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Final Independent External Peer Review Report Herbert Hoover Dike Dam Safety Modification Report & Environmental Impact Statement

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Executive Summary

Project Background and Purpose

The Herbert Hoover Dike (HHD) is an approximately 143-mile long earthen embankment system around Lake Okeechobee in southern Florida. Lake Okeechobee is the third largest freshwater lake by area in the United States and is an integral part of the Central and Southern Florida Project flood protection system, municipal water supply system, waterway navigation system, and Everglades ecosystem.

The US Army Corps of Engineers (USACE) has conducted the Herbert Hoover Dike Dam Safety Modification Study (DSMS). This study is a comprehensive, system-wide analysis to identify risks in the HHD system and to recommend the necessary measures that can reduce the risk of dike failure.

The LMI Team, consisting of consisting of Logistics Management Institute (LMI) and Analysis Planning and Management Institute (APMI) was awarded a contract by the USACE to conduct an Independent External Peer Review (IEPR) for the USACE of the Herbert Hoover Dike Dam Safety Modification Report (DSMR), Draft Environmental Impact Statement (DEIS), and supporting documents. These documents have been published as part of the Herbert Hoover Dike Dam Safety Modification Study.

The purpose of the IEPR is to analyze the adequacy and acceptability of methods, modeling, data, and analyses that have been used to develop the Tentatively Selected Plan (TSP) described in the HHD DSMS documentation.

Independent External Peer Review Process

APMI conducted the IEPR in accordance with the procedures described in the Department of the Army, USACE Engineer Circular (EC) No. 1165-2-214, *Civil Works Review*, dated 15 December 2012. The IEPR review was conducted by a panel of subject matter experts with the following relevant expertise and experience:

- Geotechnical Engineering
- Engineering Geology
- Civil Engineering
- Structural Engineering
- Hydraulic and Hydrology Engineering
- Economics/Planning
- Environmental Planning/NEPA Impact Assessment
- Water Resource Planning

The IEPR panel was “charged” with providing a broad technical evaluation of the material contained in the DSMR and DEIS and supporting documentation. This report provides the final comments of the IEPR review panel based on its review of the assigned documents.

Results of the Independent External Peer Review

The panel members agreed on the adequacy, philosophy of approach, and acceptability of the economic, engineering, and environmental models and analysis used to support the Herbert Hoover Dike DSMS. The panel members found that the supporting documentation provided in the HHD DSMR adequately communicated the project development effort. The panel offered a number of comments to clarify specific content issues and improve the project. The panel members agreed that, in general, the planning and design efforts are of high quality.

There were a total of 24 comments. Of these, 2 are identified as having high significance, 6 as Medium High significance, 7 as Medium significance, 1 as Medium Low significance, and 8 as Low significance. The following paragraphs provide a summary of these panel comments in specific subject matter areas.

Geotechnical Engineering/Engineering Geology

The DSMR report and other documentation provide a detailed description of the analytical procedures used to evaluate a project with extremely variable and complex geology and potential risk. Overall the procedures utilized a systematic approach that broke the embankment into a number of reaches based upon geological characteristics and risk. The assumptions inherent in this type of an analytical procedure were carefully evaluated in many cases by teams of engineers and in some cases outside experts. A review of the documents indicated one shortcoming in the analyses and several potential additions required to clarify the DSMR. The only analytical shortcoming identified is the seepage analysis related to the fact that infiltration of precipitation through the surface of the pervious embankment was not considered in the calibration or the implementation of the seepage modeling. The overall annual precipitation of 70 inches per year on a 250-foot-wide pervious embankment section represents a potential seepage inflow of up to 4 $ft.^3$/day/lineal ft. of embankment which is in the same order of magnitude as the computed seepage volume without input from precipitation. Although the inflow to the embankment would be reduced by evapotranspiration losses, the inclusion of infiltration through the embankment could potentially change the calibration of the seepage models and the results of the analysis for both the cutoff and drainage alternatives. A sensitivity analysis regarding the impact of precipitation infiltration could be employed to evaluate the impact of this source of seepage flow related to the selection of the TSP.

An additional concern with the DSMR report is related to the fact that the report does not identify embankment stability as a potential failure mode, or state that slope stability had been previously evaluated and determined not to be a critical potential failure mode.

Remedial measures were not considered for several reaches of the embankment due to the low level of downstream risk. Since the assumed project life is 100 years, and there is a definite potential for increased downstream development, the DSMR should specifically document the need for a program to monitor the long-term downstream risk and to reconsider remedial measures if the risk increases.

Hydraulics and Hydrology

The USACE documentation was thorough and comprehensive for the hydrology and hydraulic analyses. There are a few issues that were not fully addressed or require clarification to eliminate confusion. These are summarized as follows.

The presentation of the Monte Carlo Reservoir Analysis Model (MCRAM) modeling and modeling results ought to be the focus in the Hydrologic Hazard Assessment report and the DSMR Executive Summary since that is the basis of hydrologic modeling for the projection of future projections of flooding events. The use of the term 10,000 year and 500,000 year in the MCRAM documentation implies a projection into the future. This was clarified by the USACE after the mid-point review as follows, which is a much clearer description: ”The model is not a projection into the future. The 10,000 samples are 10,000 versions for one year of precipitation that could occur this year or any year in the near future under current climate. The model assumes that the statistical properties of the observed record are representative of today's climate.” The USACE needs to consider changing the terminology to reflect a probability of an event, rather than using the term "____"-Year, which implies a projection.

Having an inflow to Lake Okeechobee that is six times the outlet capacity is concerning. This imbalance will likely always cause potential for higher lake levels that can cause additional hydraulic pressure on the cutoff walls and on the wave action against the dikes. There was no remediation of this condition in any of the alternatives that were presented in the table of alternatives. This issue needs to be addressed in some manner that does not flood downstream areas.

There is some misinterpretation of the historic time between tropical storm events. The USACE stated during the mid-point review that other more frequent tropical storm events were evaluated, but the results were not clearly found in the report.

Climate change was stated not to have been considered in the USACE analyses, and we believe this should be addressed. The USACE stated in the mid-point review that it was not a requirement, and, if so, then documenting of the justification for not addressing climate change should be stated clearly in the report.

Finally, the history of the hydraulics and hydrology progression over time could be placed in an appendix to avoid confusion and improve readability.

Structural Engineering

The Potential Failure Modes Analysis and baseline Risk Assessment of Structures is relatively well documented. The structural engineering comments are focused primarily on the risk reduction measures discussed in the DSMR for the concrete structures and pipes penetrating the embankment. The risk reduction measures involve jet grouting to connect the embankment cutoff wall to the existing structures and to extend the embankment cutoff wall under the existing pipes. Constructing the proposed jet grouting cutoff wall under the existing pipes will be challenging due to the close spacing of the pipes. Verifying the contact between the proposed jet grouting and the existing sheet piling cutoff walls under the existing structures also will be difficult due to the configuration of the existing timber piles. In addition to the jet grouting verification tests described in the November 2015 Risk Assessment Technical Summary Report, the jet grouting test sections should verify the diameter of the grout columns that can be produced

in the dike soils and the accuracy of the drilling for the jet grouting. Also, contingency plans should be developed (such as backup power) to ensure operational capability of the bypass pumps during power outages at each of the replacement culvert sites to maintain the flood control function during construction.

Civil Engineering

In general the engineering approach and analysis as described in the Herbert DSMR is sound and was performed in accordance with appropriate standards of practice. The narrative description of the cost engineering process suggests that the project cost estimate represents an accurate estimate of the project actual cost. However, the cost estimate, project schedule and, Cost and Schedule Risk Analysis report were not available for review. Consequently the adequacy of these project elements could not be determined.

Economics/Planning and Water Resources Planning

The HHD-DSMR is an excellent decision recommendation document. Documentation of the risk of dike failure and subsequent economic, social and environmental consequences provided justification for the proposed improvements. Plan formulation included investigation of an exhaustive array of non-structural and structural improvements. Rationale for components of each plan, development of the final array of structural plans, and recommendation of a tentatively selected implementation recommendation is properly supported. Justification of each recommended improvement is based on reducing the risk of life loss (AALL) to an acceptable level or further reducing the risk of life loss and societal consequences as low as reasonably practicable (ALARP). The ALARP is a cost-effectiveness (disproportionate cost of achieving the next lower level of risk) analysis that does not attempt to balance the next increment of cost against an increment of economic output. This should be made clear in the first definition of ALARP Instead of simply indicating cost effectiveness. Two segments that have an unacceptable risk for life loss are scheduled to be addressed in the fifth year of the proposed order of work. Improvements to accomplish tolerable risk levels for AALL should be implemented as the first priority. The Everglades Agriculture Area (EAA) is a principle economic engine and driver for the population at risk and economic consequences. Sea level change, subsidence and elimination of subsidies for sugar cane could reduce or eliminate the consequences that support the proposed investment recommendation. Alternatively, the need for the proposed improvements would become more substantial with accelerated development if agriculture is suspended, raising the issue of how appropriate the recommended improvements are in an alternative future. Justification of the proposed improvements is based on exceedance of tolerable risk in terms of AALL, annual probability of failure (APF) and ALARP. These values have been computed with the DAMRAE and FIA models and depend on factors that are hard-wired, such as fatality rate for persons caught during mobilization. These models must simulate the conditions in the HHD impact area. Warning times are estimated for various pool loadings, but for an overwash and/or overtopping event it is speculative whether these would be realized.

Environmental Planning/NEPA Impact Assessment

The DSMR Draft EIS does an excellent job of explaining the Purpose and Need for the project and instilling in the reader the importance of addressing safety issues associated with improving the HHD. The material is presented in a clear and straightforward manner, and the document was very well organized. The EIS also gave a thoughtful presentation of Future Without Action conditions (FWAC); the EIS did not simply extrapolate present conditions.

The environmental analysis in the Draft EIS is clear and brief, but comprehensive enough to meet the requirements of National Environmental Policy Act in addressing the variety of areas that might be impacted by the project. However, while the conclusions appear reasonable given the focus of the project on the berm area, the lack of detail under existing conditions and impacts, especially regarding natural resources, makes it more difficult to verify the findings regarding impacts. This is not a critical issue, since significant adverse impacts are not anticipated, but is of concern in presenting the material to an educated public that is already vocal about impacts of existing adverse impacts of discharges from the lake on downstream ecosystems. The document could definitely benefit from a more regional approach, both in describing existing conditions (e.g. water management and downstream impacts), Future Without Action conditions (e.g. implications of continuing those water management policies on downstream ecosystems) as well as explaining how this particular project fits in with the multitude of regional water and ecosystem management initiatives in south Florida (i.e. cumulative impacts-positive and negative). The panel recognizes that more detailed information to support the assessment of environmental impacts and mitigation approaches will be added to the final report, specifically including more detailed analysis of mitigation and monitoring,. However, the existing EIS should be revised to reflect the considerations described above.

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1 Introduction

1.1 Introduction and Report Overview

This Independent External Peer Review (IEPR) Report provides the results of the IEPR of documents associated with the Herbert Hoover Dike Dam Safety Modification Study for the Herbert Hoover Dike (HHD) on Lake Okeechobee in southern Florida (Figure 1). Lake Okeechobee is the third largest freshwater lake by area in the United States and an integral part of the Central and Southern Florida Project flood protection system, municipal water supply system, waterway navigation system, and Everglades ecosystem. The HHD is an approximately 143-mile long earthen embankment system around the lake (Figure 2).

This IEPR report contains the comments of the IEPR panel convened to review the assigned documents prepared by the US Army Corps of Engineers (USACE). The IEPR report also contains a description of the IEPR objectives and process, an overview of Lake Okeechobee and the Herbert Hoover Dike, and a summary of the IEPR panel members' expertise.

Section 1 of the IEPR Report provides a description of the objectives of this effort, general background information on the IEPR, and a brief introduction to the LMI/APMI team that managed the IEPR process and supported and assisted the IEPR panel. Section 2 provides an overview of Lake Okeechobee and the Herbert Hoover Dike, and risk reduction measure activities to date. Section 3 summarizes the process followed to perform the IEPR. Section 4 describes the IEPR panel composition and the panel members' expertise. Section 5 presents a summary of the IEPR panel comments. References are listed in Section 6. Appendix A of this IEPR Report provides the final IEPR panel comments. Appendix B reproduces the "charge" provided to the panel for the IEPR. Appendix C contains the completed organizational conflict of interest forms completed by LMI and APMI. Appendix D provides short resumes for the IEPR panel members.

1.2 IEPR Overview

The USACE lifecycle review strategy for Civil Works projects provides for a review of project documents from initial planning through the project phases of design; construction; and operation, maintenance, repair, replacement and rehabilitation. The strategy provides procedures for ensuring the quality and credibility of USACE decision, implementation, and operations and maintenance documents and work products.

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

The USACE conducts IEPRs as part of implementing the USACE review strategy. Using IEPRs in the review process is called for and described in Department of the Army, USACE Engineer Circular (EC) No. 1165-2-214, *Civil Works Review*, dated 15 December 2012. The IEPR panel was supported and assisted by LMI and APMI, both not-for-profit companies (see Section 1.4).

