local regulatory agencies; evaluation of existing data (e.g., historical reports, bathymetry, sediment characteristics and chemistry, aerial photographs, degraded wetlands, fisheries data, benthic surveys, and water quality data); identification of potential beneficial-use placement sites; and development of a matrix of placement alternatives.
- **NEPA Environmental Assessment and Feasibility Study New Jersey Intracoastal Waterway, New Jersey, USACE, Philadelphia District, Project Scientist.** As coauthor of the combined feasibility study/EA document, assisted with identification of dredge material placement alternatives, habitat restoration sites, and beneficial reuse options for maintenance dredging of approximately 70 miles of New Jersey's Intracoastal Waterway. Major project tasks included evaluation of existing data (e.g., land use, bathymetry, aerial photographs); coordination with regulatory agencies; and identification of viable habitat creation, restoration, and enhancement opportunities to improve degraded ecological conditions on historic dredge spoils sites within the project area. Prepared text sections on ecological benefits and impacts **Port Authority of New York and New Jersey, Program Manager.** Acted as program manager overseeing eight call-in contracts, including one for Ecological Services, the other for Lead/ Asbestos Design Services, each with a capacity of \$1.5M. Responsibilities also included oversight of a Bioassay contract under which WESTON completed several task orders involving collection and analysis of sediments within the New York Harbor area. Supervised staff in management of various projects ranging from underground storage tank investigations, remedial investigations of contaminated sediment and soil, evaluation of stormwater impacts and flood hazard area permitting, preparation of stormwater pollution prevention plans, wetland delineations, mitigation and permitting, evaluation of potential wetland mitigation banking sites in New York and New Jersey, NEPA consulting, air quality impacts from harbor dredging operations, development of an electronic environmental compliance monitoring system, and consulting regarding emissions offsets and purchase of carbon credits to offset air quality impacts from port operations.
- **Project Management, Various Locations, USACE, New York District, Biological, Environmental, and Cultural Resources (BECR) Contract, Project Manager.** Managed several projects, including wetland restoration projects involving evaluation of contamination issues, environmental site assessments under the hazardous, toxic, radioactive waste (HTRW) and Defense Environmental Restoration Program – Formerly Used Defense Site (DERP-FUDS) programs, community relations plans for site cleanups, wetland mitigation studies and plans, and assessment of environmental impacts.
- **Environmental Impact Assessment (EIA) and Permitting, Philadelphia, PA, Metro Machine Corporation, Project Manager.** Conducted an assessment of potential environmental impacts from a proposed 100,000 cubic yard (yd³) dredging project at the Philadelphia Naval Yard. Prepared permitting documents, interfaced with federal and state regulatory agencies, and successfully received applicable permits. Conducted an evaluation of disposal alternatives for dredged material, and received approval for disposition of the material at a confined disposal facility operated by USACE.
- **EIA and Ecological Restoration, Clarkstown, NY, Town of Clarkstown, Principal Scientist.** Conducted

wetland delineation and assessment of environmental impacts associated with dredging a section of the Hackensack River, including floodplain effects and wildlife habitat impacts. Developed stream bank stabilization/restoration plan, and provided input/ recommendations regarding nature trail construction and recreational potential of the riverine corridor.

- **Port Authority of NY & NJ - Teterboro Airport Wetland Delineation** - Performed 78 wetland delineations within the project area of the Teterboro Airport in October 2006. Wetlands were identified using the three-parameter approach for the delineation of wetlands as required by New Jersey state regulations. This approach relies upon three indicators for the identification and delineation of wetlands: the presence of hydrophytic vegetation, hydric soils and/or wetland hydrology. Flagged the boundaries of the wetlands using flagging tape and pin flags. Wetland boundaries were assigned a unique alpha-numeric identifier numbered sequentially. Wetland boundaries were also recorded using a Trimble® Pathfinder ProXRS backpack Global Positioning System (GPS). Photographs were taken at various observation points to document the vegetation and other features of each area. Project location and historical wetland delineation maps were used to aid in conducting the wetland delineation.
- **Port Authority of NY & NJ - Wetlands Permitting and Mitigation Alternative Analysis- Teterboro Airport, NJ** - Supported the Port Authority of New York & New Jersey (Port Authority) determining the feasibility of different mitigation alternatives to offset wetland impacts from the proposed Taxiway N & C at Teterboro Airport. This assessment report provided a characterization and a qualitative evaluation of wetland mitigation alternatives. An estimated 0.38 acre of freshwater emergent wetlands will be impacted by construction of Taxiway N & C. The wetlands are dominated by sedges and other herbaceous species. The impacts are unavoidable in that the runway is being extended for safety reasons. As a result of the above analysis, Mr. Jaworski recommended mitigation by In Lieu Fee payment and calculated all the costs for said mitigation resulting in successful issuance of the NJDEP permit.
- **Port Authority of NY & NJ - Wetlands Permitting and Mitigation Alternative Analysis, McLester Street, Newark** –On behalf of the Port Authority of New York & New Jersey (Port Authority), Mr. Bovitz conducted a wetland mitigation alternative analysis for impacts within a 102-acre parcel adjacent to McLester Street at Port Elizabeth, Elizabeth, New Jersey. McLester Street is proposed for realignment to facilitate road expansion. The realignment is projected to impact 0.54 acre of estuarine shrub/scrub wetland. After the alternative analysis indicated that an In-Lieu Fee contribution was the preferred mitigation alternative, the mitigation fees were calculated using the *NJDEP Monetary Contribution Proposal Checklist for Completeness* per State regulations N.J.A.C. 7:7A-15. These estimates included costs for engineering, grading, construction, planting, maintenance, legal support and land acquisition costs.
- **Port Authority of NY & NJ - Call-In Contracts for Ecological Services and Environmental and Engineering Services, Project Manager.** Directed several environmental investigations involving evaluation of contaminated soils and groundwater within the proposed corridor of the Second Lead Rail project on Bay Avenue in Port Elizabeth, and the Corbin Street Rail and Realignment project at Port Newark. Directed wetland investigations at Teterboro Airport, Ports Newark and Elizabeth as a basis for permit applications filed on behalf of the Port Authority for proposed projects, and evaluated potential sites for potential use as a wetland mitigation bank.
- **Port Authority of New York & New Jersey - NY Harbor Mitigation Banking Study** - Performed highly detailed siting study on behalf of the Port Authority to identify potential mitigation bank construction project sites on Staten Island, NY, and in central New Jersey that could be used to offset the impacts of ongoing and future Port Authority projects. Screened potential sites by site size, location, suitability for a mitigation bank, assessed real estate value, ownership, site use, type of wetland community, accessibility, and elevation range. Evaluated 15 sites and identified a total of 10 sites (5 on Staten Island, NY, and 5 in New Jersey) for further evaluation in this assessment, in accordance with the scope of work.
- **Ecological Risk Assessment, Edison, NJ, U.S. Army Corps of Engineers (USACE), New England Division, Task Manager.** Directed baseline ecological risk assessment of the former Raritan Arsenal, a 3,500-acre site in Edison, NJ. Directed an extent of contamination study of surface water and sediment, and prepared a physical characterization report for the Phase II remedial investigation/feasibility study (RI/FS) for the site, which described contaminant migration patterns and potential bioavailability of surface water and sediment. Directed screening level risk assessment (SLRA) of all media used to identify contaminants of potential concern, and integrated it with site-specific ecological data from the site to develop a conceptual model of ecological

exposure pathways. Directed the baseline ecological risk assessment for the site, which involves evaluation of over 30 areas of concern divided among eight different drainage areas, and the adjacent tidal Raritan River and associated wetlands.