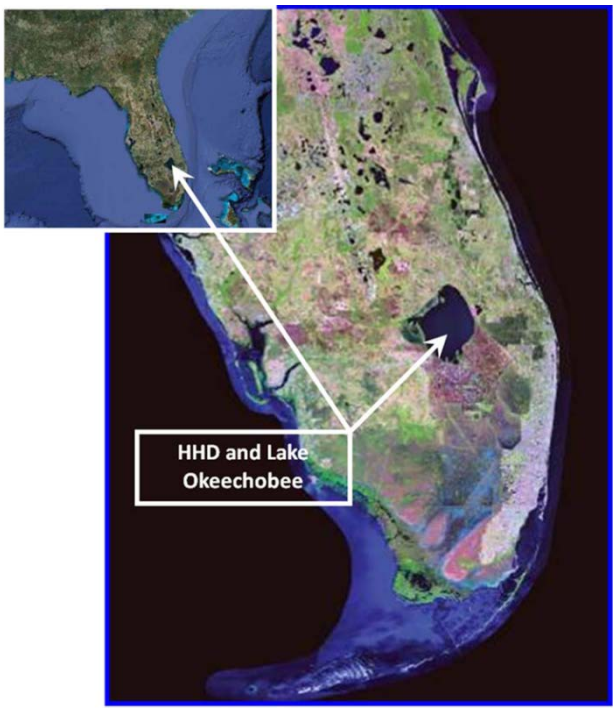

Figure 1 – Location of the Herbert Hoover Dike and Lake Okeechobee in Southern Florida

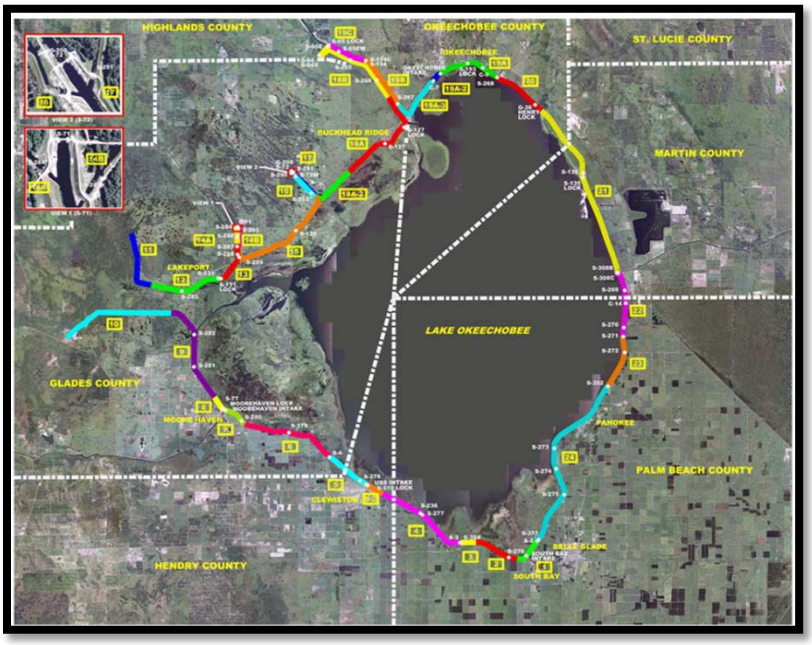

Figure 2 – Location of Herbert Hoover Dike Around Lake Okeechobee Showing Segments Identified in the Dam Safety Modification Report

1.3 IEPR Objective

The objective of this IEPR is to conduct a review of the technical basis for the economic, engineering and environmental methods, models, data, analyses, and assumptions supporting the Dam Safety Modification Report and Environmental Impact Statement (DSMR and EIS), Dam Performance Report (DPR), and other documents for the Herbert Hoover Dike on Lake Okeechobee in southern Florida.

The review was conducted by a panel comprising subject matter experts with extensive experience in engineering, economic, and environmental issues associated with dam safety considerations. The panel members were "charged" with responding to specific technical questions as well as providing a broad technical (engineering, economic, and environmental) evaluation of the overall project. The review panel was guided by the general charge questions listed in §Appendix B on page 59 for each phase of the project. The review panel did not comment on whether a particular alternative should be implemented, as the USACE Chief of Engineers is ultimately responsible for the final decision on USACE work products. The IEPR was limited to technical review and did not involve policy review.

As described in EC 1165-2-214, Section 8, reviewers reviewed the assumptions that underlie all the analyses and evaluated the soundness of models, surveys, investigations, and methods. The review panel assessed whether the assumptions of the planning analysis are sound and whether or not the conclusions based on the planning analysis are appropriate and logically follow from the stated problems, opportunities, objectives, constraints, screening, and alternatives evaluation. The review panel could also offer their opinions as to whether there are sufficient analyses upon which to base the Tentatively Selected Plan (TSP).

1.4 LMI Team Qualifications

A team of LMI and APMI supported a panel of experts and conducted the IEPR. LMI and APMI are not-for-profit science and technology organizations that provide impartial, independent assistance free of conflict of interest with federal government organizations. LMI and APMI have not performed or advocated for or against any federal water resources projects and have no real or perceived conflict of interest for conducting IEPRs. LMI, APMI, and the IEPR panel for this IEPR review have not been involved in any capacity with the projects documented in the Herbert Hoover Dike DSMR and EIS, DPR, and associated documents. Both LMI and APMI are free from conflict of interest with the USACE and any other national, regional, or local public, private, or nonprofit entities regarding water management or with interests and possible litigation relating to water management in the Okeechobee, FL. area.

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2 Project Description

2.1 Background

Lake Okeechobee in southern Florida (see Figure 1) is the third-largest freshwater lake by area in the United States and is an integral part of the Central and Southern Florida Project flood protection system, municipal water supply system, waterway navigation system, and Everglades ecosystem. The HHD is an approximately 143-mile long earthen embankment system around Lake Okeechobee (see Figure 2).

The USACE Jacksonville District has conducted the Herbert Hoover Dike Dam Safety Modification Study. This study is a comprehensive, system-wide analysis to identify risks in the HHD system and to recommend the necessary measures that can reduce the risk of failure.

HHD is currently a USACE Dam Safety Action Class I dam. A DSAC I classification is defined as Urgent and Compelling (Unsafe)). Dams classified as DSAC I have the characteristics "Critically near failure or Extreme high risk."

The HHD DSMR was prepared in accordance with USACE Engineering Regulation, ER 1110-2-1156, *Safety of Dams - Policy and Procedures*. The USACE Jacksonville District coordinated with the USACE South Atlantic Division, HQUSACE, and USACE Risk Management Center to produce the DSMR.

2.1.1 Herbert Hoover Dike Construction

Components of the HHD embankment system have been constructed intermittently since the early 1900's. Initial segments were constructed by state and local water control districts prior to the 1930's. After two devastating hurricanes in 1926 and 1928 caused massive flooding and significant life loss and economic damage around Lake Okeechobee, the USACE was authorized by Congress to construct levees in the south and north areas of the lake. A portion of the alignment that exists today was constructed in the 1930's around the northern and southern ends of the lake. In the 1960's the existing embankments were raised and additional embankments were constructed around the northeast and northwest portions of the lake. As completed in the 1960's, HHD surrounds the approximately 730 square miles of Lake Okeechobee, except for the Fisheating Creek area (see Figure 2).

2.1.2 Lake Okeechobee Hydrology

Inflow to Lake Okeechobee occurs from direct rainfall, Fisheating Creek, Harney Pond Canal, Indian Prairie Canal, Kissimmee River, Nubbin Slough, and Taylor Creek. In total, about 5,600 square miles of surrounding land contribute inflow to the lake, primarily from the north and west. Water can also be directed into the lake from nine pump stations located throughout the system.

Outflows from Lake Okeechobee occur at St. Lucie Canal, the Caloosahatchee River, and four canals flowing south to water conservation areas. Numerous culverts located throughout the HHD also discharge lake water into landside canals and downstream toe swales/ditches.

HHD does not include a conventional spillway and, therefore, has limited outflow capacity. Outflow capacity constraints result in a maximum discharge capacity of approximately 19,000 CFS (excluding evapotranspiration), which is approximately 0.1 feet of drawdown per day. The outflow capacity corresponds roughly to only a sixth of the inflow potential. As a result, HHD needs the capability to withstand

large hydraulic loads for an extended period of time after significant inflows while the lake level is gradually lowered.

2.1.3 Regional Flooding Risk

Regional topography around the lake varies in elevation from approximately elevation 35 ft near the town of Okeechobee north of the lake to elevation 10 ft south of the lake; however, this variance over such a large area is minor. In the event of a dam breach, inundation would spread over a wide area near the lake instead of following a narrower downstream path (Figure 3). In addition, prolonged releases via controlled structures can cause local flooding in low-lying areas near HHD and along connected canals.

2.2 Recent and Ongoing Risk Reduction Actions for the Herbert Hoover Dike

Due to the age and structural deterioration of the HHD culvert structures constructed in the 1930s, all 32 Federal gated culverts through the HHD embankment present a significant risk because of a high probability of failure, primarily from the threat of collapsing of the culvert or from seepage along the conduit and/or into the conduit. Removal, replacement, or abandonment of these structures started in 2011 and is scheduled to be completed in 2020.

From 2007 to 2012, a partially-penetrating seepage barrier ("cutoff wall") was installed though the crest of about 22 miles of HHD in Segments 22, 23 and 24 (Reach 1) (see Figure 2) to reduce risk associated with internal erosion of the embankment and foundation. The cutoff wall is a soil-bentonite-cement mixture, nominally 3-feet thick and 50-60 feet deep. Tip elevations vary and are at least 5 to 10 feet below the lower horizon of the surficial limestone and sandstone strata.

It became evident while conducting the Dam Safety Modification Study that the work that has been completed for Reach 1, while providing protection for lives and public safety, does not fully reduce the risks of economic or social impacts in Reach 1. Modeling demonstrated that a breach in Reach 3 would inundate large portions of Reach 1. These inundation areas together make up what is referred to as "CIZ A" in the DSMR. In lieu of waiting for the approval of the DSMR, and in order to expeditiously reduce risk for the public in Reach 1, a Supplement to the Reach 1 Major Rehabilitation Report and an associated environmental assessment identified an additional 6.8 miles of cutoff wall for which to accelerate construction in 2017, therefore providing risk reduction measures to the community and environment.

2.3 Proposed Risk Reduction Actions for the Herbert Hoover Dike

Cutoff walls would be constructed at several locations along the HHD to prevent a dam breach caused by internal erosion of the embankment and foundation. To address dam breach from overtopping of the embankment, floodwalls or armoring of the embankment would be constructed at certain low sections of the HHD, such as at some water control structures and road crossings. These actions to reduce the likelihood of breaching the HHD are discussed in detail in the DSMR.

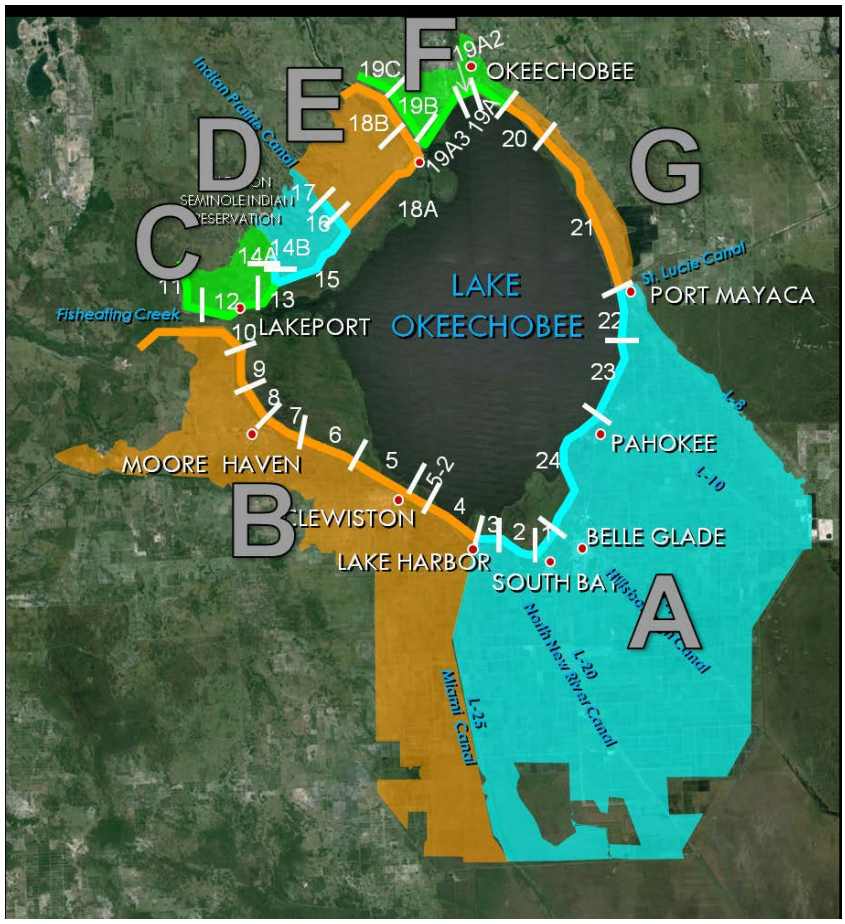

Figure 3 – Common Inundation Zones Resulting from Breaches in Herbert Hoover Dike Segments

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3 Independent External Peer Review Process

Under the guidance of LMI, APMI performed the IEPR in accordance with the procedures described in the Department of the Army, USACE Engineer Circular (EC) No. 1165-2-214, Civil Works Review, dated 15 December 2012. This section summarizes the process for conducting the IEPR. Figure 4 below shows the overall process.

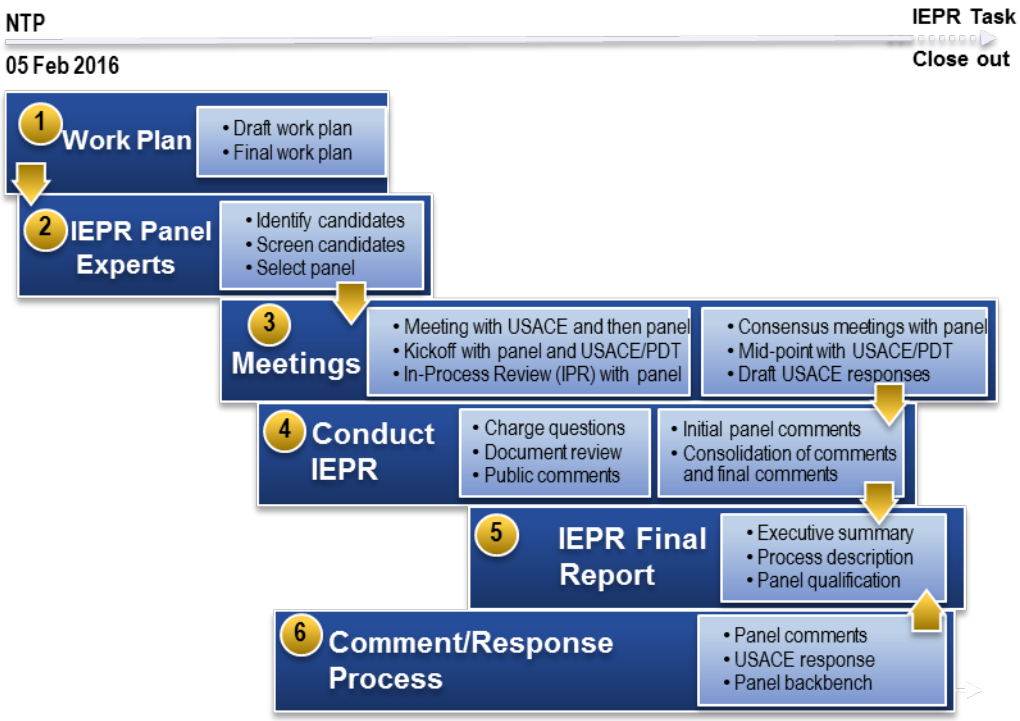

Figure 4 – Summary of the Independent External Peer Review Process

3.1 Project Management

To manage this effort and meet the project schedule, APMI prepared a draft and final Work Plan to define and manage the process for conducting the IEPR. The work plan included the process for screening and selecting independent reviewers, communicating and meeting with the USACE project team, maintaining the project schedule and quality control, compiling and disseminating the independent reviewers' comments, and project management and administration. The work plan included the schedule for conducting the IEPR review.