- **Environmental Impact Assessment, New York City, New York City Department of Sanitation (NYCDOS), Task Manager.** Prepared or directed the preparation of several documents in support of the 6 NYCRR Part 360 permit application for the Fresh Kills Landfill. Provided technical direction and preparation of the natural resources and water resources sections of the draft EIA, including supervision of staff in data collection, analysis, and review; interpretation of data and impacts analysis; client/agency negotiation; and authoring report sections. Provided direction/preparation of the draft and final surface-water quality/wetland sections of several major permitting documents. These tasks involved extensive data interpretation and summary of results of water quality and sediment data, including relationships between surface-water quality and contaminant hydrogeology; study design for environmental monitoring; review of water quality modeling results and integration with surface-water quality data; preparation and review of reports for consistency with federal, New York State, and New York City regulations; and integration of report sections with other disciplines (e.g., human health risk assessment, land use, landfill engineering, and surficial geology).
- **Ecological Risk Assessment, Suffolk, VA, Former Nansemond Ordnance Depot, Task Manager.** Directed baseline ecological risk assessment of wetland areas of concern on the former military site that are contaminated by metals and organic compounds. Assessed risks from metals and organic contaminants to the ecological communities present, including the Horseshoe Pond and Main Burning Ground areas using site-specific data collected on frogs, small mammals and soil invertebrates. Evaluated impacts of contamination along the shoreline of the Nansemond and James River beachfronts, and provided recommendations for restoration.
- **Ecological Risk Assessment/Wetlands Mitigation, New Jersey, Precision Roll Products, Inc., Principal Scientist.** Directed preparation of a baseline ecological risk assessment and derivation of ecologically based site cleanup criteria for remediation of forested wetland soils contaminated with metals and PCBs. Negotiated site cleanup levels and risk management decisions with NJDEP based on risk assessment results. Directed preparation of necessary wetland and stream encroachment permit applications and wetland/stream restoration plans for the site, which included excavation and restoration of Black Ditch, a contaminated lagoon, and three forested wetland areas on-site.
- **Remedial Investigation, Feasibility Study and Natural Resources Damage Assessment, Corfu, NY, Confidential Client, Principal Scientist.** Conducted baseline remedial investigation of saline impacts from a pipeline rupture that resulted in a brine spill over 3.5 acres of forested wetlands in western New York. Collected sufficient samples to delineate the extent of saline contamination in the wetland, sampled adjacent potable wells, measured salinity levels in surface water, and prepared a report summarizing the extent of project impacts. Subsequently evaluated remedial alternatives from the perspectives of regulatory requirements, long-term likelihood of success, logistical considerations, and costs. Prepared a natural resources assessment summarizing the extent of damages from the loss of trees at the site, and different methods of ascertaining damages.
- **Baseline Ecological Inventory, Essential Fish Habitat (EFH) Investigation and Wetland Restoration, Delaware River, PA, Confidential Client, Task Manager.** Directed a baseline aquatic resources survey for a 50-acre area adjacent to an oil refinery consisting of tidal mudflat, adjacent tidal emergent wetlands, and open water areas. The study consisted of a year-long investigation of sediment quality, fisheries, benthos, and other aquatic resources in the immediate vicinity of the refinery to be used as a basis for evaluating potential environmental impacts associated with different dredged material management alternatives presently under consideration at the site. The study involved collection of over 20,000 fish using a variety of methods, as well as characterization of benthic macroinvertebrate community structure, ecological screening of sediment analytical data, and comparison of fish stomach contents to available benthos as a measure of habitat quality using the Benthic Resources Assessment Technique (BRAT) model developed by USACE. Analyzed results and presented them to reviewing agencies in a final report. The baseline data will also be used to develop conceptual design plans for a proposed tidal wetland creation project.
- **Risk Assessment, Nyanza Superfund Site, Sudbury, MA, USACE, Project Manager.** Directed preparation of a baseline ecological and human health risk assessment addressing potential risks to Sudbury River biota from organic compounds and metals present in groundwater. Initially prepared a SLRA that identified contaminants of concern in groundwater entering the river. Subsequently worked with reviewing agencies on behalf of USACE to develop a work plan/study design to address toxicity of groundwater using bioassay tests.

Subsequently analyzed the data and prepared a report that formed the basis of a follow-up work plan to address in situ toxicity of groundwater entering the river via pore water. Integrated results with hydrogeological data to develop a conceptual model of ecological exposure, and prepared a final report used by USACE and EPA Region 1 to evaluate risk management alternatives regarding contaminated groundwater at the site.

- **Remedial Investigation/Risk Assessment (RI/RA), Housatonic River Superfund Site, MA, U.S. Environmental Protection Agency (EPA), Principal Scientist.** Assisted in study design and coauthored soil, sediment, and surface-water sampling plans for RI of PCB-contamination along a 30-mile stretch of the Housatonic River. Developed sediment sampling methodology using hand-held corers to a depth of 4 feet, and directed its implementation. Prepared sampling plans for collection of biota tissue (e.g., frogs and soil invertebrates) for use in the risk assessment, including literature reviews of PCB effects. Directed field activities for collection of frog tissue. Assisted in field processing fish tissue for over 900 individual fish caught along the river.
- **EIA and Permitting, Biogenesis Soil Washing Pilot Demonstration Project, Permitting Coordinator.** Evaluated environmental impacts and obtained necessary permitting documents for a pilot-scale soil washing facility for treatment of contaminated dredged material from the New York-New Jersey Harbor.
- **Risk Assessment/Wetlands Mitigation, New Jersey, Confidential Client, Task Manager.** Directed ecological risk assessment of two approximately 30-acre forested wetland sites and one 5-acre site impacted by paint waste from a former manufacturing facility. The sites encompass several streams within the same watershed that have been contaminated with metals and organic compounds. Prepared ecological and human health risk assessment portions of the Phase I RI report, and made recommendations regarding remedial design alternatives.
- **EIA and Permitting, Bronx, NY, American Marine Rail, Principal Scientist.** Conducted assessment of environmental impacts associated with dredging and construction of a proposed marine transfer solid waste handling facility on the East River. Prepared sampling and analysis plan for sediments to be dredged, evaluation of potential aquatic habitats and estuarine biota affected, final report, and environmental assessment (EA) for the facility. Coordinated with regulatory review agencies (USACE and New York City Department of Environmental Protection [NYCDEP]).
- **Environmental Permitting and Compliance, New York, Consolidated Edison, Principal Scientist.** Researched, developed, and prepared Corporate Environmental Procedures, General Environmental Instructions, and Technical Bid Specifications for the client's corporate environmental policy. Prepared corporate documents summarizing regulatory issues and corporate procedures in several areas: wetlands and dredging impacts and permitting; fish and wildlife impacts; and State Pollutant Discharge Elimination System (SPDES) permitting, including construction dewatering, and pesticide application.
- **Ecological Restoration, Clarkstown, NY, Town of Clarkstown, Principal Scientist.** Conducted investigation of watershed impacts on Swartout Lake, an approximately 24-acre lake within a suburban/rural environment. Conducted lake sampling, survey of aquatic vegetation and habitat types, and watershed analysis, including impacts of non-point source pollution sources. Provided recommendations regarding lake restoration.
- **Brownfields Development, Staten Island, NY, Confidential Client, Principal Scientist.** Conducted a field wetlands delineation and preliminary environmental survey to identify issues and provide recommendations pertaining to future development of an industrial site, including stormwater management and wetlands restoration along a tidal creek.
- **Ecological Assessment, Tennessee, EPA/Environmental Response Team (ERT).** Directed field ecological assessment of contaminant risks at a former charcoal producing facility. Studies focused on effects of polynuclear aromatic hydrocarbons (PAHs) and metals on soil invertebrates and small mammals in order to determine cleanup levels.
- **Ecological Assessment, New Jersey, EPA/ERT, Task Leader.** Developed standard operating procedures (SOPs) for small mammal trapping and tissue processing for use by EPA.
- **Ecological Assessment, Tennessee, EPA/ERT, Task Leader.** Conducted ecological risk assessment modeling of contaminant risks using the Hazard Quotient Method at a former landfill site. Identified contaminants of concern and indicator species, derived lowest-observed-effect level (LOEL) data from the literature, and

determined potential toxicological effects in order to establish site soil cleanup levels.

- **Wetland Assessment/Mitigation, New Jersey, EPA/ERT, Project Team Member.** Provided development and oversight of a wetlands mitigation plan for the Zshiegner Refining Company Superfund site. Characterized site vegetation, delineated wetlands, and helped develop site soil removal and revegetation plan.
- **Ecological Assessment, Wisconsin, EPA/ERT, Subtask Leader.** Developed sampling design and directed extent of contamination study of surficial soils at a former wood-treating facility. Collected baseline data for ecological risk assessment.
- **Ecological Assessment, Connecticut, EPA/ERT, Task Leader.** Coordinated field activities for an emergency response investigation focusing on the risks of asbestos and PCB contamination to local residents in the Town of Stratford. Acted as liaison with several federal agencies and their support teams, and supervised the collection and screening of soil samples. Monitored subcontracted surveying team, and assisted with the development of a base map of areas investigated.
- **Ecological Assessment, Colorado, EPA/ERT, Senior Field Team Member.** Conducted an assessment of freshwater wetlands potentially affected by groundwater contamination from an abandoned industrial facility, and performed a vertebrate species inventory for use in determining if the site qualified for National Priorities List (NPL) ranking. In addition, assisted with the collection of groundwater data.
- **Ecological Assessment, Michigan, EPA/ERT, Task Leader.** Prepared a quality assurance (QA) work plan and supervised the dissection, processing, and analysis of muskrat tissues collected from a potentially contaminated stretch of the Kalamazoo River. Tissue was analyzed for histopathology, metals, PCBs, and semivolatile organic compounds (SVOCs).
- **Ecological Assessment, New Jersey, EPA/ERT, Task Leader.** Directed an off-site extent of contamination study of arsenic contamination in the vicinity of a former chemical plant facility to determine health risks to the public. Sampled surface and subsurface soils, as well as groundwater within residential areas potentially affected by runoff from the site. Presented results in a final report to EPA.
- **Ecological Assessment, Maryland, EPA/ERT, Task Leader.** Prepared and implemented an emergency response plan for the biomonitoring of white phosphorus release from sediment at the Aberdeen Proving Ground (APG) from a major storm event. The plan was implemented in March 1993 to determine if white phosphorus was released into the water column following a winter storm and if it was available for uptake by a representative fish species (sheepshead minnow). An in situ technique was used for this purpose. Interpreted results and presented conclusions in a final report to EPA. This plan has since been used as a contingency plan for any major storms affecting the APG area.
- **Ecological Assessment, New Jersey, EPA/ERT, Task Leader.** Directed a broad-scale field investigation of the terrestrial and aquatic impacts of lead contamination at a former smelting facility. Developed and implemented the work plan, and directed a field crew in the collection of data on soils, water, and target biota (small mammals, fish, and frogs). Used an in situ technique to measure the bioaccumulation of lead in two species of earthworms. Additional responsibilities included statistical analysis and interpretation of contaminant data, interpretation of results, and preparation of a final report to EPA for use in determining ecologically relevant remedial levels. In a follow-up study, evaluated soil slated for removal using the Toxicity Characteristic Leaching Procedure (TCLP) to determine if soils met Resource Conservation and Recovery Act (RCRA) criteria.
- **Ecological Assessment, Utah, EPA/ERT, Subtask Leader.** As part of a larger integrative study, conducted an inventory of small mammals present in a wetland adjacent to a former silver mine. Directed field crew members in the collection of specimens and subsequent necropsy work to determine if gross pathological effects were evident in indigenous populations. In addition, assisted with a vegetative inventory of the site. Prepared results in a final report to EPA/ERT for use in evaluating the potential ecological risks posed by the site.
- **Ecological Assessment, Washington, EPA/ERT, Subtask Leader.** Directed an inventory of small mammal populations in a landfill area within a tidal wetland adjacent to Puget Sound. Collected and analyzed data aimed at describing the resident small mammal and bird communities of the site. In addition, prepared a site vegetation map.
- **Ecological Assessment, New York, EPA/ERT, Project Team Leader.** Assisted with the design and analysis