APMI developed a schedule that would meet USACE's goal of completing the IEPR as efficiently as possible in accordance with the Performance Work Statement. The schedule of activities was agreed upon by APMI and USACE. Table 1 shows the major milestones and deliverables for the IEPR.

APMI provided USACE with project status reports on a biweekly basis to communicate the status of the project. The project status reports included details of each task and noted any schedule changes. APMI also held two In-Progress Review meetings with the panel to ensure proper and timely communication of information among the panel members and between the panel and APMI.

Table 1 – Independent External Peer Review Schedule

Activity	Attendees	Date
Notice to Proceed		Feb 5, 2016
Initial Protocol Meeting	PCX and APMI	Feb 11, 2016
Introductory Meeting	Panel and APMI	Feb 15, 2016
Kickoff meeting	Panel, APMI, LMI, PCX, PDT	Feb 16, 2016
In-Progress Review Meeting	Panel and APMI	Mar 01, 2016
Midpoint Review Meeting①	Panel, APMI, LMI, PCX, PDT	Mar 09, 2016
Final IEPR panel report submitted to USACE		Mar 22, 2016

① *Purpose was for panel members to ask USACE clarifying questions and get additional information needed to complete review and finalize comments.*

3.2 Selecting the IEPR Panel

Reaching out to its various pools of experts, APMI identified experts who met and exceeded the technical expertise and requirements of this IEPR. APMI provided potential candidates with a scope of work, which included the required expertise and project schedule, and conducted informal and formal discussions to identify any technical expertise concerns or potential conflict of interest issues. Consistent with the guidelines of the US Office of Management and Budget (OMB) *Final Information Quality Bulletin for Peer Review (M-05-03),* issued December 16, 2004, 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 with the projects in Okeechobee, FL, or in producing the documents to be reviewed.
- **Conflict of interest –** Identification of 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 Conflict of Interest (COI) issues in accordance with the requirements and guidelines of the National Academy of Sciences and OMB M-05-03, several candidates were selected for further screening and evaluation to ensure they met or exceeded the requirements of this task (One candidate was disqualified because of COI). The list was then narrowed down to identify the most qualified candidates that would be available to serve on the IEPR panel. APMI provided the list of selected panelists along with their detailed résumés to the USACE to determine if any had a potential COI based on USACE knowledge of the individual's past involvement with the project. USACE acknowledged the proposed panel members' experience relative to the requirements of the IEPR and that there were no perceived COI issues. Information on the panel members is provided in §4.

3.3 Preparing and Charging the IEPR Panel

The USACE provided APMI the documents to be reviewed by the IEPR panel. APMI provided these documents to the panel members along with the final Charge to Reviewers. These charge questions, which were developed and approved by USACE, established the general boundaries for the IEPR. The charge questions are shown in Appendix B.

APMI and the panel had an introductory meeting via teleconference during which APMI outlined the steps of the IEPR process, identified the overall schedule and deadlines, and instructed the IEPR panel members on how to access the documentation and to undertake the review.

Subsequent to a cursory review of the documents by the panel, but prior to the actual detailed IEPR, a kickoff meeting was held via teleconference with the USACE Product Delivery Team (PDT) to familiarize the IEPR panel members with the technical aspects of the project. As part of this meeting, the PDT provided a detailed briefing on the HHD project, reviewed project features and requirements, and provided the opportunity for the panel and USACE to exchange technical information and discuss the project.

Following the kickoff meeting, the panel began a detailed review of the documents provided. APMI provided them with instructions and guidance for preparing their comments to ensure proper coverage of all important issues and consistency in preparing the IEPR comments. APMI remained as the conduit for information exchange between the panel and USACE throughout the project in order to ensure a truly independent review.

3.4 Performing the IEPR

After the panel received proper Operational Security training and was oriented with the general scope and background information of the project, the panel initiated a detailed review of the assigned documents using the supporting documentation to help with the review. The 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 documents. The review was limited to a technical review and did not involve policy issues. The IEPR panel members used the charge questions as guidance for identifying relevant information and developing their comments and recommendations.

APMI coordinated a teleconference with the panel members and the USACE at the approximate midpoint of the review process so that the panel members could ask clarifying questions of the USACE and request any additional information related to panel concerns. Subsequently, USACE provided additional information to APMI for dissemination to the panel.

APMI communicated to the panel all relevant project information, instructions, and required actions and deadlines. APMI held two In-Progress reviews, which proved to be effective for ensuring adequate information exchange and early identification and resolution of issues. Any identified information or documents that the panel required to support its review were noted. APMI used internal tools to track comments, issues, and information requests by the panel members during the evaluation process. APMI remained as the conduit for information exchange between the panel and USACE throughout the project in order to ensure a truly independent review.

3.5 Finalizing the Panel Comments

After completing the review, the IEPR panel members submitted a draft of their final comments to APMI. APMI collated the panel comments and ensured they were complete and responsive to the charge. APMI ensured that the panel focused on performing a technical review of the documents and did not comment on policy-related issues.

APMI convened a panel 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, identify any overlapping comments, and resolve any contradictions. Further refinement and consolidation of the comments occurred via email exchange following the meeting. The panel discussion resulted in the final IEPR comments that were submitted to USACE. The final IEPR comments are presented in Appendix A.

Each IEPR panel member comment consisted of four parts:

Comment – A clear statement of the concern
Basis for Comment – A narrative basis for the concern
Significance – A significance rating of the concern (the importance of the concern with regard to project implementability) as well as a statement supporting this significance rating. Comments are rated as "high", "medium high", "medium", "medium low", or "low" to indicate the general significance the comment has to project implementability.
Recommendation[s] for Resolution – Recommended actions necessary to resolve the concern to include a description of any additional research that would appreciably influence the conclusions.

APMI 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.

3.6 USACE Responses to Panel Comments

Following the submittal of this IEPR final report, the USACE will evaluate the IEPR panel comments and submit draft USACE evaluator responses to the comments to APMI. APMI will provide the draft USACE evaluator responses to the IEPR panel members for review.

APMI will conduct a teleconference with USACE and the IEPR panel to seek any needed clarification on the IEPR comments and to discuss the USACE draft evaluator responses to the panel comments.

Following the teleconference, USACE will submit the final USACE evaluator responses to the IEPR comments. The final USACE evaluator responses will indicate if the USACE "concurred" or "non-concurred" with each comment. In response to the IEPR panel recommendation for resolution of each comment, USACE will include a statement to "adopt," "not adopt," or "adopt in future" for each recommendation, along with a response describing where documentation will or will not be expanded, revised, or changed.

3.7 IEPR Panel Backcheck Responses

After the submittal of the final USACE evaluator responses, APMI will meet with the IEPR panel to discuss the responses and the approach for preparing the panel's concluding backcheck comments. The backcheck comments will provide panel concurrence or non-concurrence with the USACE responses and indicate whether the responses adequately address the panel's identified concerns.

After APMI inputs the panel backcheck comments to each USACE evaluator response, APMI will provide USACE with the final IEPR comments, the final USACE evaluator responses to those comments, and the panel's concluding backcheck comments.

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4 Panel Organization

APMI assembled a panel of experts that met the qualifications set forth by the USACE in the Performance Work Statement for the task, which was to conduct the IEPR and provide independent comments. APMI supported and assisted the panel in carrying out its review and served as the intermediary for communications between the panel and USACE during the IEPR process. Figure 5 shows the organization of HHD IEPR.

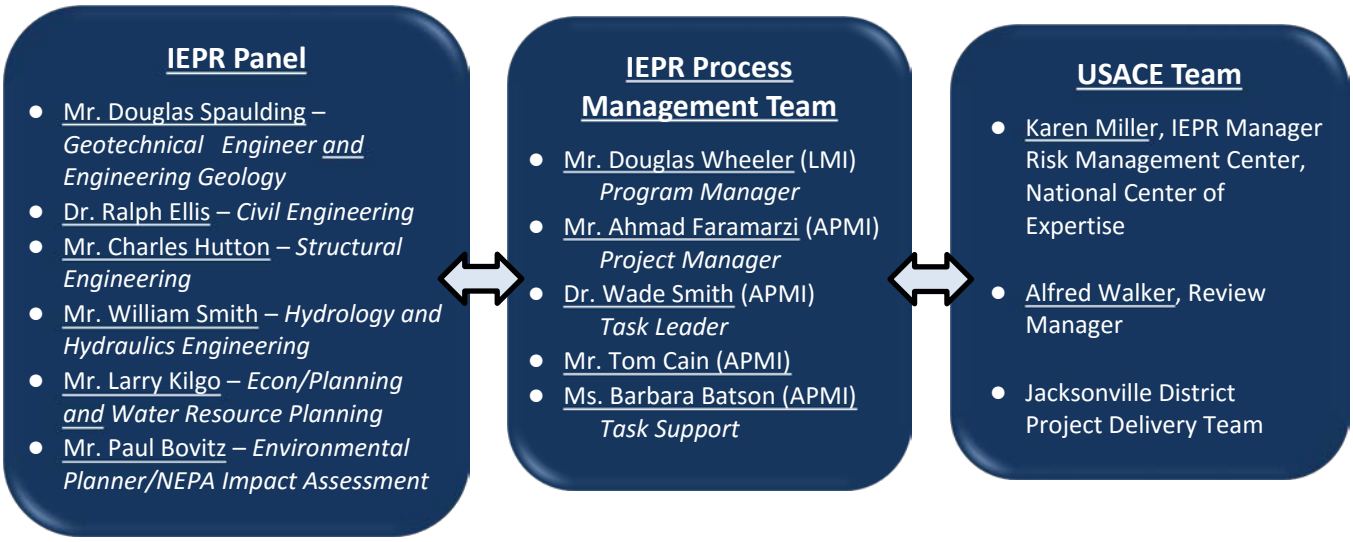

Figure 5 Organization for the Herbert Hoover Dike Independent External Peer Review

4.1 IEPR Panel Description

APMI selected six panel members who were collectively qualified in the eight required areas of expertise called for by the USACE:

- Civil Engineering
- Economics /Planning
- Engineering Geology
- Environmental Planning /NEPA Impact Assessment
- Geotechnical Engineering
- Hydraulic and Hydrology Engineering
- Structural Engineering
- Water Resource Planning

The panel members met and exceeded the minimum requirements for each of the specified areas of expertise. The panel represented a balanced mix of individuals from industry, academia, and independent consultants including direct past experience with USACE.

Table 2 depicts how the panel members meet the specific USACE requirements specified for this IEPR review.

Table 2 – Summary of IEPR Panel Member Qualifications by Discipline

Discipline	Requirements	Mr. Douglas Spaulding	Dr. Ralph Ellis	Mr. Charles Hutton	Mr. William Smith	Mr. Larry Kilgo	Mr. Paul Bovitz
	Highest Degree	MS	PhD	MS	BS	MS	MS
	Years of Experience	47	30+	48	41	39	30
	Experience with USACE (Direct, Indirect, None)	Dir	Ind	Ind	Ind	Dir	Ind
Geo-technical Engineering	Has a MS degree with professional engineering (PE) registration as a geotechnical engineer although a BS degree with professional engineering registration or PhD degree in geotechnical engineering is acceptable.	✓					
	Has a minimum 15 years' experience in geotechnical embankment dam design and evaluation.	✓					
	Have at least 10 years' experience in piping and seepage failure-mode analysis and risk analysis of embankment dams.	✓					
	Have some experience with DAMRAE (USACE risk analysis software) and @Risk software.	✓					
Engineering Geology	Registered professional geologist (PG) with 10 years or more of demonstrated experience in the general field of engineering geology.	✓					
	Have extensive experience in similar types of work as described in the project description.	✓					
	Active participation in related professional engineering and scientific societies is encouraged.	✓					
	Proficient in assessing seepage and piping through and beneath dams constructed on or within various geologic environments, including but not limited to alluvial soils, colluvium, and other geological formations.	✓					
	Familiar and knowledgeable with identification of geological hazards; field & laboratory testing and the determination of in-situ material properties; foundation inspection and assessment; foundation grouting and other foundation treatment methods including construction of foundation seepage barriers; and the design, installation and assessment of instrumentation.	✓					
	Familiar with preparation of factual data and interpretative geology reports, including the preparation of Geotechnical Baseline Reports for USACE project.	✓					