of seed germination and root elongation studies to measure the effectiveness of bioremediation techniques for treatment of creosote-contaminated soils.

- **Ecological Assessment, New Jersey, EPA/ERT, Task Leader.** Directed a field ecological assessment of the impacts of contamination on the bog community at the Burnt Fly Bog Superfund site. Responsibilities included assisting EPA/ERT in study design; directing a field crew in the collection of small mammals, vegetation, and soils; analyzing and interpreting results; and presenting the findings in a report to EPA/ERT to be used in site remedial recommendations.
- **Risk Assessment Modeling, New York, EPA/ERT, Subtask Leader.** Working independently, adapted a food chain model described in the literature to predict the effects of contamination on four selected target vertebrate species (black duck, great-blue heron, muskrat, and red-winged blackbird) inhabiting a freshwater marsh. Derived model inputs from the literature, calibrated the model, and presented the results in a report to EPA/ERT for use in site remedial recommendations.
- **Ecological Assessment, New Mexico, EPA/ERT, Senior Field Team Member.** Collected data on small mammals, vegetation structure, and soils for use in an ecological risk assessment of lead contamination at the CalWest Superfund site.
- **Ecological Assessment, New Jersey, EPA/ERT, Senior Field Team Member.** Conducted a study of the impacts of contamination on a freshwater tidal marsh at the Kin-Buc Landfill Superfund site, and later directed an extended investigation of the lower Raritan River watershed. Assisted with the development of a field sampling design for the collection of muskrats and sediment samples. Collected, dissected, and processed muskrats for tissue analysis. Reviewed histopathological results, and assisted with data interpretation and report review.
- **Ecological Assessment, Wisconsin, EPA/ERT, Senior Field Team Member.** Collected soil and water samples used to determine the extent of contamination and sediment toxicity in a freshwater marsh at the OECl Superfund site. Directed field activities during one phase of the project, and prepared a report for EPA/ERT based on Geosoft contour mapping of site contamination.
- **Ecological Assessment, Delaware, EPA/ERT, Task Leader.** Assisted EPA/ERT with study design and decision-making flow chart to ascertain potential effects of contamination from a chemical facility on a freshwater tidal marsh at the Halby Chemical Superfund site. Directed a field crew in the collection of sediments for analysis and toxicity testing. Prepared a final report for use by EPA/ERT in determining future activities on-site.
- **Emergency Response/Ecological Assessment, Minnesota, EPA/ERT, Task Leader.** Provided field support to EPA/ERT in determining the extent and potential impacts of submerged drums found in Lake Superior. Used a remotely operated vehicle (ROV) to determine the number, extent, and condition of submerged drums found off-shore. Presented the results in a technical report submitted to EPA.
- **Ecological Assessment, Ohio, EPA/ERT, Senior Field Team Member.** Collected small mammals and soils, mapped vegetative cover types, and delineated wetlands at the Ormet Superfund site. Assisted with report preparation.
- **Wetland Delineation/Assessment, New Jersey, EPA/ERT, Task Leader.** Co-directed a wetland delineation of an area adjacent to the Lone Pine Landfill Superfund site using the federal jurisdictional procedure. Conducted a functional wetland assessment of surrounding wetlands using the Wetland Evaluation Technique (WET) modeling procedure. Provided remedial and mitigation recommendations to EPA/ERT.
- **Ecological Assessment/Site Characterization, Various Locations, EPA/ERT, Field Team Member/Senior Field Team Member.** Participated in site characterization projects geared at evaluating potential threats to human health. Responsibilities included direction of field staff; establishing and implementing field sampling designs; data collection using screening measurements or techniques such as immunoassay test kits, X-ray fluorescence (XRF) spectrometry, portable magnetometer, Hach kits, etc.; as well as sample collection from the following matrices: surface and subsurface soils, soil gas, surface water, and groundwater. Experienced in a variety of geographic areas throughout the continental United States.
- **Wetland Delineation/Assessment, New Jersey, Probst Enterprises, Inc., Project Manager.** Directed a large-scale wetlands delineation of a 3,000-acre site in the Pine Barrens region. Collated natural resources data

assembled from several agencies with satellite and aerial photographs, collected field data to determine the wetlands boundary and state resource classification, and to make land use recommendations.

- **EIA/Review, Walkill, NY, Town of Walkill, Task Manager.** Reviewed data on wetlands, wildlife, stormwater management, and vegetation impacts; and provided critical comments for the development of a shopping mall.
- **EIA, New York, Saccardi and Schiff, Inc., Project Manager.** Evaluated wildlife habitat and provided a vegetation cover map for use in an environmental impact statement (EIS) for a proposed health care center in the Long Island Pine Barrens.
- **Ecological Assessment, New York, RPPW, Inc., Project Manager.** Evaluated wildlife habitat, prepared a vegetation cover map, and conducted a wetlands delineation for use in an EIS for a proposed residential development on a 200-acre deciduous forested site.
- **Ecological Assessment, New York, RPPW, Inc., Project Manager.** Evaluated wildlife habitat for an endangered turtle and migratory bird species, prepared a vegetation cover map, and conducted a wetlands delineation for use in an EIS for a proposed residential development in an urban forested area.
- **Wetland Delineations/Assessments, New Jersey and New York, Multiple Clients, Project Manager.** Conducted or assisted with wetland delineations at more than 80 sites. Authored proposals, directed field work, managed budgets, prepared reports for clients, met with regulatory agencies, advised clients, prepared regulatory permits, and negotiated collections.
- **EISs, New Jersey, Multiple Clients, Project Manager.** Prepared EISs for municipal and state agencies on several projects. Collected or assisted with the collection of data on traffic impacts, air pollution, vegetation, wildlife, wetland impacts, and infrastructure impacts. Modeled noise impacts from highway improvements.
- **Ecological Studies, New Jersey, Rutgers University, Research Associate.** Working independently, designed study, trapped and mistnetted bird species, and monitored their movements and behavior using radiotelemetry to test hypotheses regarding the adaptive significance of communal roosting. Analyzed data and presented results in a thesis.
- **Wildlife Damage Assessment, New Jersey, Confidential Client, Research Associate.** Assisted in the field collection of data on populations of three species of toads and assessed potential agricultural damage impacts. Censured toads by direct observation, pitfall trapping, and mark-recapture techniques.

Related Publications and Presentations

- Weaver, C.J., P.J. Bovitz, J.T. Moore, and J.A. Kelly. 2007. "A Vapor Intrusion Study Using Multiple Lines of Evidence." University of Massachusetts Soils Conference.
- Bovitz, P. and R. Brown. 2005. "Ecological Risk Assessment of the Former Nansemond Ordnance Depot." Society of Environmental Toxicology and Chemistry, 26th Annual Meeting, Baltimore, MD.
- Bovitz, P. and R. Brown. 2003. "An Essential Fish Habitat (EFH) Assessment of a Tidal Mudflat in the Delaware River." American Fisheries Society, 133rd Annual Meeting, Quebec City, Quebec.
- Kim, P.Y., P. Bovitz, B. Vanderveer, M. Donohue, K. Munney, and M. Sprenger. 1994. "The Use of Chemical, Histopathological, and Toxicity Evaluations To Investigate a Wildlife Kill." Society of Environmental Toxicology and Chemistry 15th Annual Meeting, Denver, CO.
- Bovitz, P. and M. Sprenger. 1993. "A Bioaccumulation Study of Earthworms at a Superfund Site." Society of Environmental Toxicology and Chemistry 14th Annual Meeting, Houston, TX.
- Sprenger, M., K. Kracko, and P. Bovitz. 1993. "An Ecological Risk Assessment for Lead Ingested by Biota at a New Jersey Superfund Site." Society of Environmental Toxicology and Chemistry 14th Annual Meeting, Houston, TX.
- Sprenger, M., R. Bennett, R. Knight, and P. Bovitz. 1991. "Assessment of Contaminant Migration into a Delaware Tidal Marsh." Society of Environmental Toxicology and Chemistry 12th Annual Meeting, Seattle, WA.
- Bovitz, P., G. Buchanan, and M. Sprenger. 1991. "A Food Chain Model of Cadmium Accumulation in a Tidal

Freshwater Marsh.” Society of Environmental Toxicology and Chemistry 12th Annual Meeting, Seattle, WA.

- Munney, K. and P. Bovitz. 1991. “The Use of Muskrats as Bioindicators of Environmental Contamination.” Society of Environmental Toxicology and Chemistry, 12th Annual Meeting, Seattle, WA.
- Beltman, D., M. Sprenger, R. Henry, P. Bovitz, and M. Huston. 1991. “Screening Field Bioassessment Tools at a Hazardous Waste Site.” Society of Environmental Toxicology and Chemistry 12th Annual Meeting, Seattle, WA.
- Munney K. and P. Bovitz. 1991. “An Ecological Investigation of PCBs and Metals Contamination in a New Jersey Freshwater Tidal Marsh.” Water Environment Federation Annual Conference, Toronto, ON.
- P. Bovitz. 1988. “Communal Roosting Behavior in American Robins and European Starlings as Related to Foraging Considerations.” First International Conference of Behavioral Ecology, Vancouver, BC.

Professional Associations

- New Jersey Department of Environmental Protection Science Advisory Board, Ecological Sciences Committee, Standing Member (2010–present)
- New Jersey Department of Environmental Protection, Comparative Ecological Risk Project, Technical Committee (2001–2003)

Kathryn R. Malarich

Qualifications Summary

- Twenty years experience in economic evaluations, including transportation as well as water resources. Breadth of economic evaluation experience and graduate degrees in Natural Resources Management and Economics are assets that do contribute to my ability to serve as an economics reviewer.
- Various watershed plans, Natural Resource Conservation Service. Senior economist in a number of such watershed plans. Quantified the benefits of maintaining flood protection for agriculture, roads, bridges, commercial and residential properties. Quantified the impact of various project alternatives on upstream land values and land development potential. Besides flood protection, benefits quantified sometimes included those of the detention pool itself including recreation, water supply, and aesthetic/amenity value to adjacent properties.
- Lower Beaver River Sedimentation Study, USACE. Conducted a cost-benefit analysis for alternatives for relieving sedimentation and debris problems on the Lower Beaver River. Quantified benefits to the many marinas on the river segment and benefits to recreational boaters who dock on the Lower Beaver River.
- North Fork Hughes River Recreation Study (WV), NRCS. Estimated the net recreational benefits of the proposed 300-acre reservoir. Method included the USACE Similar Project Method to develop visitation estimates. Applied USFS recreation day values to visitation estimates. The project was highly controversial and the study was conducted under court order to address deficiencies in a previous study conducted by another party. The study successfully withstood critical reviews by economists working on behalf of organizations engaged in litigation against the project.
- Water Resources Study, Randolph County, VA (NRCS). Similar to North Fork Study. Estimated visitation to proposed 75-acre reservoir using distance-visitation relationship for similar facilities, while considering visitation of substitute and complementary resources in the region. Net benefits estimate considered lost in-stream values and effects on visitation estimates of substitute and complementary resources in the region.
- Evaluation of Social and Economic Effects of Unreliable Lock Service, PA, OH, and WV, USACE, Pittsburgh District. Quantified and evaluated the costs associated with a variety of environmental and social features, such as fuel usage, air emissions, accidents and safety, tire wear, and pavement damage connected with modal shifts that might occur if the Pittsburgh waterways system experienced greater delays or extended closings due to the infrastructure's age and deteriorating conditions.
- Review of Cost-Benefit Analysis of Coastal Zone Projects (USEPA). The study included an assessment of USACE procedures for accounting for sea-level rise in its cost-benefit analyses.
- Review of Cost-Benefit Analysis of Tellico Dam. As a graduate student in Natural Resources Economics, prepared a case study to be used in an undergraduate Natural Resource Economics class that critically evaluated the USACE cost-benefit analysis of the proposed Tellico Dam Project.

Education

- M.S., Natural Resources Management, University of Michigan, 1989
- M.A., Economics, University of Michigan, 1988
- B.S., Economics, The Pennsylvania State University, 1985

Summary of Professional Experience

Gannett Fleming—Senior Economist

- Responsible for economic impact analysis, cost-benefit analysis, financial analysis, and economic development studies. Clients have included federal- and state-level agencies, counties, local municipalities, and firms in the private sector.

KEY PROJECTS

- **Flood-Retarding Structure Rehabilitation Study, Fredonia, AZ, U.S. Department of Agriculture, Natural Resources Conservation Service.** Senior Economist responsible for providing consultation and quality assurance review in the preparation of a cost-benefit analysis of the merits of rehabilitating versus decommissioning a flood-control impoundment in rural Arizona. The estimation of crop damage reduction benefits occupied the majority of the study effort.
- **Environmental Assessment and Watershed Plan, East Fork Above Lavon Watershed, Collin and Grayson Counties, TX, U.S. Department of Agriculture, Natural Resources Conservation Service.** Senior Economist responsible for determining the economic ramifications during our firm's evaluation of the watershed plan, which would impact the East Fork above Lavon Watershed. The options included either rehabilitating or removing four floodwater retaining structures. Our firm quantified the benefits of maintaining flood protection for agriculture, roads, bridges, and commercial and residential properties and quantified the impact of various project alternatives on upstream land values and land development potential.
- **Environmental Assessment and Watershed Plan, Upper Brushy Creek Watershed, Williamson County, TX, U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS).** Senior Economist responsible for an economic analysis for the watershed plan. Our firm conducted a costbenefit analysis of the project alternatives using the NRCS National Watershed Manual guidelines. The benefits of maintaining flood protection for agriculture, residential and commercial properties, roads, and bridges were quantified. The NRCS URB1 model was used to estimate the benefits of continuing residential flood protection. Our firm also quantified the benefits that the sediment pool behind the dam provided, including recreation, water supply, stormwater detention, and an aesthetic/amenity value to adjacent properties. The benefits and costs were then converted to an annual average equivalent, allowing our firm to identify the alternative that would maximize net benefits.
- **Environmental Impact Statement (EIS), Mountaintop Mining With Valley Fill, WV, U.S. Environmental Protection Agency, Region 3.** Project Economist responsible for the assessment of social and economic impacts of alternative regulatory approaches to highly controversial mining methods. Worked cooperatively with interagency project steering committee to define the issues and scope of approach to analyses. Coordinated with technical study leads at agencies and universities who conducted detailed analyses of impacts on economic conditions, social conditions, and quality of life. Incorporated study results into the EIS document. Performed qualitative analysis of social and economic issues not addressed in special technical studies.
- **Evaluation of Social and Economic Effects of Unreliable Lock Service, PA, OH, and WV, U.S. Army Corps of Engineers, Pittsburgh District.** Economist responsible for assisting in preparing a study documenting the environmental, social, and economic effects resulting from unreliable lock service at the Emsworth, Dashields, and Montgomery Locks and Dams along the Ohio River near Pittsburgh. Quantified and evaluated the costs associated with a variety of environmental and social features, such as fuel usage, air emissions, accidents and safety, tire wear, and pavement damage connected with modal shifts that might occur if the Pittsburgh waterways system experienced greater delays or extended closings due to the infrastructure's age and deteriorating conditions. The study included an analysis of mode shifts and investigated how those shifts would impact the highway and rail network, as well as economic implications for the region.
- **Green Business Initiative, York, PA, U.S. Environmental Protection Agency (U.S. EPA).** Project Economist responsible for investigating prospects for sustainable economic development in York, a participating U.S. EPA "Green Community." Interviewed York-area businesses to identify existing trends and determine the factors constraining and promoting "green" business practices. Evaluated approximately one dozen vacant urban industrial sites in terms of their marketability as locations for "green" business firms.
- **Water Resources Study, Randolph County, WV, U.S. Department of Agriculture, Natural Resources Conservation Service.** Economist responsible for estimating the net recreation benefits of a potential 75-acre impoundment. Applied distance-visitation relationship estimated for a similar-sized reservoir in Ohio to estimate levels of various recreational uses. Applied U.S. Forest Service activity-day valuations to estimate value of recreation benefits. The assessment considered lost in-stream values and effects on visitation estimates of substitute and complementary resources in the region.
- **Sedimentation Study for the Lower Beaver River, Beaver County, PA, U.S. Army Corps of Engineers, Pittsburgh District.** Project Economist responsible for conducting a cost-benefit analysis for alternatives for

relieving sedimentation and debris problems on the Lower Beaver River. Quantified benefits to the many marinas on the river segment and benefits to recreational boaters who dock on the Lower Beaver River. Worked with the Beaver County Corporation for Economic Development to develop a questionnaire for marina operators. Developed spreadsheets that calculated present value of benefits over a 35-year time horizon as the difference between with- and without-project conditions for each of the alternatives.