Discipline	Requirements	Mr. Douglas Spaulding	Dr. Ralph Ellis	Mr. Charles Hutton	Mr. William Smith	Mr. Larry Kilgo	Mr. Paul Bovitz
Civil Engineering	Possess a MS degree with professional engineering registration as a Civil Engineer, although BS degree with professional engineering registration or a PhD degree in civil is acceptable.		✓				
	Have a minimum of 10 years' experience in earthen/dam embankment design per USACE design regulations for Civil Works projects.		✓				
	Have experience in cost estimation.		✓				
Structural Engineering	Have a MS degree with professional engineering registration as a Civil Engineer or Structural Engineer, although BS degree with professional engineering registration or a PhD degree in civil or structure engineering is acceptable.			✓			
	Have 10 years' experience in design of dynamic site-specific structural engineering, specifically in lock structures, pump stations, and spillways.			✓			
Hydraulic and Hydrology Engineering	Registered professional engineer with a minimum BS degree or higher in engineering science.				✓		
	Have 15 years' experience in the analysis and design spillways for embankment dams and 10 years' experience in physical and numerical modeling and have familiarity with USACE standard hydrologic and hydraulic computer models.				✓		
	Familiar with USACE application of risk and uncertainty analyses in flood damage-reduction studies and a familiarity with standard USACE hydrologic and hydraulic computer models.				✓		
Economics/ Planning	Have 10 or more years of experience directly related to water resource economic evaluation or review, should possess a Bachelor's degree or higher in economics.					✓	
	Direct experience working for or with USACE is highly preferred but not required, and active participation in related profession societies is encouraged.					✓	
	Familiar with the USACE plan formulation process, procedures, standards, guidance, and economic evaluation techniques.					✓	
	Familiar with the USACE flood risk-reduction analysis and economic benefit calculations, including use of standard USACE computer programs including HEC-FIA.					✓	
	Have demonstrated experience in working with project teams to identify and evaluate measures and alternatives using appropriate planning methodologies to reduce life safety risk.					✓	

Discipline	Requirements	Mr. Douglas Spaulding	Dr. Ralph Ellis	Mr. Charles Hutton	Mr. William Smith	Mr. Larry Kilgo	Mr. Paul Bovitz
Environ-mental Planning/ NEPA Impact Assessment	Be an environmental planner / wetland ecologist / fisheries biologist / scientist with 10 or more years of experience directly related to water resource environmental evaluation or review, implementation of the NEPA compliance process and Endangered Species Act requirements.						✓
	Have a MS degree or higher in a related field.						✓
	Have extensive demonstrated experience in the USACE environmental assessment process and evaluations.						✓
	Have knowledge of: cultural surveys, biological assessments, endangered species, Lakes and river ecosystems, and cumulative effects analyses						✓
Water Resource Planning	Have a Bachelor's degree or higher in water resources/planning.					✓	
	Be a senior water resources planner with 15 plus years' experience in plan formulation of flood risk-management projects with a background in environmental water resource planning.					✓	

4.2 IEPR Panel Members

Summaries of the IEPR panel member qualifications are presented below in alphabetical order.

Mr. Paul Bovitz

Role: Environmental Planning/NEPA Impact Assessment
Affiliation: WorleyParsons Group

Mr. Bovitz is a certified professional wetlands scientist and ecologist with an MS in Ecology and over 30 years of experience, much of it directly applicable to the issues being addressed in the peer review. He is experienced in NEPA compliance, having completed several EAs, DMMPs, EIS and other NEPA documents. He has also has extensive USACE contracting experience in preparing NEPA compliant feasibility studies for habitat restoration and environmental remediation projects. Thus, he is well familiar with the USACE planning process for civil works projects.

Mr. Bovitz has contracted and reviewed cultural resources surveys for several NEPA related projects, performed and reviewed biological assessments nationwide, evaluated endangered species issues, worked in both lake and river ecosystems, having performed aquatic surveys and ecological risk assessments at several sites. In addition, he has performed extensive cumulative impacts analyses, including one for the Meadowlands Mills EIS on behalf of the New York District Regulatory Branch, wherein he evaluated potential impacts of several concurrent projects within the Hackensack Meadowlands on flooding, wildlife and other wetland values.

Dr. Ralph Ellis

Role: Civil Engineering
Affiliation: University of Florida

Dr. Ellis has over 30 years of civil engineering and construction experience. Dr. Ellis worked in the industry for 15 years. Prior to joining the University of Florida, he was president of Hammer Corporation, a construction firm and Director of Projects for the FMI-Hammer Joint Venture. He was responsible for estimating and delivering all design and construction projects including many projects for the US Army Corps of Engineers. In his university position, Dr. Ellis teaches a wide range of civil engineering and construction engineering subjects. He has worked closely with the Florida Department of Transportation in both research and industry training initiatives. Dr. Ellis was selected to serve an industry advisor to the US State Department's Bureau of Overseas Building Operations. He was an appointed member to the American Society of Civil Engineer's Committee on Critical Infrastructure. This is a Board of Direction level committee, providing input on national infrastructure renewal issues. He has served as a member on eleven IEPR panels. More specifically as an expert in the areas of Construction Engineering, Cost engineering, and Civil Engineering. He is currently an active member an active member of the American Society of Civil Engineers and the Southeastern Construction Owners and Associates Roundtable. He is a registered Professional Engineer.

Mr. Charles Hutton

Role: Structural Engineering
Affiliation: Independent Consultant

Mr. Hutton has a MS degree in Structural Engineering and professional engineering registration as a Civil Engineer. He has 48 years of experience in the design and management of water resource projects involving dams, hydraulic structures, hydropower, pumping plants, and water conveyance facilities in Asia, Africa, Latin America, Middle East and the United States. His expertise includes preparing feasibility studies, designs, drawings, and specifications for RCC, gravity and arch dams, hydropower plants, pumping plants, pipelines, canals, waterways, spillways and other hydraulic structures; performing dam safety inspections; conducting condition assessments of existing dams, hydropower facilities and water conveyance systems; developing designs for rehabilitation; technical review; project management and construction management. The first 15 years of his career was with the Bureau of Reclamation in Denver, Colorado followed by 23 years with the international water resource firm AECOM (formerly ECI Consultants).

Mr. Hutton completed training for the Sandia National Laboratories Risk Assessment Methodology for Dams (RAM-D) and performed vulnerability and risk assessments for concrete and earth dams and their appurtenant facilities. He also has completed training for the Federal Energy Regulatory Commission (FERC) Dam Safety Performance Monitoring Program and Potential Failure Mode Analysis methodology and has been involved in numerous projects that required application of this methodology. He also participated in Risk Analysis Training conducted by Prof. David Bowles, Managing Principal at RAC Engineers and Economists, for a Corps of Engineers contract. He has served as a FERC qualified independent consultant for the safety inspection of over 25 dam and hydroelectric projects. He has been the IEPR Dam Safety Assurance Program Structural Engineer panel member for four previous Corps of Engineers projects including: Bluestone Dam in West Virginia, Dover Dam in Ohio, Rough River Dam in Kentucky and Addicks and Barker Dams in Texas. Mr. Hutton is currently a Structural Engineer for the Morris Sheppard Dam Concrete Assessment and Service Life Extension project for the Brazos River Authority in Texas that will involve a comprehensive Probable Failure Mode Analysis and Risk Assessment.

Mr. Larry Kilgo

Role: Economics/Planning *and* Water Resource Planning
Affiliation: Independent consultant

Mr. Kilgo has over 30 years of experience in Economic Analysis and Water Resources Planning serving as a Senior Economist with the US Army Corps of Engineers Mississippi Valley Division. Specifically, Mr. Kilgo was a Leader of the Economic and Social Analysis Community of Practice, responsible for guiding professional development of the economic workforce and managing the quality of economic and financial analyses conducted. His economic evaluations supported authorization of Morganza to the Gulf, Hurricane Risk Reduction Project located in Terrebonne and Lafourche Parish, Louisiana. He prepared economic and financial evaluations that supported authorization for the Fargo Moorhead Metropolitan Area, Flood Risk Reduction Project, located in North Dakota and Minnesota and for the Cedar Rapids, Iowa, Metropolitan Area Flood Risk Reduction Project.

Mr. Kilgo led the USACE Mississippi Valley Division interdisciplinary team assigned to identify impacts on Mississippi River resources that would result from modified operation of the Missouri River Reservoirs (Missouri River Master Manual and Supporting Final Environmental Impact Statement). He also developed and implemented an outreach program to market USACE technical capabilities to other Federal Agencies and to State and Local Governments. He also provided quality assurance and technical review of economic evaluations supporting water resources investment recommendations. He was also a Principal course instructor for the USACE Professional Development Center's course "Project Cooperation Agreement/ Financing Analysis", which addresses municipal and non-Federal financing for Army cost-shared projects.

Mr. William Smith

Role: Hydraulic and Hydrology Engineering
Affiliation: Hydropower International Services Inter-National Consultancy, LLC

Mr. Smith is President of Hydropower International Services Inter-National Consultancy, LLC, a private consulting firm. He has extensive expertise in providing engineering services for hydroelectric generating projects, and other hydrologic, hydraulic, and floodplain management projects. He is a graduate of the Missouri School of Mines with a BS in Civil Engineering specializing in hydrology and hydraulics.

Mr. Smith was President of the National Hydropower Association (NHA) from 1988-1989 and an active member of NHA's Board of Directors for over five years (1984-1989). He also served as Vice President, Creator and Chairman of both the FERC Committee and the International Committee and represented NHA as a technical specialist on Trade Missions throughout the world from 1989 to 1994. He is the recipient of the NHA 2008 *Dr. Kenneth Henwood Lifetime Achievement Award*. In Oct 2009, along with Dr./Ms. Linda Church Ciocci, he was recognized by the International Water Power & Dam Construction's list as one of the 60 most influential people who have helped shape the course of the global hydropower and dam business in the world over the past 60 years. Mr. Smith is also a Past Chair of the Oklahoma Floodplain Managers Association for 2007-2008 and remains active in the Association coordinating a Disaster Response Team, Training Cadre, and is the current Vice Chair (2nd time).

Mr. Smith has conducted independent reviews of dams over the past 25 years as a Federal Energy Regulatory Commission (FERC) Independent Part 12D Inspection Consultant. He has experience with using the USACE HEC HMS and HEC RAS computer programs for. regularly in performing floodplain management and storm water design projects. He has designed non-federal hydropower projects such as USACE navigation locks and dams and prepared designs in accordance with USACE design standards. Mr. Smith has been designated as the Chief Dam Safety Engineer for FERC Licensed Hydropower Projects by two of his clients in accordance with the requirements of dam safety for FERC projects.

Mr. Douglas Spaulding

Role: Geotechnical Engineering *and* Engineering Geology
Affiliation: Independent Consultant

Mr. Spaulding has over 47 years of experience in the design, evaluation and inspection of water retaining structures such as dams, levees, and flood walls. His experience includes 10 years with the Corps of Engineers where he served as Chief of the Levee & Channel Design Section for the USACE St. Paul

District. He also has worked as an Independent Consultant conducting inspections, evaluation, and design of over 70 flood control and hydroelectric dams throughout the United States. His recent experience includes serving as a facilitator for the FERC's Potential Failure Mode Evaluation for over 70 dams located throughout the U.S. Mr. Spaulding has an MSCE degree in geotechnical engineering and is currently a registered professional engineer in four states. He has served on several IEPR panels for projects located throughout the US and has provided design services, project management, and peer review for over 18 local flood protection projects located throughout the United States. These projects have included earth levee systems, diversion channels, concrete channels, floodwalls, gate wells and pumping stations. The foundation conditions for these projects have ranged from soft lacustrine clay deposits to stratified granular deposits requiring seepage berms and relief well design. The majority of the projects were located in urban areas, which involved analyses of trade-offs between right away costs and structural costs. Mr. Spaulding's career includes evaluation of risks associated with the long-term performance and design associated with water retaining structures and conveyance facilities. This process requires evaluating appropriate analytical procedures, making appropriately conservative assumptions and obtaining sufficient geotechnical data to both describe the subsurface profiles and performance characteristics. Each project is unique and must be viewed and evaluated without preconceived concepts of risk or performance.

4.3 IEPR Process Management Team

The LMI/APMI IEPR process management team consisted of the following members.

Doug Wheeler, PMP, CCP, RMP, Program Manager (LMI)

Mr. Wheeler is an industrial and mechanical engineer with more than 20 years of experience in strategic process engineering and financial analysis including work for USACE, DOE, and GSA. For USACE, he led a consultant and client team in a business process reengineering effort for the Navigation Locks and Dams High-Performing Organization. He also led project teams in a variety of tasks to provide reengineering services to the USACE IT function. Because of his work leading the review of the USACE MKARNS maintenance activity and his support for the USACE IMTS, Mr. Wheeler understands the USACE's water navigation business area and supporting projects. He has also focused on real property and lease-related projects for GSA as well as economic assessments of infrastructure projects for DOE. Mr. Wheeler will apply LMI's COI process by reviewing each TO RFP with LMI's management team. LMI's process ensures that each LMI business unit manager is aware of TO scope and can raise organizational COI issues before LMI responds. He currently is focused on LMI's project cost engineering practice, privatization, and competitive sourcing services. Mr. Wheeler holds an MBA and a Bachelor of Science in mechanical engineering from Columbia University and an MSE in industrial engineering from Arizona State University.

Ahmad Faramarzi, PE, PMP, Project Manager (APMI)

Mr. Faramarzi supervised project personnel and communicated policies, procedures, and goals to the IEPR Team. In coordination with Mr. Wheeler, Mr. Faramarzi maintained regular contact with USACE and was responsible for the overall project plan, project performance, and client satisfaction on this as well as future tasks for USACE. He will also have multiple technical and administrative staff as direct reports. Mr. Faramarzi is a registered professional engineer and a certified project management professional with 35 years of experience providing managerial and technical expertise to government clients, including the USACE, Office of the Secretary of Defense, the U.S. Army, the U.S. Air Force, and Defense

Nuclear Facilities Safety Board. He has organized and managed several important and highly visible expert panels in response to recommendations by the NAS. Mr. Faramarzi has a Post-Masters applied scientist/engineer degree from The George Washington University in Aerospace and Mechanical engineering (fluid mechanics), an MS in Thermofluid Engineering, and a Bachelor of Science in Nuclear Engineering. He is on the Board of Directors of the Washington, DC Section of the American Society of Mechanical Engineers and an active member of the Fluid Dynamics branch.