- **North Fork Hughes River Recreation Study, Ritchie County, WV, U.S. Department of Agriculture, Natural Resources Conservation Service.** Project Economist responsible for estimating the net recreational benefits of a proposed 300-acre reservoir. Developed an estimate of project visitation using the U.S. Army Corps of Engineers' "similar project" method. The recreational value of the visitation projection was quantified by applying U.S. Forest Service activity-day values to a projected mix of activities at the proposed project. Net benefits were calculated by subtracting the value of recreation diverted from other parks and the value of recreation currently occurring at the project site from the estimated gross benefits. The study successfully withstood critical reviews by economists working on behalf of organizations engaged in litigation against the project.
- **Offshore Extraction Draft Supplemental Environmental Impact Statement, Gulf of Mexico, U.S. Environmental Protection Agency, Region 4.** Environmental Planner responsible for preparing an environmental impact statement for the issuance of general new source National Pollutant Discharge Elimination System (NPDES) permits for oil and gas extraction in federal waters in the Gulf of Mexico. Served as primary author of the chapters on "Purpose and Need for the Action and Description of Alternatives." Coordinated production and authored many of the sections of the chapter on "Affected Environment and Potential Environmental Consequences of Alternatives." Dealt with environmental issues, including marine water impacts, impacts on seagrasses and other live bottom communities, naturally occurring radioactive materials, and risk of oil spills.
- **Technical Manual for U.S. EPA Programs and National Environmental Policy Act (NEPA) Reviews, NEPA Contract, U.S. Environmental Protection Agency (U.S. EPA), Region 4.** Economist on a project team responsible for preparing a manual to assist the U.S. EPA in reviewing programs and NEPA documents in light of global climate change. Surveyed available methods and practices for mitigating global climate impacts of projects under NEPA review. Mitigation methods reviewed included afforestation, energy conservation landscaping, alternative electricity generation technologies, and alternative fuels for motor vehicles.
- **Review of Cost-Benefit Analysis of Coastal Projects, U.S. Environmental Protection Agency, Region 4.** Economist responsible for conducting an examination of the impact of global climate change on sea level and its implications for cost-benefit analyses of coastal zone projects and programs. Part of the study consisted of developing and implementing a questionnaire concerning a sea-level rise impacts analysis for distribution to coastal management professionals. The study included an assessment of the U.S. Army Corps of Engineers' procedures for accounting for sea-level rise in its cost-benefit analyses.

Related Publications and Presentations

- "Economic Impacts of Railroads in Pennsylvania." Presented at 2005 Pennsylvania Rail Freight Conference and Seminar.
- Malarich, Kathryn R., James Elliott, and Paul Herbert. "Development of Equitable and Incentive-Compatible Service Fees in Integrated Waste Management Systems." Published in Proceedings of the Eighth International Conference on Solid Waste Management and Secondary Materials, 1992.
- Rothdeutsch, Kathryn. A Guidebook to Integrated Solid Waste Management. Published by Michigan Environmental Council, 1989.

Professional Associations

- Public Recycling Officials of Pennsylvania

Timothy D. Stark, P.h.D., PE, D.GE

Qualifications Summary

- Has been a licensed professional engineer for 17 years.
- Has been in academia for about 25 years.
- Involved in design of flood control works including levee and underseepage control features. HNTB, Baton Rouge, LA: Geotechnical expert for Dallas Floodway System in Dallas, TX, 2010 – date – Project involves levee stability and underseepage for 23 miles of levee through downtown Dallas. U.S. Army Corps of Engineers, Kansas City District, Kansas City, MO: Advisory Panel seismic retrofit of Tuttle Creek Dam near Manhattan, Kansas, 2005 – date – Project involves underseepage control, relief well construction and protection, and design and construction of 351 cement-bentonite shear walls transverse to the dam axis with dimensions of 4 feet wide by 45 feet long by generally 62 feet deep to stabilize the downstream slope from Stations 24+92 and 73+60
- Involved (since 1988) in a variety of Geoenvironmental projects including waste containment design, excavation and re-disposal of contaminated materials, and liner and cover system designs for contaminated soils
- lived in Illinois for 21 years and familiar with the Mississippi River Floodplain and geotechnical practices in the floodplain. Spent two summer working at Waterways Experiment Station in Vicksburg, Mississippi working on dam and levee related projects.
- Has demonstrated experience in performing cost engineering/construction management for all phases of flood risk management related projects to include as an expert for geomembrane lined reservoir slope failures and repair at O'Hare Airport, geotechnical expert for Flooding in Fairfax County, Va., expert for stability of Cull Creek Flood Control Dam in Castro Valley, Calif., and as an expert for stability of Don Castro Flood Control Dam in Castro Valley, Calif.
- Familiar with geotechnical practices associated with floodwall design and construction, to include as a geotechnical expert for Dallas Floodway System in Dallas, Tex., serving on the Advisory Panel seismic retrofit of Tuttle Creek Dam near Manhattan, Kans., and geotechnical expert for Flooding in Fairfax County, Va.
- Served as Session Organizer, Geosynthetic Floating Covers Systems and Elevated Temperatures in Landfills, Geo-Frontiers 2011 Conference, 2010 – 2011; Organizer, Annual Ralph B. Peck Spring Seminar, Chicago ASCE Geotechnical Group at University of Illinois at Chicago, 2011; Editorial Board Member, ASCE Journal of Geotechnical and Geoenvironmental Engineering; Technical Program Committee, Geosynthetics Conference 2007, North American Geosynthetics Society and Industrial Fabrics Association International; Session Organizer, Slope Stability Research, Geosynthetics; Session Organizer, Legal and Liability Issues in Geotechnical Engrg., ASCE Geo-Frontiers Conference; and Member, Embankment Dams and Slopes Committee, ASCE Geotechnical Engineering Division.

Education

- Ph.D., Geotechnical Engineering, Virginia Polytechnic Institute & State University, 1987
- M. Engineering, Geotechnical Engineering, University of California at Berkeley, 1984
- B.S., Civil Engineering, University of Delaware (with Honors), 1981

Certifications and Licenses

- Professional Civil Engineer, State of Illinois (#062-048775, 1994)

Summary of Professional Experience

University of Illinois at Urbana-Champaign (UIUC) —Professor of Civil and Environmental Engineering; Director, Fabricated Geomembrane Institute-Technology Program; Director, PVC Geomembrane Institute-Technology Program; Program Coordinator, Transportation Networks Program, Mid-America Earthquake Center; Associate Professor of Civil Engineering; Assistant Professor of Civil Engineering

San Diego State University —Assistant Professor of Civil Engineering

Virginia Polytechnic Institute —Teaching and Research Assistant

- Instruction in graduate geotechnical engineering courses; research on strength loss in stiff clays and probabilistic settlement analyses

University of California, Berkeley —Research Assistant

- Laboratory investigation on the formation of borehole breakouts in rock

Woodward-Clyde Consultants, Walnut Creek, Calif. —Staff Engineer

- Subsurface investigations and design of remedial measures for landslides in Contra Costa County, geotechnical and structural design of retaining walls, and lateral load behavior of drilled shaft foundations; Liquefaction analyses, probabilistic seismicity evaluations, and seismic response analysis of power plants and earth dams

Consulting Experience

- USACE, Engineering Research and Development Center (ERDC), Vicksburg, MS: Enhancing consolidation, secondary compression, and desiccation of dredged fill microcomputer program PSDDF, 2010-2012.
- USACE, ERDC: Expert for shear strength testing for Dallas Floodway System, TX, 2010 - date.
- HNTB, Baton Rouge, LA: Expert for slope stability analyses for Dallas Floodway System in Dallas, TX, 2010 - date.
- Dan Brown and Assoc., Kansas City, MO: Design review for pile supported embankment in Hasting, MN, 2010 - date.
- E2, Inc., Charlottesville, VA: Expert for re-development of Superfund Site in Utah, 2010 - date.
- Stantec Consultants, Nashville, TN: Expert for stability evaluation of upstream slope of Wolf Creek Dam, 2010 - date.
- Fehseke & Eschman Law Offices, Fort Madison, IA: Expert for slope movement cause, Fort Madison, IA, 2010 - date.
- John Deere Company, Moline, IL: Evaluate pressures applied by new high speed dozer, 2010 - date.
- Terracon, San Antonio, TX: Expert for landslide cause and repair, 2010 - date.
- Terracon, Des Moines, IA: Expert for MSE wall failure near Kansas City, Missouri, 2010 - date.
- Law Offices of Alan M. Mayer, Inc., San Francisco, CA: Expert for slope movement cause, Clayton, CA, 2010 - date.
- Applied Earth Sciences, Los Angeles, CA: Expert for landslide complex at Frank Bowerman Landfill, Los Angeles, California, 2008 - date.
- de la Pena & McDonald, LLP, San Francisco, CA: Expert for slope movement cause, San Rafael, CA, 2009 - date.
- Blazosky Associates, Valley Forge, PA: Expert for Landfill fire in Pennsylvania, 2006 - date.
- Los Angeles Department of Water and Power, Los Angeles, CA: Expert for landslide cause and repair in Bel Air, California, 2006 - date.