Wade H. B. Smith, Ph.D., Task Leader (APMI)

Dr. Smith is an ecologist and environmental scientist who received his Ph.D. in environmental engineering sciences from the University of Florida. He has over 30 years of experience with environmental regulations, including the National Environmental Policy Act (NEPA) process, and with analyzing the environmental impacts of a wide variety of types of federal projects. Examples include dredging and dredged material disposal, offshore oil and gas exploration and production, domestic and industrial wastewater disposal, operation of electric power generating stations, construction and operation of coastal recreational developments, pipeline construction and operation, realignment and re-stationing of military forces, closing of military installations, operation of chemical munitions destruction facilities, and dismantling of chemical warfare agent production facilities. Dr. Smith is experienced in working on scientific and engineering issues involving complex and controversial projects. He has participated in all aspects of the NEPA process. He has prepared programmatic and site-specific Environmental Impact Statements (EISs), Environmental Assessments (EAs), and subject-specific environmental analyses. Dr. Smith has been responsible for all elements of analysis of the physical, biological, and socioeconomic environments. He has participated in all NEPA phases–scoping, draft EIS, public hearings, response to public comments, final EIS, and record of decision. Dr. Smith has also prepared NEPA and environmental analysis guidance documents to be used by federal environmental managers and planners.

Tom Cain, Task Support (APMI)

Mr. Cain is a Principal Chemical/Process Engineer with over 30 years of experience providing managerial and technical expertise to government clients, including the USACE, Office of the Secretary of Defense, the US Army, the US Air Force, the Department of Justice, and other government agencies. He has organized and managed and/or participated in several important and highly visible expert panels and conducted numerous studies in response to recommendations by the National Academy of Sciences. Mr. Cain has experience with environmental regulations, including the National Environmental Policy Act process, and with analyzing the environmental impacts of a wide variety of types of federal projects, particularly the technical aspects. Mr. Cain has routinely applied his engineering, scientific, and analytical skills to unclassified, sensitive, and classified government programs. Areas of expertise are primarily related to the Chemical, Biological, Radiological, Nuclear, and high-yield Explosive (CBRNE) field with particular subject matter expertise in chemical and explosives areas. Roles range from team contributor to technical lead to task/project/program manager while working across multiple disciplines and organizations to solve challenges, collaborate in research, and share expert knowledge.

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5 Summary of the Independent External Peer Review Findings

The panel members agreed on the adequacy, philosophy of approach, and acceptability of the economic, engineering, and environmental models and analysis used to support the Herbert Hoover Dike Dam Safety Modification Study. The panel members found that the supporting documentation provided in the Dam Safety Modification Report and Draft Environmental Impact Statement adequately communicated the project development effort. The panel offered a number of comments to clarify specific content issues and improve the project. The panel members agreed that, in general, the planning and design efforts are of high quality.

There were a total of 24 final comments. Of these, 2 were identified as having high significance, 6 as Medium High significance, 7 as Medium significance, 1 as Medium Low, and 8 as Low significance. The following paragraphs provide a summary of these panel comments in the specific areas of engineering, environment, and economics areas.

5.1 Geotechnical Engineering/Engineering Geology

The DSMR report and other documentation provide a detailed description of the analytical procedures used to evaluate a project with extremely variable and complex geology and potential risk. Overall the procedures utilized a systematic approach that broke the embankment into a number of reaches based upon geological characteristics and risk. The assumptions inherent in this type of an analytical procedure were carefully evaluated in many cases by teams of engineers and in some cases outside experts. A review of the documents indicated one shortcoming in the analyses and several potential additions required to clarify the DSMR. The only analytical shortcoming identified is the seepage analysis related to the fact that infiltration of precipitation through the surface of the pervious embankment was not considered in the calibration or the implementation of the seepage modeling. The overall annual precipitation of 70 inches per year on a 250-foot-wide pervious embankment section represents a potential seepage inflow of up to 4 $ft.^3$/day/lineal ft. of embankment which is in the same order of magnitude as the computed seepage volume without input from precipitation. Although the inflow to the embankment would be reduced by evapotranspiration losses, the inclusion of infiltration through the embankment could potentially change the calibration of the seepage models and the results of the analysis for both the cutoff and drainage alternatives. A sensitivity analysis regarding the impact of precipitation infiltration could be employed to evaluate the impact of this source of seepage flow related to the selection of the TSP.

An additional concern with the DSMR report is related to the fact that the report does not identify embankment stability as a potential failure mode, or state that slope stability had been previously evaluated and determined not to be a critical potential failure mode.

Remedial measures were not considered for several reaches of the embankment due to the low level of downstream risk. Since the assumed project life is 100 years, and there is a definite potential for increased downstream development, the DSMR should specifically document the need for a program to monitor the long-term downstream risk and to reconsider remedial measures if the risk increases.

5.2 Hydraulics and Hydrology

The USACE documentation was thorough and comprehensive for the hydrology and hydraulic analyses. There are a few issues that were not fully addressed or require clarification to eliminate confusion. These are summarized as follows.

The presentation of the Monte Carlo Reservoir Analysis Model (MCRAM) modeling and modeling results ought to be the focus in the Hydrologic Hazard Assessment report and the DSMR Executive Summary since that is the basis of hydrologic modeling for the projection of future projections of flooding events. The use of the term 10,000 year and 500,000 year in the MCRAM documentation implies a projection into the future. This was clarified by the USACE after the mid-point review as follows, which is a much clearer description: ”The model is not a projection into the future. The 10,000 samples are 10,000 versions for one year of precipitation that could occur this year or any year in the near future under current climate. The model assumes that the statistical properties of the observed record are representative of today's climate.” The USACE needs to consider changing the terminology to reflect a probability of an event, rather than using the term "____"-Year, which implies a projection.

Having an inflow to Lake Okeechobee that is six times the outlet capacity is concerning. This imbalance will likely always cause potential for higher lake levels that can cause additional hydraulic pressure on the cutoff walls and on the wave action against the dikes. There was no remediation of this condition in any of the alternatives that were presented in the table of alternatives. This issue needs to be addressed in some manner that does not flood downstream areas.

There is some misinterpretation of the historic time between tropical storm events. The USACE stated during the mid-point review that other more frequent tropical storm events were evaluated, but the results were not clearly found in the report.

Climate change was stated not to have been considered in the USACE analyses, and we believe this should be addressed. The USACE stated in the mid-point review that it was not a requirement, and, if so, then documenting of the justification for not addressing climate change should be stated clearly in the report.

Finally, the history of the hydraulics and hydrology progression over time could be placed in an appendix to avoid confusion and improve readability.

5.3 Structural Engineering

The Potential Failure Modes Analysis and baseline Risk Assessment of Structures (in the January 2014 Report) is relatively well documented. The Structural Engineer was not assigned to review the March 2014 Baseline Risk Assessment Report or the July 2014 Risk Reduction Assessment Report and, therefore, cannot comment on the thoroughness or completeness of these reports. The structural engineering comments are focused primarily on the risk reduction measures discussed in the DSMR for the concrete structures and pipes penetrating the embankment. The risk reduction measures involve jet grouting to connect the embankment cutoff wall to the existing structures and to extend the embankment cutoff wall under the existing pipes. Constructing the proposed jet grouting cutoff wall under the existing pipes will be challenging due to the close spacing of the pipes. Verifying the contact between the proposed jet grouting and the existing sheet piling cutoff walls under the existing structures also will be

difficult due to the configuration of the existing timber piles. In addition to the jet grouting verification tests described in the November 2015 Risk Assessment Technical Summary Report, the jet grouting test sections should verify the diameter of the grout columns that can be produced in the dike soils and the accuracy of the drilling for the jet grouting. It is also suggested that backup power for the bypass pumps be considered at each of the replacement culvert sites to maintain the flood control function during construction.

5.4 Civil Engineering

In general the engineering approach and analysis as described in the Herbert Hoover Dike Dam Safety Modification Study is sound and was performed in accordance with appropriate standards of practice. The narrative description of the cost engineering process suggests that the project cost estimate represents an accurate estimate of the project actual cost. However, the cost estimate, project schedule and, Cost and Schedule Risk Analysis report were not available for review. Consequently the adequacy of these project elements could not be determined.

5.5 Economics/Planning and Water Resources Planning

The HHD-DSMR is an excellent decision recommendation document. Existing risk of dike failure and subsequent economic, social and environmental consequences provided justification for the proposed improvements. Plan formulation included investigation of an exhaustive array of non-structural and structural improvements. Rationale for components of each plan, development of the final array of structural plans and recommendation of a tentatively selected implementation recommendation is supported. Justification of each recommended improvement is based on reducing the risk of life loss (AALL) to an acceptable level or further reducing the risk of life loss and societal consequences as low as reasonably practicable (ALARP). The ALARP is a cost effectiveness (disproportionate cost of achieving the next lower level of risk) analysis that does not attempt to balance the next increment of cost against an increment of economic output. Make this clear in the first definition of ALARP Instead of simply indicating cost effectiveness. Two segments that have an unacceptable risk for life loss are scheduled in the fifth year of the proposed order of work. Improvements to accomplish tolerable risk levels for AALL should be implemented as the first priority. The Everglades Agriculture Area (EAA) is a principle economic engine and driver for the population at risk and economic consequences. Sea level change, subsidence and elimination of subsidies for sugar cane could reduce or eliminate the consequences that support the proposed investment recommendation. Alternatively, the need for the proposed improvements would become more substantial with accelerated development if agriculture is suspended. How appropriate are the recommended improvements in an alternative future? Justification of the proposed improvements is based on exceedance of tolerable risk in terms of AALL, APF and ALARP. Computation of these is accomplished with the DAMRAE and FIA models and depends on factors that are hard-wired, such as fatality rate for persons caught during mobilization. These models must simulate the conditions in the HHD impact area. Warning times are estimated for various pool loadings. For an overwash and/or overtopping event it is speculative whether these would be realized.

5.6 Environmental Planning/NEPA Impact Assessment

The DSMR EIS does an excellent job of explaining the Purpose and Need for the project, and instilling in the reader the importance of addressing safety issues associated with improving the berm. The material is presented in a clear and straightforward manner and the document was very well organized. The

EIS also gave a much more thoughtful presentation of Future Without Action conditions (FWAC); the EIS did not simply extrapolate present conditions like many other documents tend to do.

The environmental analysis is clear and brief, but comprehensive enough to meet the requirements of NEPA in addressing the variety of areas that might be impacted by the project. However, while the conclusions appear reasonable given the focus of the project on the berm area, the lack of detail under existing conditions and impacts, especially regarding natural resources makes it more difficult to verify the its findings regarding impacts. This is not a critical issue, since significant adverse impacts are not anticipated, but is of concern in presenting the material to an educated public that is already vocal about impacts of existing adverse impacts of discharges from the lake on downstream ecosystems. The document could definitely benefit from a more regional approach, both in describing existing conditions (e.g. water management and downstream impacts), Future without action conditions (e.g. implications of continuing those water management policies on downstream ecosystems) as well as explaining how this particular project fits in with the multitude of regional water and ecosystem management initiatives in south Florida (i.e. cumulative impacts-positive and negative). The panel recognizes that more detailed information to support the assessment of environmental impacts and mitigation approaches, specifically including more detailed analysis of mitigation and monitoring, will be added to the Final Report. However, the existing EIS should be revised to reflect the considerations described above.

Appendix A Independent External Peer Review Panel Comments

This Appendix provides the comments of the IEPR panel members on the Herbert Hoover Dike Independent External Peer Review. The comments cover a range of issues that pertain to the technical aspects of the documents reviewed.

Appendix A.1 is a summary of the final panel comments.

Appendix A.2 provides the complete comments of each panel member.

There were a total of 24 comments. Of these, 2 were identified as having high significance, 6 as Medium High significance, 7 as Medium significance, 1 as Medium Low, and 8 as Low significance.

A.1 Summary of IEPR Panel Comments

Table 3 below provides a summary list of all IEPR comments organized by their significance from high to low.

Table 3 – Summary of Comments Identified by the IEPR Panel

Panel Comment
Significance – High
The USACE has confirmed that the inflow to Lake Okeechobee is 6 times greater than the outflow capacity of the St. Lucie and Caloosahatchee canals which are the primary outlets to the lake. This deficit does not seem to even be considered as part of any alternative of the remediation project. There is no discussion related to the history of the Project as to why the outlet capacity been so out of balance with the inflow or if the St. Lucie and Caloosahatchee canals have the capacity to discharge an amount of flow that would reduce this ratio of inflow to outflow.
The USACE requirement for considering Climate Change on this multi-million dollar project is not clearly defined or discussed.
Significance – Medium High
The seepage analyses conducted for the project evaluation did not include the effects of infiltration attributable to precipitation falling on the pervious embankment slopes.
The creation of a stochastic hydrology extrapolation repeatedly refers to a desired 10,000 year model of events.
There is no description of how bypass pump operation will be maintained at culvert construction sites if power is lost during large storm events during the construction period.
There is no description of how the USACE determined the number of culverts that can be replaced concurrently and still be able to provide adequate flood protection during a large storm event that might occur during construction.

Panel Comment
The adequacy of the project construction schedule could not be determined because the construction schedule was not provided in the review documents.
The adequacy of the project risk analysis and risk management planning could not be determined because the Cost and Schedule Risk Analysis Report was not provided in the review documents.
Significance – Medium
As discussed at the mid-point conference, we understand there were other scenarios for tropical storms considered than just those that were described as the "mean amount of time between historical tropical storm events is 145.7 days." However, this information is not included in the documentation.
Using jet grouting at several locations on HHD that have difficult infrastructure situations will require assurances that the method is implemented successfully to prevent leakage and seepage.
An evaluation of the adequacy of the project cost estimate could not be made because the cost estimate was not provided in the review documents.t.
It is not clear if the construction contractor will be required to install a test section of the cutoff wall before being permitted to continue with production work.
The DSMR EIS does not provide sufficient detail on existing and Future Without Action Conditions (FWAC) for the reader to fully evaluate and understand existing natural resources and the impacts associated with selection of the tentatively selected plan (TSP
The DSMR EIS does not provide sufficient detail on FWAC and cumulative project impacts for the reader to fully understand the relationship of the tentatively selected plan (TSP) to other regional initiatives geared at managing water quality, restoring wetlands and protecting wildlife, water quality, recreation and other resources of the region.
The DSMR EIS does not give sufficiently detailed consideration of climate change on the future ecology of Lake Okeechobee and surrounding region, both with and without implementation of the tentatively selected plan.
Significance – Medium Low
The USACE should conduct period monitoring of downstream development to assess if risk is changing.
Significance – Low
The report does not make any mention of slope stability as a potential failure mode
The explanation for the use of the Monte Carlo Reservoir Analysis Model (MCRAM) that was developed by the USACE Risk Management Center and was approved for a one-time use for this study was understood better after final completion of the readings. It would have helped if the "history" of the analysis (HEC-1, HEC HMS, and HEC ResSim) was separated from the actual modeling description and results.
The DSMR does not provide an estimated date for the replacement of the Florida Department of Transportation of the SR78 bridges over Harney Pond, Indian Prairie and Kissimmee River.

Panel Comment
Sea level change, subsidence, or modified agriculture policy could eliminate the supposed consequences of a possible HHD failure.
DAMRAE and FIA models must simulate the risk and consequences for the HHD impact area.
Improvements to accomplish reductions in AALL should be implemented as the first priority.
Assumptions about "Warning Issuance Times" are speculative.
Additional definition of ALARP is needed.

A.2 Complete IEPR Panel Comments

This appendix contains the complete comments of the IPER panel. Each comment consists of four parts:

1. Clear statement of the concern
2. Basis for the concern
3. Significance of the concern
4. Recommended actions necessary to resolve the concern.

Comments are rated to indicate the general significance the comment has to the project implementability. The significance ratings are defined as follows:

- **High** – Comment describes a fundamental problem with the project that could affect the recommendation or justification of the project.
- **Medium High** – Comment affects the completeness or overall understanding of the recommendation or justification of the project. Resolution of the issue determines if it is fundamental problem with the project or not.
- **Medium** – Comment affects the completeness or overall understanding of the recommendation or justification of the project.
- **Medium Low** – Comment affects the technical quality and understanding of the project based on the presentation of information related to the recommendation or justification of the project. However, the panel does not have sufficient information to determine the effect on project implementability.
- **Low** – Comment affects the technical quality and understanding of the project based on the presentation of information related to the recommendation or justification of the project, but there is limited concern regarding project implementability.

Significance - High

Comment #1
The USACE has confirmed that the inflow to Lake Okeechobee is 6 times greater than the outflow capacity of the St. Lucie and Caloosahatchee canals which are the primary outlets to the lake. This deficit does not seem to even be considered as part of any alternative of the remediation project. There is no discussion related to the history of the Project as to why the outlet capacity been so out of balance with the inflow or if the St. Lucie and Caloosahatchee canals have the capacity to discharge an amount of flow that would reduce this ratio of inflow to outflow.
Basis for Comment
This comment is based on a statement under the LORS description on Page 11 that states there is an under-sized outlet capacity that is 1/6 of the inflow at St. Lucie and Caloosahatchee canals. It seems that the only justifiable solution in any of the alternatives (Table in Draft DSMR Executive Summary) is to enhance the seepage cutoff walls, armoring of slopes, internal drainage systems, floodwall at Segment 72; and no action (as risk is considered tolerable). This raises significant issues as follows: Does this situation not inherently cause a condition whereby the dike is in constant jeopardy due to rising water surface in the lake because water cannot be released in critical times due to a restriction in outlet capacity? Does the sum of the outflow capacities of the lake, less consideration of evaporation, still maintain the 6 times greater inflow than outflow? If there were additional spillway capacity would it only cause more downstream flooding of the Everglades Agricultural Area (EAA)? Is it correct that there are no additional outlet canals into which additional spillway discharge of inflow could be allowed to flow?
Significance: High
We believe that this is a critical issue of concern that can affect the impact of the dikes and potential overtopping of the dikes and needs to be very clearly explained in the report. The reliance becomes that of seepage cutoff wall integrity and dike height to prevent overtopping and/or wave erosion during high lake levels to avoid a breach.
Recommendation for Resolution
It is recommended that consideration of spillway capacity be addressed and if it is not going to be addressed as an alternative, a detailed explanation be provided.

Comment #2
The USACE requirement for considering Climate Change on this multi-million dollar project is not clearly defined or discussed.
Basis for Comment
There are no references found in the Hydrologic Hazard Assessment - Final Draft 7-27-15; the HHD Standard Project Flood 2015-11-3; the Basis of Authorization of the Standard Project Flood; or the MCRAM Sensitivity related to this subject. In the ARA-Okeechobee-Hurricane-Surge-Lake-Stage Report--5-18-2015 there is one sentence that states "Using this model, a 500,000-year simulation of hurricanes was performed. The simulation does not consider the impact that climate change might have on future hurricane frequencies or intensities." When asked this question during the mid-point review "How did the USACE consider Climate Change, we heard the response that the USACE did not. And, that it was not required. The original question asked was if the USACE believes that there will be no type of climate change in the next 500,000 years based on the way the text was written, as quoted above? The USACE responded this was a probability simulation only, not a projection of the next 500,000 years, but as stated, that is not what was written in the Final Draft of the HHA. In reading portions of the USACE June 2014 "Climate Change Adaptation Plan" is seems that the approach to considering climate change has been considered for some time. The document states, in part, "It is the policy of USACE to integrate climate change preparedness and resilience planning and actions in all activities for the purpose of enhancing the resilience of our built and natural water-resource infrastructure and the effectiveness of our military support mission, and to reduce the potential vulnerabilities of that infrastructure and missions to the effects of climate change and variability."
Significance: High
We believe that this is an issue that needs to be clarified to stipulate whether Climate Change was considered or not in the documents, and if not, the basis of not complying with the understood USACE requirements to address Climate Change as stipulated in the *USACE Climate Change Adaptation Policy Statement* and a governance structure to support mainstreaming adaptation in 2011 following the release of Executive Order 13514 and its Implementing Instructions. With the release of the President's Climate Action Plan (PCAP) and Executive Order 13653, Preparing the United States for the Impacts of Climate Change, in which the policy has been updated.
Recommendation for Resolution
The USACE should provide a detailed explanation in the report as to why considering Climate Change was not required and why the USACE did not address it in the report.

Significance - Medium High

Comment #3
The seepage analyses conducted for the project evaluation did not include the effects of infiltration attributable to precipitation falling on the pervious embankment slopes.
Basis for Comment
The impact of this this source of seepage water related on the safety of the embankment has not been analyzed and is not known The seepage analyses for various embankment sections did not include any contribution from infiltration attributable to rain falling on the surface of the embankment. The report indicates that the annual precipitation in the project area is proximately 70 inches of rainfall. The embankment sections are generally composed of relatively permeable sand deposits and the width of the embankments can vary from 200 feet to over 250 feet or more. The day volumetric rate of precipitation falling on a 250 wide embankment section is 4 cfs/day/ lineal ft of embankment. This potential inflow to the groundwater system is the same general magnitude as the computed seepage flow discharging from the embankment and foundation. Although the infiltration of will be significantly less than the precipitation due to the effects of evapotranspiration, this inflow could have an impact on the computed exit gradients for the cutoff wall alternative and the volume of seepage required to be handled under the drain alternatives. The infiltration is not attributable to just one rainfall event but it is an average which will contribute to the seepage flow continually. The occurrence of infiltration is demonstrated by a number of the piezometer readings which indicate perched water levels above the level of the reservoir.
Significance - Medium High
Infiltration of water through the embankment surface will increase the volume of seepage water flowing through the embankment and to some extent perhaps the foundation. This in turn will increase the volume of water required to be handled under the drainage alternatives and has the potential to increase the exit gradients related to the cutoff wall alternatives. Although it was stated by the Corps that the drainage alternatives had a significant amount of overcapacity, the precipitation would fall on the entire embankment and would increase the volume of water to be handled by any drain and pump. Under the cutoff alternative the addition of infiltration water would have some unknown effect on the overall seepage system and could increase exit gradients to some level. Since the overall impact of the infiltration is unknown it is difficult to assess the impact of this condition on the analyses supporting the report
Recommendation for Resolution
It is recommended that a sensitivity analysis be conducted on several cross-sections to evaluate whether the inclusion of a reasonable value of infiltration would significantly change the results of the analyses. The focal point of these sensitivity analyses should be several cross-sections which show the most critical conditions utilizing the cutoff wall alternatives as recommended in the TSP. The computer code SEEPW used for the original analyses can be used for this sensitivity analyses. It suggested that the analyses in these sections be recalibrated to incorporate the effects of infiltration. If the results of the sensitivity analyses indicate no significant impacts, then a section of the report should be developed to discuss these conclusions and the supporting sensitivity analyses. If the results of the sensitivity analyses indicate conditions that would have a significant adverse impact on the safety of the structure, revisions should be considered to other cross-sections. Since the drainage alternatives are not included in the current TSP, the impact of infiltration does not need to be determined.

Comment #4
The creation of a stochastic hydrology extrapolation repeatedly refers to a desired 10,000 year model of events.
Basis for Comment
For example in Chapter 1, Paragraph 1.1 it states “MCRAM continuously simulates hydrologic conditions at a daily time step for 10,000 years using a deterministic hydrologic model while treating precipitation and wind as random variables instead of fixed values.” However, during our mid-point review, it was specifically clarified verbally and in a follow-up email that: ”The model is not a projection into the future. The 10,000 samples are 10,000 versions for one year of precipitation that could occur this year or any year in the near future under current climate. The model assumes that the statistical properties of the observed record are representative of today's climate.” This explanation is different than referring to 10,000 years of simulation of hydrologic conditions, and is more representative of what is being performed.
Significance: Medium High
We believe that a clarification of this comment to an outside reader would not lead to a misunderstanding of the intent of the stochastic modeling process.
Recommendation for Resolution
It is recommended that this explanation be presented early in the report and use a different terminology than “10,000 years” throughout the document. We understand it is intended to be a probabilistic projection, not an analysis of 10,000 years into the future.

Comment #5
There is no description of how bypass pump operation will be maintained at culvert construction sites if power is lost during large storm events during the construction period.
Basis for Comment
The Culvert Replacement Methodology described in the March 2011 Culvert Letter Report indicates that the existing culvert will be removed and the new culvert constructed in the same locations. Temporary cofferdams will be placed at both ends of the culvert so the site can be dewatered for removal of the existing culvert. Temporary bypass pumping will be used to maintain the operational function of the culvert during the construction period. Since the purpose of the culverts is to provide flood protection, it is important to maintain this operational function during construction, particularly where multiple culverts will be under construction at the same time.
Significance: Medium High
It is necessary to be able to operate the bypass pumps during power outages to maintain the flood protection function.
Recommendation for Resolution
Develop contingency plans for maintaining bypass pump operating capability during power outages at culvert construction sites.

Comment #6
There is no description of how the USACE determined the number of culverts that can be replaced concurrently and still be able to provide adequate flood protection during a large storm event that might occur during construction.
Basis for Comment
According to Table 3 in the March 2011 Culvert Letter Report, multiple culverts will be replaced at the same time over the next several years. The information in the DSMR Appendix B-3 indicates the culverts are being replaced at a different schedule and in a different sequence than indicated in the Culvert Letter Report. There is no discussion in any of the reports on how the culvert replacement sequence was determined. A culvert replacement schedule was not included in the documents for review during the IEPR. Therefore, it is unknown when each of the culverts will be replaced and how many will be under construction at the same time in a given area. If too many culverts are under construction simultaneously in the same area, it will be difficult to maintain the flood protection function of the culverts.
Significance: Medium High
The flood control function must be maintained while multiple culverts are under construction simultaneously.
Recommendation for Resolution
Consider using a risk assessment or other method to determine the culvert replacement sequence and the number of culverts that can be under construction simultaneously while maintaining an adequate flood control capability.

Comment #7
The adequacy of the project construction schedule could not be determined because the construction schedule was not provided in the review documents.
Basis for Comment
The Construction Schedule (Attachment E of the Engineering Appendix) was omitted from the DSMR. The construction schedule documentation has not been provided to allow a reasonable assessment of the project construction schedule.
Significance: Medium High
A review of the construction schedule would confirm that the project construction schedule is realistic and represent a reasonable estimate of the required project construction duration. Given the absence of construction schedule detail it is not possible to determine the adequacy of the construction schedule.
Recommendation for Resolution
1) The construction schedule should be included in the project documentation package. 2) The construction schedule should be independently peer reviewed.

Comment #8
The adequacy of the project risk analysis and risk management planning could not be determined because the Cost and Schedule Risk Analysis Report was not provided in the review documents.
Basis for Comment
The Cost and Schedule Risk Analysis Report (Attachment B of the Engineering Appendix) was omitted from the DSMR. The Cost and Schedule Risk Analysis Report documentation has not been provided to allow a reasonable assessment of the project risk analysis and risk management planning.
Significance: Medium High
A review of the Cost and Schedule Risk Analysis Report (CSRA) would confirm that the project risk analysis and risk management planning have been adequately performed. Additionally, a review of the CSRA would identify critical project elements requiring more extensive review.
Recommendation for Resolution
1) The Cost and Schedule Risk Analysis Report should be included in the project documentation package. 2) The Cost and Schedule Risk Analysis Report should be independently peer reviewed.

Significance - Medium

Comment #9
As discussed at the mid-point conference, we understand there were other scenarios for tropical storms considered than just those that were described as the "mean amount of time between historical tropical storm events is 145.7 days." However, this information is not included in the documentation.
Basis for Comment
Page 3-28 of the Hydrologic Hazard Assessment it states "The mean amount of time between historical tropical storm events is 145.7 days".
Significance: Medium
We believe that this is an issue that needs to be clarified to show that other tropical storms were evaluated that can affect the impact of the dikes and potential overtopping of the dikes.
Recommendation for Resolution
1) We suggest considering updating the reference on Page 3-28 of the Hydrologic Hazard Assessment and further state that there was also modeling of multiple tropical storm events in shorter time periods. 2) The results of the evaluation of tropical storms that were evaluated on a more frequent basis should also be addressed.