- McConaughy & Sarkissian, P.C., Denver, CO: Expert for differing site condition claim near Glenwood Springs, Colorado, 2008 - date.
- Terracon, Des Moines, IA: Expert for landslide cause and repair near Boone, Iowa, 2008 - date.
- Montgomery-Watson-Harza, Chicago, IL: Expert for geomembrane lined reservoir slope failures and repair at O'Hare Airport, 2007 - date.
- de la Pena & McDonald, LLP, San Francisco, CA: Expert for mudslide cause and repair, San Rafael, CA, 2007 - 2008.
- USACE, Kansas City District, Kansas City, MO: Advisory Panel seismic retrofit of Tuttle Creek Dam near Manhattan, Kansas, 2005 - date.
- Ohio Environmental Protection Agency, Columbus, OH: Expert for landfill slope failure and fire in Ohio, 2007 - date.
- National Cooperative Highway Research Program, 24-11(02): Guidelines for Geofoam in Slope Stabilization Applications, Transportation Research Board, Washington, D.C., 2006 – date.
- Geo-Logic Associates, Inc., Los Angeles, CA: Expert for liquefaction and slope stability for proposed landfill expansion on San Francisco Bay, 2006 - date.
- Aquaterra, Jefferson City, MO: Expert for slope stability of expansion of Lemons Landfill in Dexter, MO, 2005 - date.
- ENVIRON Environmental Consulting, Newark, NJ: Expert for developing guidance document for physical groundwater barriers at contaminated sites in Italy, 2007 - date.
- Blazosky Associates, Valley Forge, PA: Expert for landfill with elevated temperatures, 2009 - date.
- American Electric Power, Columbus, OH: Expert for landslide cause and repair in Ohio, 2007 - 2008.
- American Electric Power, Columbus, OH: Expert for slope stability problem in landfill in West Virginia, 2007 - 2008.
- Ohio Department of Transportation, Columbus, OH: Dispute Resolution Board Member for large Interstate expansion and reconstruction project in Cleveland, 2006 - date.
- Bell, Rosenberg & Hughes, Oakland, CA: Expert for construction claims related to Privatized Toll Road project near San Diego, California, 2005 - date.
- Blazosky Associates, Valley Forge, PA: Expert for PVC geomembrane liner system in MSW landfill, 2006 - date.
- Waste Management, Oak Brook, IL: Stability expert for new landfill near Chicago, IL, 2006 - 2008.
- Levin, Fishbein, Sedran, and Berman, Philadelphia, PA: Expert for Flooding in Fairfax County, Virginia, 2006 - 2007.
- Federal Highway Administration, Washington, D.C.: Expert for Synthesis on Use of Geosynthetics in Pavements and Development of a Roadmap to Geosynthetically-Modified Pavements, 2006 - 2009.
- Morgan, Miller Blair, LLP, San Francisco, CA: Expert for landslide cause and repair near Livermore, CA, 2003 - 2008.
- Waste Management, East St. Louis, IL: Expert for expansion of Milam Landfill in East St. Louis, IL, 2005 - 2007.
- Geomatrix, Los Angeles, CA: Slope stability expert for design of large landfill in California, 2006 - 2008.
- Oxford Mining, Oxford, OH: Expert for new MSW Landfill in Oxford, OH, 2004 - 2006.
- Cal Engineering & Geology, Walnut Creek, CA: Expert for static and seismic stability of Cull Creek Dam in Castro Valley, CA, 2004 - 2006.
- Cal Engineering & Geology, Walnut Creek, CA: Expert for static and seismic stability of Don Castro Dam in Castro Valley, CA, 2004 - 2006.
- U.S. Bureau of Reclamation, Denver, CO: Columbia River Stability Assessment at Grand Coulee Dam, 2004 –

2006.

- American Electric Power, Columbus, OH: Expert for vertical expansion of landfill over a fly ash tailings reservoir in Steubenville, Ohio, 2003 - 2006.
- American Electric Power, Columbus, OH: Expert for vertical expansion of landfill in Conesville, Ohio, 2003 - 2005.
- Camp, Dresser, and McKee, Chicago, IL: Expert for converting waste filled quarry to a large recreation complex in Chicago, 2005 - 2006.
- Altshuler, Berzon, Nussbaum, Rubin, and Demain, LLC, San Francisco, CA: Expert for static and seismic stability of large landfill expansion near Los Angeles, 2005 - 2006.
- Jackson Kelly, PLLC, Denver, CO: Expert for slope failure in water retention pond, 2005 - 2006.
- Thompson, Hine, LLP, Cincinnati, OH: Expert for landslide cause and repair near Cincinnati, Ohio, 2005 - 2006.
- U.S. Silica, LaSalle, IL: Stability expert for sand and gravel quarry mine expansion in La Salle, IL, 2004 - 2005.
- Dakota County Environmental Management Department, Hastings, Minnesota: Expert review of geotechnical evaluation for leachate recirculation project at Burnsville Solid Waste Landfill in Burnsville, Minnesota, 2004.
- Clorox Company, Oakland, CA: Expert for expansive soil issues, 2004 - 2005.
- Ohio Environmental Protection Agency, Cleveland, OH: Expert for Slope Failure during Redevelopment of Closed Landfill, 2004 - 2005.
- STS Consultants, Green Bay, WI: Expert for vertical and lateral expansion of bioreactor landfill in Illinois, 2003 - 2004.
- Camp, Dresser, and McKee, Raleigh, NC: Expert review of geotechnical stability evaluation for Buncombe Project XL bioreactor at Buncombe County Solid Waste Landfill in Alexander, North Carolina, 2002 - 2003.
- USACE, Waterways Experiment Station, Vicksburg, MS: Revising and enhancing microcomputer program PSDDF (Primary consolidation, Secondary compression, and Desiccation of Dredged Fill), 2001 - 2003.
- Rich and Henderson, P.C., Annapolis, MD: Expert for slope failure in a landfill final cover system, 2002 - 2004.
- Lanahan & Reilley, LLP, San Francisco, CA: Expert for landslide near San Francisco, California, 2001 - 2004.
- Transportation Technology Center, Inc. (subsidiary of Association of American Railroads), Pueblo, CO: Review of technologies for real-time detection of landslides and other wayside hazards, 2000 - 2002.
- Godfrey and Kahn, Milwaukee, WI: Expert geotechnical engineering analyses for proposed mining project, 2001 - 2003.
- Ohio Environmental Protection Agency, Columbus, OH: Expert for Geotechnical Engineering Issues, 1996 - 2003.
- Bell, Rosenberg & Hughes, Oakland, CA: Expert for landslide near San Francisco, California, 1999 - 2001.
- U.S. Geological Survey, Reston, VA: Interpretation of Paleoliquefaction Features using Cone Penetration Test Results, 2001 - 2004.
- Chemical Waste Management, Model City, NY: Expert stability analyses for Hazardous Waste Landfill in Model City, New York, 1999 - 2000.
- Golder Associates, Inc., Los Angeles, California: Measurement and use of drained residual shear strengths in stability analyses for Otay Mesa Landfill slope failure, San Diego, CA, 1999.
- Andrews Engineering, Pontiac, IL: Stability Analyses for Design of Landfill Cover Systems, 1999 - 2000.
- Ohio Environmental Protection Agency, Columbus, OH: Review of settlement analyses and permit application for Countywide and Cuyahoga Landfills, 1999 - 2001.
- Pillori and Associates, Red Bank, NJ: Expert opinion for Heap Leach Pad slope failure involving a geomembrane in Santiago, Chile, 1998 - 1999.