Comment #10
Using jet grouting at several locations on HHD that have difficult infrastructure situations will require assurances that the method is implemented successfully to prevent leakage and seepage.
Basis for Comment
At Pump Station S-236 Construction of the jet grouting cutoff wall between and under the three 42" discharge pipes near the embankment crest at Pump Station S-236 may be difficult. Successful jet grouting is required to achieve a continuous cutoff wall under the discharge pipes. DSMR, Appendix B-3, Section B.9.2.2 indicates that the pump station discharge pipes will be exposed at the centerline of the embankment to verify their location and condition. It is further indicated that jet grouting adjacent to and between the pipes will be used to construct a continuous cutoff wall across the structure penetration. It will likely be difficult for the jet grouting drill to access the areas between the pipes with the pipes exposed. Specialized jet grouting equipment may be required to generate large diameter columns to achieve a continuous cutoff wall under the pipes. **At US Sugar Raw Water Intake** Construction of the jet grouting cutoff wall between and under the four pipes and adjacent to the existing concrete collar at the US Sugar Raw Water Intake will be difficult and risky. Contact of the jet grout wall with the pipes and collar is critical to prevent a potential seepage path along the existing pipes. DSMR, Appendix B-3, Section B.9.2.3 indicates the location of the concrete seepage collars will first be confirmed by rotary borings. This approach will be risky and could result in damage to the existing pipes. The 2.0

foot diameter pipes are spaced at 4.5 foot centers with a clear distance of 2.5 feet between the pipes. Accurate location of the existing pipes will be necessary to avoid damaging the pipes with the jet grout drill. The jet grout columns will need to be at least 6.5 foot diameter to provide overlap. It might be difficult to achieve a jet grout column dimeter of 6.5 feet in the clay material. Specialized jet grouting equipment and procedures may be required to generate large diameter columns to achieve a continuous cutoff wall under the pipes.

At Lock S-310

It may be difficult to achieve good contact between the existing steel sheet piling cutoff wall under the Lock S-310 structure and the proposed jet grouting due to the presence of the timber piles along the edge of the concrete foundation slab. Closure between the end of the DSMR embankment cutoff wall and the lock structure are critical to prevent a potential seepage path through the dike.

DSMR, Appendix B-3, Section B.9.2.4 indicates jet grouting in the area between the end of the proposed DSMR embankment cutoff wall and the existing steel sheet piling cutoff wall along the structure side wall just downstream of the original gate recess. According to the drawings for this lock structure in the DSMR and Risk Assessment of Structures Report, the first row of timber piles along the edge of the structure are outside of and very close to the steel sheet piling. The timber piles will be between the jet grout drill and the face of the steel sheet piling. The timber piles along the edge of the structure may produce shadows of uncemented soils due to their close spacing and short distance from the steel sheeting piling. Contact with the steel sheet piling will be uncertain and difficult to verify. It will be difficult to verify that the soilcrete from the jet grouting will be fully in contact with the steel sheet piling.

The location of the existing steel sheet piling under Lock S-310 appears to be uncertain, which might change the location of the jet grout cutoff wall shown in the DSMR TSP. The location of the existing steel sheet piling wall under the S-310 lock is critical to the location of the proposed jet grout wall to avoid drilling into the foundation concrete slab. The location also is critical to achieve a seal between the existing steel sheet piling and the jet grout column.

DSMR, Appendix B-3, Section B.9.2.4, Figure 8 indicates the location of the existing sheet pile cutoff wall under the structure is near the downstream edge of Gate Recess No. 1. Overlaying the Footing Excavation and Piling Plan with the General Plan and Section (at the same scale) for the Lock S-310 structure indicates that the steel sheet piling cutoff wall is further downstream from the location shown on Figure 8.

At Lock S-77

It may be difficult to achieve good contact between the existing steel sheet piling cutoff wall under the Lock S-77 structure and the proposed jet grouting wall due to the presence of the timber piles along the edge of the concrete foundation slab. Closure between the end of the DSMR embankment cutoff wall and the lock structure are critical to prevent a potential seepage path through the dike.

DSMR, Appendix B-3, Section B.9.2.8 indicates jet grouting in the area between the end of the proposed DSMR embankment cutoff wall and the existing steel sheet piling cutoff wall along the structure side wall at the upper gate structure gate recess. According to the drawings for this lock structure in the DSMR and Risk Assessment of Structures Report, the first row of timber piles along the edge of the structure are outside of and very close to the steel sheet piling. The timber piles will be between the jet grout drill and the face of the steel sheet piling. The timber piles along the edge of the structure may produce shadows of uncemented soils due to their close spacing and short distance from the steel sheeting piling. Contact with the steel sheet piling will be uncertain and difficult to verify. It will be difficult to verify that the soilcrete from the jet grouting will be fully in contact with the steel sheet piling.

Significance Medium

If jet grouting is not implemented successfully at these locations, there will not be an effective seal to prevent leakage and seepage through the dike.

Recommendation for Resolution

At Pump Station S-236

1. Consider access restrictions when developing final designs and specifications for jet grouting under the discharge pipes.
2. Backfilling over the pipes may be required to provide drill access to the areas between the pipes for jet grouting and avoid overloading the existing discharge pipes.
3. Consider identifying methods for verification testing of jet grouting to ensure a continuous cutoff wall under the pipes.
4. Full scale field tests and/or test sections should be required to verify assumed construction parameters and performance.

At US Sugar Raw Water Intake

1. Consider locating the seepage collar closest to the lake by open excavation.
2. Consider locating the alignment of the pipes by open excavation where they are nearest the ground surface on each side of the dike.
3. It also might be possible to use utility locating devices or ground penetrating radar to identify the alignment of the pipes and the concrete collars.

At Lock S-310

1. Work with jet grouting contractors to develop a procedure to achieve good contact between the soilcrete column and the steel sheet piling.
2. The drawings for Lock S-310 should be examined closely to determine the accurate location of the existing steel sheet piling cutoff wall under the structure. The proposed jet grout cutoff wall should be located accordingly to avoid drilling into the existing foundation slab and to achieve a seal with the existing steel sheet piling.

At Lock S-77

Work with jet grouting contractors to develop a procedure to achieve good contact between the soilcrete column and the steel sheet piling.

Comment #11

An evaluation of the adequacy of the project cost estimate could not be made because the cost estimate was not provided in the review documents.

Basis for Comment

The MII TSP Cost Report (Attachment D of the Engineering Appendix) was omitted from the DSMR. The cost estimate documentation has not been provided to allow a reasonable assessment of the project cost estimate.

Significance: Medium

A review of cost estimate data and analyses would confirm that the project cost are realistic and represent a reasonable estimate of the probable actual project cost. Given the absence of cost estimate detail it is not possible to determine the adequacy of the cost estimate.

Recommendation(s) for Resolution

1) The MII TSP Cost Estimate should be included in the project documentation package.

2) The MII TSP Cost Estimate should be independently peer reviewed.

Comment #12

It is not clear if the construction contractor will be required to install a test section of the cutoff wall before being permitted to continue with production work.

Basis for Comment

Successful construction of the cutoff wall feature is largely dependent on the skill of the construction contractor and the contractor's methodology. In the previous cutoff wall project, several different contractors employed different construction techniques to construct the cutoff walls. Given the USACE intent to utilize a performance based specification for the cutoff wall construction, it would appear reasonable to require the contractor to demonstrate the suitability of the proposed methodology in a test section prior to permitting production work.

Significance: Medium

Proceeding with an inadequate construction method will result in negative consequences for the project such as additional quality management challenges and delays caused by the need for rework.

Recommendation for Resolution

Require a demonstration by the contractor of the proposed construction method for the cutoff wall prior to permitting production work.

Comment #13

The DSMR EIS does not provide sufficient detail on existing and Future Without Action Conditions (FWAC) for the reader to fully evaluate and understand existing natural resources and the impacts associated with selection of the tentatively selected plan (TSP).

Basis for Comment

The EIS provides a clear and well organized discussion of existing conditions, and thoughtful discussion of future without action conditions. However, in many cases more detail is warranted, as the focus appears to be on the immediate project area. NEPA requires analysis of both direct and indirect impacts of the project. Without a regional focus on existing conditions, it is hard to gauge potential impacts of the tentatively selected plan (TSP) or validate certain conclusions of the EIS regarding impacts. Examples are provided below:

Section 3. p. 3-1 paragraph one. The Draft Environmental Impact Statement text "*describes existing environmental resources of the areas that would be affected on the HHD dike*" if any of the alternatives were implemented. This implies that the study area is the dike area itself where in fact the NEPA analysis should address any downstream conditions that may be affected as well.

Section 3.1 Geology

Significant description is provided of historical berm construction, etc. but the reader would benefit from an understanding of regional geology responsible for formation of the limestone basin within which Lake Okeechobee sits. That historical understanding of natural conditions provides a basis for understanding how man-

altered the present lake is. It also would help the reader understand the basis for statements elsewhere in the DSMR that hydrological inputs to the lake are six times the output.

Section 3.2 Soils

The discussion of soil types lacks a figure that would enable the reader to better understand their distribution in the study area in relation to the proposed project.

Section 3.5 Water Quality

The text does not adequately address how existing water quality downstream (all the way to the Bay) is affected by current water management policies designed to relieve pressure on the berm and thereby reduce risks to public safety. This is important to understand the implications of the TSP and other alternatives at improving long term regional water quality.

Section 3.7 Wetlands

Cursory discussion is provided of wetlands with little discussion of actual acreages; a figure would be very helpful in understanding the distribution of wetland types as a basis for understanding any impacts. For example, the text states that a littoral zone is present on the western end of the lake but would be outside the project area, but the reader should be able to confirm this.

Section 3.8 Endangered Species

The discussion is excellent and focuses on endangered species as summarized by the U.S. Fish and Wildlife in Appendix E, but their analysis focuses entirely on Lake Okeechobee and there is no discussion of regional wildlife resources, species lists, etc. that would enable the reader to understand ultimately whether any of the alternatives differ in terms of their impacts.

Section 3.18 Cultural Resources

A graphic showing the extent of nearby sites would be helpful in interpreting their location relative to future proposed activities.

Section 4.2.3.10 Environment

The text states “existing conditions for the ecosystems south of HHD were thoroughly discussed in the Central Everglades Planning Project EIS”. The pertinent material from that EIS should be brought forward to provide a regional discussion, rather than requiring the public to look for it. As guidance, NEPA does not intend a document to be encyclopedic, but more detail should be provided than is within the present text, which describes species present in generalities such as “aquatic invertebrates” and “small fish, reptiles and amphibians”.

Section 4.7 Wetlands

The document does not address the long term water quality impacts and impacts on wetlands and wildlife from continuing present lake management policies without implementation of the TSP or other alternatives. As a result, it may be more difficult for the public to fully understand the need for the project.

A figure showing the extent of different wetland/habitat types should be presented as a basis for understanding potential acreage impacts from the TSP.

Section 4.8 Wildlife

Again, the discussion seems focused primarily on “if the dike were to fail” as opposed to what would happen in the future without the project, specifically allowing high nutrient freshwater to flow into the Bay during severe storm events.

Significance: Medium

The examples provided and issues raised are not likely to significantly affect the overall analysis of alternatives but are critical to meeting NEPA requirements. Addressing the comment would provide the public with sufficient detail to understand the project in a regional context.
Recommendation for Resolution
Include greater detail as noted in the examples above.

Comment #14
The DSMR EIS does not provide sufficient detail on FWAC and cumulative project impacts for the reader to fully understand the relationship of the tentatively selected plan (TSP) to other regional initiatives geared at managing water quality, restoring wetlands and protecting wildlife, water quality, recreation and other resources of the region.
Basis for Comment
Section 1.8 provides a succinct summary of several related regional projects aimed at improving water management over much of the State. These include the Comprehensive Everglades Restoration Plan, the Lake Okeechobee Interim Regulation Schedule (LORS), the South Florida Water Management District Restoration Strategies Project, Central Everglades Planning Project, and others. These projects are clearly interrelated and have many overlapping goals. The TSP is a critical first step component that is primarily focused on public safety but also has major regional implications toward regional water quality and other resource values. Section 4 of the EIS describing Future Without Action Conditions provides a clear and thoughtful presentation of what might happen in the future without the project, but focuses mainly on the berm construction area itself and not regional downstream conditions. Existing water management policies and their impacts on downstream regional water quality should be discussed, since the TSP would be the first step in attempting to alleviate some of these downstream impacts on the estuarine ecology of the region. Likewise, the cumulative impacts section of the EIS in 5.23 should describe the TSP in greater detail in relation to the various regional initiatives first introduced in Section 1.8 so that the reader understands the importance of this project in a regional context.
Significance: Medium
The examples provided and issues raised are not likely to significantly affect the overall analysis of alternatives but are critical to meeting NEPA requirements. Addressing the comment would provide the public with sufficient detail to understand the project in a regional context.
Recommendation for Resolution
Include greater detail as noted in the examples above.

Comment #15
The DSMR EIS does not give sufficiently detailed consideration of climate change on the future ecology of Lake Okeechobee and surrounding region, both with and without implementation of the tentatively selected plan.
Basis for Comment
Given the 100-year planning horizon for this project, FWAC conditions and future conditions with the project should consider the long term nature of climate change on regional ecological conditions. The coastal zone consistency determination concluded that, "*the project is located inland and would have no effect on saltwater resources directly or indirectly through discharge downstream*." However, Executive Order 13553 requires that federal projects consider climate change in their analyses. The 100-year planning horizon would be a very long period to maintain the current water management policy used to relieve pressure on the berm during severe storm events, and would almost certainly affect the long term water quality and ecology of the downstream wetlands extending 60 miles to the Bay. This is because high nutrient freshwater would continue to further impact estuarine wetlands. It would seem that climate change in the form of more frequent and severe storm events would only further exacerbate those conditions, making it more imperative that the District act to implement the TSP or another reasonable alternative. The EIS does not appear to address this issue.
Significance: Medium
Omitting this from the analysis would appear to result in undervaluing the project from an long-term ecological perspective.
Recommendation for Resolution
Include greater detail as noted in the examples above.