- Advanced GeoServices Corporation, Chadds Ford, PA: Static and seismic slope stability analyses for proposed Superfund landfill in Portland, OR, 1998 - 1999.
- Ohio Environmental Protection Agency, Columbus, OH: Stability analyses for landfill slope failure involving leachate recirculation at Geneva Landfill, 1998 - 2000.
- Monroe County Landfill, Bloomington, IN: Static and seismic slope stability analyses for permit application for conversion of MSW landfill to a balefill, 1998 - 2001.
- Ohio Environmental Protection Agency, Columbus, OH: Review of permit application and conduct slope stability analyses for Suburban South RDF, Inc., Brownsville, Ohio, 1998 - 1999.
- Jay Janssen Law Group, Peoria, IL: Expert for fatal landslide at East Side Park in East Peoria, 1998-1999.
- STS Consultants, Chicago, IL: Measurement and use of residual shear strengths for slope failure at industrial landfill near Chicago, 1998-2001.
- Clausen-Miller, P.C., Chicago, IL: Expert for landslide at Rumpke Sanitary Landfill near Cincinnati, 1997-1999.
- Ohio Environmental Protection Agency, Columbus, OH: Permit application review for Waste Control Services and 3M-Copley Landfills in Ohio, 1998-1999.
- Arkansas Environmental Protection Agency, Little Rock, AR: Development of technical presentations on static and seismic slope stability for solid waste containment facilities, 1998-2000.
- Ohio Environmental Protection Agency, Columbus, OH: Development of technical presentations and short courses on static and seismic slope stability for solid waste containment facilities, 1997-2000.
- Missouri Department of Natural Resources, Jefferson City, MO: Development of technical guidance document on static and seismic slope stability for solid waste containment facilities, 1997-1999.
- Cotton, Shires & Associates, San Francisco, CA: Measurement and use of drained residual shear strengths in slope stability analyses for Anaheim Hills and Partridge Hills Landslides, San Francisco and Los Angeles, CA, 1998.
- Woodward-Clyde Consultants, San Francisco, CA: Measurement and use of drained residual shear strengths in slope stability analyses for Keller Canyon Landfill, San Francisco, CA, 1998.
- American Geotechnical, Inc., San Diego, CA: Measurement and use of cohesive soil residual strength in slope stability analyses for Niguel Summit Landslide, Los Angeles, 1998.
- Ohio Environmental Protection Agency, Columbus, OH: Review of stability analyses and measurement of cohesive soil residual strength for landslide at Vandale Superfund Landfill near Marietta, Ohio, 1998-2000.
- EBA Waste Technologies, Santa Rosa, CA: Three-dimensional slope stability analysis for permit application for Phase IIa of Toland Road Landfill, Los Angeles, CA, 1997 - 1998.
- Korean Architects Collaborative International, Seoul, KOREA: Evaluation of geosynthetic clogging potential of geosynthetics in permanent dewatering system of Passenger Terminal Building No. 1 at the new Incheon International Airport, Incheon, Korea, 1997 - 1998.
- Soil Testing Engineers, Inc., Baton Rouge, LA: Measurement and use of drained and undrained residual shear strengths in analysis of Port Allen retaining wall failure, New Orleans, LA, 1997.
- Woodward-Clyde Consultants, Denver, CO: Measurement and use of undrained residual shear strengths in slope stability analyses for tailings dams at Kennecott Mining Company, Salt Lake City, Utah, 1997.
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Refereed Publications Submitted and In Preparation

- Stark, T.D., Walberg, F.C., Nicholson, P.J., Axtell, P.J., Lewis, J.R., Dillon, J.C., Empson, W.B., Topi, J.E., and Mathews, D.L. "Jet Grouting and Dam Safety," to be submitted to DFI Journal, Deep Foundations Institute, December, 2010.
- Stark, T.D., Walberg, F.C., Nicholson, P.J., Axtell, P.J., Lewis, J.R., Dillon, J.C., Empson, W.B., Topi, J.E., and Mathews, D.L. "Seismic Retrofit of Tuttle Creek Dam," to be submitted to Canadian Geotechnical Journal, December, 2010.
- Stark, T.D. and A. Sadrekarimi, "Earthquake Induced Excess Pore Water Pressures in the Upper San Fernando Dam during the 1971 San Fernando Earthquake," TO BE SUBMITTED to Canadian Geotechnical J., January, 2009.
- Stark, T.D., N. Fawad, and T. Keuscher, "Comparison of Single and Multiple Geosynthetic Geosynthetic Interface Tests," TO BE SUBMITTED TO Geosynthetics International Journal, June, 2008.
- Stark, T.D., E.J. Newman, and S. M. Olson, "Liquefaction Resistance Using CPT and Field Case Histories," TO BE SUBMITTED to Journal of Geotechnical and Geoenvironmental Engineering, ASCE, March, 2010.
- Stark, T.D., H. Choi, and T.-B. Nguyen, "Performance-based Evaluation of a Double Composite Landfill Liner System Based on Leakage Rate," SUBMITTED to Journal of Geotechnical and Geoenvironmental Engineering, ASCE, January, 2010.
- Stark, T.D., H. Choi, and T.-B. Nguyen, "Performance-based Evaluation of a Double Composite Landfill Liner System Based on Solute Transport," SUBMITTED to Journal of Geotechnical and Geoenvironmental Engineering, ASCE, January, 2010.

- Stark, T.D. and H. Choi, "Use of FLAC for Slope Stability Analyses," TO BE SUBMITTED to Canadian Geotechnical Journal, Canadian Geotechnical Society, June, 2009.
- Stark, T.D. and E. Newman, "Importance of Stress Distribution on Hillside Stability," TO BE SUBMITTED to Geotechnical and Geoenvironmental Engineering, ASCE, June, 2009.
- Stark, T.D. and E. Newman, "Interpretation of Ground Shaking from Paleoliquefaction Features," TO BE SUBMITTED to Journal of Geotechnical and Geoenvironmental Engineering, ASCE, June, 2009.
- Stark, T.D., P. Wotring, and B. Fouke, "Constraints on Relative Timing and Stratigraphy of Colluvium and Its Identification," TO BE SUBMITTED to Journal of Engineering Geology, July, 2009.
- Stark, T.D., P. Stover, and B. Fouke, "Design of Colluvial Slopes", ASCE, Journal of Geotechnical and Geoenvironmental Engineering, July, 2009.

Professional Associations

- Associate Editor, Geotechnical and Geoenvironmental Engineering Journal, ASCE – 2009 - date
- Member, Geoenvironmental Engineering Committee, ASCE – 2009 - date
- Member, GeoEngineering Earthquake Reconnaissance (GEER) Association
- Faculty Member, American Society of Foundation Engineers (ASFE)
- Member, American Society for Testing and Materials (ASTM) Committees:
D-18 - Soil and Rock
D-35 - Geotextiles, Geomembranes, and Related Products
- Fellow, American Society of Civil Engineers, Geotechnical Engineering Division – 2006 – Present
- Member, American Society of Civil Engineers, Geotechnical Engineering Division – 1985 – 2005
- Member, International Society of Soil Mechanics and Foundation Engineering
- Member, International Society of Explosives Engineers

Awards

- Nominee, 2009 U.S. Army Corps of Engrs. Dam Safety Award, Seismic Retrofit of Tuttle Creek Dam, Northwest Division.
- Elected Diplomate, Geotechnical Engineering, Academy of Geo-Professionals, ASCE, 2010
- Classic Paper in Geosynthetics, (Stark and Poeppel, 1994, ASCE Journal of Geotechnical and Geoenvironmental Engineering, "Landfill Liner Interface Strengths from Torsional Ring Shear Tests"), Geo-Americas Conference, 2008
- Elected Fellow, American Society of Civil Engineers (ASCE), 2005
- R.M. Quigley Award, for "best" paper in the Canadian Geotechnical Journal in 2002, "Liquefied Strength Ratio from Liquefaction Flow Failure Case Histories", Canadian Geotechnical Society, September, 2003
- Standards Development Award, Standard Designation D6467: Standard Test Method for Torsional Ring Shear Test to Determine Drained Residual Shear Strength of Cohesive Soils, American Society for Testing and Materials, 2002
- Walter L. Huber Civil Engineering Research Prize, "advancing the basic understanding of natural slopes, the stability of man-made slopes, and the evaluation of the strength/stability of soils subjected to earthquake loadings", ASCE, 1999
- University Scholar, University Scholars Program, University of Illinois at Urbana-Champaign, 1998-2001
- Thomas A. Middlebrooks Award for "best" paper in the Journal of Geotechnical and Geoenvironmental Engineering, "Slope Stability Analyses in Stiff Fissured Clays", ASCE, 1998

- Outstanding Paper Nomination, one of eight papers nominated for ASCE Journal of Performance of Constructed Facilities annual outstanding paper award, Editors Note, February 2001
- Outstanding Section Campus Representative Award, IL/IN Section, American Society for Engrg. Education, 1998.
- List of Teachers Ranked as Excellent by Their Students, Univ. of Illinois, 1995, 1996, 2004, 2005, 2006, 2007, 2008, 2009.
- News Correspondent Award, ASCE, 1995
- William J. and Elaine F. Hall Scholar (First Recipient), Dept. of Civil Engrg., UIUC, 1994-1996.
- DOW Outstanding New Faculty Award, American Society for Engineering Education, 1994.
- Xerox Award for Faculty Research, College of Engineering, UIUC, 1993
- Presidential Citation for Outstanding Alumni Achievement, University of Delaware, 1993
- Arthur Casagrande Professional Development Award, “residual strength of cohesive and liquefiable soils and the seismic stability of slopes”, ASCE, 1992
- Edmund Friedman Young Engineer Award for Professional Achievement, ASCE, 1991
- Timeos Award, Outstanding Assistant Professor at San Diego State Univ. (SDSU), Phi Eta Sigma Honor Society, 1990
- Outstanding Civil Engineering Professor Award, San Diego St. Univ.(SDSU), Chi Epsilon Honor Society, 1990
- Meritorious Performance and Professional Promise Award by President of SDSU, 1990
- Outstanding College of Engineering Professor, SDSU, Tau Beta Pi Honor Society, 1989
- USACE Summer Research Fellow, Waterways Experiment Station, 1988 & 1991

Appendix C – Charge for IEPR Panel

The general charge questions provided by the USACE to support the IEPR for the Wood River Project are listed below. This was provided to the panel to guide its review.

C.1 Objectives

The objective of this task is to describe the project and provide information in order that an IEPR of the LRR can be performed. IEPR is one of the important procedures used to ensure the quality of published information meets the standards of the scientific and technical community. Peer review typically evaluates the clarity of hypotheses, the validity of the research design, the quality of data collection procedures, the robustness of the methods employed, the appropriateness of the methods for the hypotheses being tested, the extent to which the conclusions follow from the analysis, and the strengths and limitations of the overall product.

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The panel will identify, recommend, and comment upon the assumptions underlying the analyses as well as evaluating the soundness of models and planning methods. The panel should be able to evaluate whether the interpretations of analyses and conclusions are technically sound and reasonable, provide effective review in terms of both usefulness of results and creditability, and have the flexibility to bring important issues to the attention of decision makers. The panel may offer opinions as to whether there are sufficient technical analyses upon which to base the ability to implement the project. The panel will address factual inputs, data, the use of geotechnical analyses, assumptions, and other scientific and engineering tools/methodologies to inform decision-making.

C.2 Documents Provided

The following documents pertaining to the IEPR were provided:

- *Limited Reevaluation Report, Wood River Levee System, Design Deficiency Corrections, Madison County, Illinois*, with plates and appendices and supporting documentation (approximately 414 pages)
- Agency Technical Review Comments and Responses (provided as a courtesy to the panel if they wish to read)
- Value Engineering Study, Wood River Levee LRR, Seepage Control
- Wood River Levee System General Reevaluation Report Economic Appendix

C.3 Charge for Peer Review

The purpose of the IEPR is to analyze the adequacy and acceptability of economic, engineering, and environmental methods, models, data, and analyses performed for the LRR. The review will be limited to technical review and will not involve policy review. The IEPR will be conducted by an expert panel with extensive experience in NEPA impact assessment, civil/geotechnical

engineering, and economics. The panel will be “charged” with responding to specific technical questions as well as providing a broad technical (engineering, economic, and environmental) evaluation of the overall project.

C.4 General Charge Guidance

Please answer the scientific and technical questions listed below and conduct a broad overview of the Wood River LRR. Please focus on your areas of expertise and technical knowledge. Even though there are some sections that do not specifically have charge 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 1 and 2 below per USACE guidance (EC No. 1165-2-209; Appendix D).

1. Assess the adequacy and acceptability of the evaluation and selection of alternatives.
2. If appropriate, offer opinions as to whether there are sufficient analyses upon which to base a recommendation for construction, authorization, or funding.
3. Evaluate whether the interpretations of analysis and conclusions are reasonable.
4. Please focus the review on scientific information, including factual inputs, data, the use and soundness of models, analyses, assumptions, and other scientific and engineering matters that inform decision makers.
5. 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.
6. If desired, panel members can contact one other. 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.

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.

C.5 General Charge Questions

1. Were all models used in the analyses used in an appropriate manner?
2. Are the models used sufficiently discriminatory to support the conclusions drawn from them (i.e. identify meaningful differences between alternatives)?
3. Were risk and uncertainty sufficiently considered?
4. Are potential life safety issues accurately and adequately described under existing, future without project, and future with project conditions?
5. In your opinion, are there sufficient analyses upon which to base the recommendation?

Problem, Opportunities, Objectives, and Constraints

1. Are the problems, opportunities, objectives, and constraints adequately and correctly defined?

2. Do the identified problems, opportunities, objectives, and constraints reflect a systems, watershed, and/or ecosystem approach, addressing a geographic area large enough to ensure that plans address the cause and effect relationships among affected resources and activities that are pertinent to achieving the study objectives; i.e., evaluate the resources and related demands as a system?
3. Did the study address those resources identified during the scoping process as important in making decisions relating to the study?

Existing and Future Without Project Resources

1. Has the character and scope of the study area been adequately described and is the identified study area appropriate in terms of undertaking a systems/watershed/ecosystem based investigation?
2. Do you agree with the general analyses of the existing social, financial, and natural resources within the study area?
3. For your particular area of expertise, provide an in-depth review of whether the analyses of the existing social, financial, and natural resources within the project area are sufficient to support the estimation of impacts of the array of alternatives.
4. Given your area of expertise, does this section appropriately address the existing conditions of all resources pertinent to the study?
5. Were there surveys conducted to evaluate the existing social, financial, and natural resources adequate? If not, what types of surveys should have been conducted?
6. Were socioeconomic conditions adequately addressed? Were specific socioeconomic issues not addressed?
7. Was the hydrology discussion sufficient to characterize current baseline conditions and to allow for evaluation of how forecasted conditions (with and without proposed actions) are likely to affect hydrologic conditions. Is the discussion complete on the relationship between subsurface hydrology and the hydrodynamics of the project area?
8. Was the discussion of natural resources sufficient to characterize current baseline conditions and to allow for evaluation of forecasted conditions (with and without proposed actions)?
9. Were the assumptions used as the basis for developing the most probable future without project conditions reasonable? Were adequate scenarios effectively considered (applied during analyses where relevant and/or reasonably investigated)? Were the potential effects of climate change addressed?
10. Are the future conditions expected to exist in the absence of a Federal project logical and adequately described and documented?
11. Please comment on the conclusion of the most probable future without project condition. Do you envision other potential probable outcomes?

Plan Formulation/Alternative Development

1. Was a reasonably complete array of possible measures considered in the development of alternatives?
2. Did the formulation process follow the requirement to avoid, minimize, and then mitigate adverse impacts to resources?
3. Does each alternative meet the formulation criteria of being effective, efficient, complete and acceptable?
4. Were the assumptions made for use in developing the future with project conditions for each alternative reasonable? Were adequate scenarios considered? Were the assumptions reasonably consistent across the range of alternatives and/or adequately justified where different?
5. Are the changes between the without and with project conditions adequately described for each alternative?
6. Are the uncertainties inherent in our evaluation of benefits, costs, and impacts, and any risk associated with those uncertainties, adequately addressed and described for each alternative?
7. Are future Operation, Maintenance, Repair, Replacement, and Rehabilitation efforts adequately described and are the estimated costs of those efforts reasonable for each alternative?
8. Please comment on the screening of the proposed alternatives. Are the screening criteria appropriate? In your professional opinion are the results of the screening acceptable? Were any measures or alternatives screened out too early?
9. Were the engineering, economic, and environmental analyses used for this study consistent with generally accepted methodologies?
10. Does any alternative include identified separable elements (a portion of a project that is physically separable, and produces hydrologic effects or physical or economic benefits that are separately identifiable from those produced by other portions of the project)? If so, is each identified separable element independently justified and are the benefits, costs, and effects of the separable elements correctly divided?

Recommended Plan

1. Comment on whether you agree or disagree with how the selected alternative was formulated and selected. Comment on the plan formulation. Does it meet the study objectives and avoid violating the study constraints?
2. Are there any unmitigated environmental impacts not identified and if so could they impact plan selection?
3. Please comment on the likelihood of the recommended plan to achieve the expected outputs.
4. Please comment on the completeness of the recommended plan, i.e. will any additional efforts, measures, or projects be needed to realize the expected benefits?

5. Please comment on the appropriateness of location, sizing and design of plan features.

Flood Risk Management and Damages Reduction

1. Are residual risks adequately described and is there a sufficient plan for communicating the residual risk to affected populations?
2. Are the magnitudes and timeframes assumed for damages related to expected future losses reasonable?

Levee Safety

1. Is there sufficient information presented to identify, explain, and comment on assumptions that underlie engineering analyses?
2. Does the physical data and observed data provide adequate information to characterize the project and its performance?
3. Have all characteristics, conditions, and scenarios leading to failure, along with the potential consequences, been identified? Have all pertinent factors, including population at risk, been considered in the estimation of risk for the baseline condition? Have all the levee safety issues and opportunities been identified?
4. Have the potential impacts of each alternative been clearly and adequately presented, including expected risk reduction, residual risk, changes in existing outputs of the project, potential mitigation, implementation schedules and costs?

Economics

1. Are all costs (internal and external) of the deficiency correction that are necessary to realize the benefits, appropriately identified and included in the investment analysis?
2. Are valuations of project outputs consistent with economic theory and explained sufficiently to support the recommended improvement?
3. Are economic assumptions about the future with and without project conditions reasonable and considered consistent with other economic forecasts?
4. Has time preference of capital (interest during construction, benefits during construction, discounting of future benefits) been adequately addressed in the investment evaluation?
5. Has the timing of the investment been appropriately addressed in the investment analysis?
6. Have costs been appropriately discriminated among financial and economic costs?
7. Have critical economic problems and opportunities been described and are they consistent with current economic investment consideration?
8. Based on current economic thought and investment decision criteria, has a plan been clearly demonstrated to provide an optimum economic investment?
9. Have the key economic assumptions affecting economic justification been identified and are they consistent with current economic thought?
10. Are there economic considerations that were not investigated or were and need additional scrutiny before implementation of the recommended improvement?

11. Has the document fully communicated the physical and fiscal risks with and without implementation of the proposed improvement?
12. Has the assessment of risk been accomplished consistently with appropriate analytical tools and acceptable industry practices?
13. Are physical and fiscal risk management solutions comprehensive, complete, and effective?
14. Are the proposed risk management solutions optimal measures for minimizing the physical and fiscal risks?
15. Has the document fully communicated the uncertainty that exists in the valuation of flood risks?
16. Are the analytical tools used to identify and account for uncertainty in the evaluation and decision support, consistent with preferred industry techniques?