Significance Medium Low

Comment #16
The USACE should conduct period monitoring of downstream development to assess if risk is changing.
Basis for Comment
The proposed life of the project is 100 years or more. It is likely that during this time changes in the pattern and magnitude of downstream development will occur. Such changes could justify remediation work be done to increase the integrity of the dam for reaches where no remediation is currently recommended. Due to the low-level of downstream development and potential for loss of life, the embankment will not be upgraded in several reaches. Given the dynamic growth in the state of Florida in the past 50 years, it is likely that the area downstream of these reaches may be developed and that the potential for loss of life will increase with time.
Significance - Medium Low
Future downstream development may increase the hazard potential to a level that would remedial action to upgrade the safety of the embankment. Periodic monitoring of the downstream level of development and hazard will ensure that the risk associated with the HHD is maintained at an acceptable level.
Recommendation for Resolution
All current US ACE dams require ongoing periodic inspections to monitor dam safety issues related to the condition and operation of the embankments and other project features. It is recommended that the periodic inspection procedures for the HHD structures include specific requirements that incorporate a review and visual inspection of the downstream development. This review should include a specific section of the inspection report section documenting the current development level relative to that assumed in the DSMR study. This recommendation should be made as a paragraph in the DSMR report.

Significance - Low

Comment #17
The report does not make any mention of slope stability as a potential failure mode
Basis for Comment
The report references a study in 1986 that stated the computed factors of safety at least one embankment section were less than the required values for the steady-state seepage condition. Embankment stability is typically one of the principal failure modes that should be considered for any embankment. The presence of a peat layer at the base of the foundation for most sections is also a concern. Peat typically has relatively low shear strengths.
Significance - Low
Discussions with the Corps during the mid-point conference indicate that stability analyses for all of the sections of the embankment resulted in computed factors of safety that meet current Corps of Engineers criteria. For this reason the Corps did not consider stability to be a significant potential failure mode.
Recommendation for Resolution
It would aid in the overall understanding and completeness of the report if the potential failure mode involving embankment stability were addressed and explained. It is recommended that a paragraph be developed and included in the report which describes the results of the previous stability analyses and the reasons that slope stability was not considered as a potential failure mode for purposes of the development of remedial measures.

Comment #18
The explanation for the use of the Monte Carlo Reservoir Analysis Model (MCRAM) that was developed by the USACE Risk Management Center and was approved for a one-time use for this study was understood better after final completion of the readings. It would have helped if the “history” of the analysis (HEC-1, HEC HMS, and HEC ResSim) was separated from the actual modeling description and results.
Basis for Comment
Due to the magnitude of the data to be reviewed, the historical background led to initial confusion about the evolution and justification of the final modeling until all of the reading was completed.
Significance: Low
This is a comment that can be left alone or used as the USACE deems fit.
Recommendation for Resolution
This will be left to the USACE to determine if they choose to do some editorializing or not to help avoid similar confusion as the Project proceeds forward.

Comment #19
The DSMR does not provide an estimated date for the replacement of the Florida Department of Transportation of the SR78 highway bridges over Harney Pond, Indian Prairie and Kissimmee River.
Basis for Comment
The Dam Safety Modification Study acknowledges the need to raise the approach embankments on the SR78 brides requiring replacement of the bridges. In the interim, armoring of the existing embankment is proposed and is represented as a "permanent" solution. The stated assumption is that the bridges will be rebuilt at the end of their service life with a higher abutment elevation permitting an increase in the adjoining embankment height. A comparison of the remaining service life of the bridge with the expected service life of the armoring would appear to be useful. However, no estimate of when the bridge replacement will occur is provided in the report.
Significance: Low
The completeness of Dam Safety Modification Study will be significantly improved by including estimated replacement dates for the SR78 bridges.
Recommendation for Resolution
Include in the report a confirmation of contact with the Florida Department of Transportation and the estimated bridge replacement dates.

Comment #20
Sea level change, subsidence, or modified agriculture policy could eliminate the supposed consequences of a possible HHD failure.
Basis for Comment
The report mentions the importance of the Everglades Agriculture Area (EAA) as the economic engine and driver for the population at risk and economic consequences. Sea level change, subsidence and elimination of subsidies for sugar cane could result in the reduction or elimination of the consequences which support the proposed investment recommendation. Alternatively, the need for the proposed improvements could become more substantial with accelerated development if agriculture is suspended.
Significance: Low
EAA currently exists so any change due to these factors is speculative. The consequences for current conditions are appropriately addressed.
Recommendation for Resolution
1) Provide a section on the impact sea level change, subsidence and agriculture policy could have on the consequences described and viability of the investments if EAA were compromised. 2) Describe a probable future considering these potential changes.

Comment #21
DAMRAE and FIA models must simulate the risk and consequences for the HHD impact area.
Basis for Comment:
Non-structural measures were effectively considered and dismissed. However, the sparse population present and the shallow flooding that results from a breach of the HHD implies that testing model assumptions for sensitivity might be appropriate. For example, in Appendix E "Consequences" on Page E-22, the 91% fatality rate for "caught during mobilization" is hard wired, which could be overstated considering the expectation for shallow flooding. Large dams with high head that the DAMRAE and FIA were developed for may differ from the HHD impact area. Since AALL and APF are so critical to the investment decision, it would provide clarity to understand how accurately the model simulates the HHD impact area.
Significance: Low
AALL is potentially not significantly changed by a reduction in fatality rates, mandatory evacuation during extreme pool conditions, or more direct routes for evacuation.
Recommendation for Resolution
1) Demonstrate the sensitivity of the model to deterministic assumptions like the 91% fatality among those "caught". 2) Uncertainty could be reduced through the use of MOBILE LIDAR to enhance structure location and height.

Comment #22
Improvements to accomplish reductions in AALL should be implemented as the first priority.
Basis for Comment
Pages 243 through 245, paragraph 8.3 and Table 8-3, provide the proposed implementation plan. In this plan, work that is needed to reduce AALL in segments 14A and 14B does not start until the fifth year of the proposed order of work. To be consistent with the investment rational, work to reduce potential loss of life would be first in the order of work, even at the expense of increasing the project cost. AALL is the principle justification for the proposed improvements.
Significance: Low
The order of work will probably be reworded numerous times before construction is initiated.
Recommendation for Resolution
Revise the implementation plan to reflect AALL priority.

Comment #23
Assumptions about "Warning Issuance Times" are speculative.
Basis for Comment
Appendix E "Consequences", Page 36, Table 3, provide the expected case scenario for "Warning Times." The speculative nature of this parameter is recognized by the analysts and addressed using scenario-based planning to account for uncertainty. There are two observations about the expected case. First, if the watch is started at elevation 16.5 feet, why is there no pre-breach warning time at 17 feet? Second, is it reasonable to assume watch personnel will remain on site during an extreme event (31.1 feet)? During Katrina pump operators were removed from the stations for their safety. (See also page E-138, "Conclusions".)
Significance: Low
Reduced warning time will result in the same implementation decision.
Recommendation for Resolution
Review expectations for "warning time" on all over-wash and overtopping segments where the recommendation might be modified.

Comment #24
Additional definition of ALARP is needed.
Basis for Comment
As Low As Reasonably Practicable (ALARP) is integral to Plan Formulation and scaling of the proposed improvements. Cost effectiveness can imply obtaining a discriminating level of economic or environmental output. Since there are no discriminating levels of additional economic or environmental output (except for increment of cost per avoided risk) additional description of ALARP would have enhanced our understanding of the plan formulation. In a paper titled "**A RISK-BASED REEVALUATION OF OPERATING RESTRICTIONS TO REDUCE THE RISK OF EARTHQUAKE-INDUCED DAM FAILURE",** Dr. David Bowles and other contributors (cited in the document) presented this description of ALARP: "*This introduces the consideration of cost, but only to justify further incremental risk reduction below the tolerable risk limits, and not to justify achieving those limits in the first place. Hence, there should be no consideration of "balancing" the economic impacts of…."* Since ALARP is a "cost-effectiveness" decision criterion, it should be made clear that ALARP is based on the "disproportionate" cost associated with achieving an additional level of risk reduction.
Significance: Low
Low
Recommendation for Resolution
Include an expanded definition or description of ALARP to disclose fully that there is no "balancing" of dike improvement costs and incremental economic or environmental outputs, but, instead, there is a recognition of "disproportionate" cost for the next increment of risk reduction.

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Appendix B Charge for the Independent External Peer Review Panel

This appendix provides the list of the documents reviewed by the IEPR panel (Appendix B.1), and the final Charge to Reviewers used to guide the review by the IEPR panel members (Appendix B.2).

B.1 Documents Provided for Review

Table 4 below lists the documents reviewed by the IEPR panel.

Table 4 – IEPR Documentation for Review

Review by All Panel Members
HHD DSMR AND EIS – January 2016 Main body of report – DSMR only
HHD DSMR AND EIS – January 2016 Appendix A - "Risk Assessment Project History" (only)
Herbert Hoover Dike Review Documentation Part 6 – 01 Risk Assessment Technical Summary – Part II HHD RATS 2 Report HHD RATS 2 Report – Figures
Review by Specific Panel Members
Geotechnical Engineer
Herbert Hoover Dike Review Documentation Part 6 – 02 Baseline Risk Assessment – March 2013 (Internal Erosion) HHD PFMA RA Final Report – Section 14.0 REACH 1 BASELINE RISK (SEGMENTS 22 TO 24) HHD PFMA RA Final Report Figures (as needed)
Herbert Hoover Dike Review Documentation Part 6 – 03 Baseline Risk Assessment – March 2014 (Internal Erosion) HHD Baseline Risk Assessment Report HHD Baseline Risk Assessment Figures
Herbert Hoover Dike Review Documentation Part 6 – 04 Risk Assessment of Structures – January 2014 HHD PRMA RA Structures Report HHD PRMA RA Structures Figures
Herbert Hoover Dike Review Documentation Part 6 – 06 Risk Reduction Assessment – July 2014 HHD RA Report HHD RA Figures
Herbert Hoover Dike Review Documentation Part 6 – 05 Risk Assessment of Overtopping and Overwash – February 2014 Risk Assessment of Overwash and Overtopping Report RA Overwash and Overtopping Figures Appendix A Appendix B Appendix C
HHD DSMR and EIS – January 2016 Appendix B-3 Engineering and Cost (only)

Engineering Geology
HHD DSMR and EIS – January 2016 Appendix B-1 Geology (only)
Civil Engineer
HHD DSMR and EIS – January 2016 Appendix B-3 Engineering and Cost (only)
HHD DSMR and EIS – January 2016 Appendix E Real Estate Plan (only)
Structural Engineer
Herbert Hoover Dike Review Documentation Part 6 – 04 Risk Assessment of Structures – January 2014 HHD PRMA RA Structures Report HHD PRMA RA Structures Figures
Hydraulic and Hydrology Engineer
Herbert Hoover Dike Review Documentation Part 6 – 05 Risk Assessment of Overtopping and Overwash – February 2014 Risk Assessment of Overwash and Overtopping Report RA Overwash and Overtopping Figures Appendix A Appendix B Appendix C (text only)
Herbert Hoover Dike Review Documentation Part 3 – 01 Hydrologic Risk Assessment – Final Draft
Herbert Hoover Dike Review Documentation Part 3 – 05 ARA - Okeechobee Hurricane Surge Lake Stage Report
Herbert Hoover Dike Review Documentation Part 3 – 02 Herbert Hoover Dike - Standard Project Flood
Herbert Hoover Dike Review Documentation Part 3 – 04 MCRAM Sensitivity
Herbert Hoover Dike Review Documentation Part 3 – 03 Basis of Authorization of the Standard Project Flood
Economics/Planning **Water Resources Planner**
HHD DSMR and EIS – January 2016 Appendix C Consequences (only)
Environmental Planner/NEPA Impact Assessment
HHD DSMR and EIS – January 2016 Appendix D Environmental Impact Statement (only)

B.2 Final Charge to Reviewers

The text below reproduces the final Charge to Reviewers as prepared by the USACE and provided to the IEPR panel at the beginning of the review process:

DAM SAFETY MODIFICATION STUDY
HERBERT HOOVER DIKE
PALM BEACH, HENDRY, GLADES, OKEECHOBEE, AND MARTIN COUNTIES, FLORIDA
INDEPENDENT EXTERNAL PEER REVIEW
CHARGE TO REVIEWERS

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

The objective of the IEPR is to obtain an independent evaluation of whether the interpretations of analysis and conclusions based on analysis are reasonable for the subject study. The IEPR panel is requested to offer a broad evaluation of the overall study decision document in addition to addressing the specific technical and scientific questions included in the charge. The panel has the flexibility to bring important issues to the attention of decision makers, including positive feedback or issues outside those specific areas outlined in the charge.

The panel review is to focus on scientific and technical matters, leaving policy determinations for USACE and the Army. The panel should not make recommendations on whether a particular alternative should be implemented or present findings that become "directives" in that they call for modifications or additional studies or suggest new conclusions and recommendations. In such circumstances the panel may have assumed the role of advisors as well as reviewers, thus introducing bias and potential conflict in their ability to provide objective review.

Panel review comments are to be structured to fully communicate the panel's intent by including the comment, why it is important, any potential consequences of failure to address, and suggestions on how to address the comment. The IEPR Performance Work Statement provides additional details on how comments should be structured."

Broad Evaluation Charge Questions (4)

1. Were risk and uncertainty sufficiently estimated and characterized for the existing, future without and future with project conditions?
2. Were risk and uncertainty sufficiently considered during the study?
3. In your opinion, is there sufficient data upon which to base the tentative selection of a risk management plan?
4. In your opinion, is the tentatively selected risk management plan appropriate given the risks and uncertainty estimated at Herbert Hoover Dike?

Existing and Future without Project Resources (5)

5. Are the methods used to estimate the risk adequate and appropriate given the circumstances?
6. Have all the significant potential failure modes been identified and appropriately considered?

7. Has anything significant been overlooked in the existing project risk? Do you agree that future without action risks are generally going to be the same as existing, given the probability of pool loadings over period of analysis?
8. Have the social, financial, and cultural resources within the study area been adequately captured for the existing and future without action risk conditions?
9. Are future Operation, Maintenance, Repair, Replacement, and Rehabilitation efforts adequately described and are the estimated cost of those efforts reasonable for future without action risk condition?

Plan Formulation / Evaluation (5)

10. Was a reasonably complete array of possible measures considered in the development of alternatives, including those non-structural measures, such as removing the project?
11. In your professional opinion, are the metrics used in the alternatives evaluation and screening, that lead to a final array of alternatives, acceptable?
12. Please comment on the evaluation and comparison of the proposed alternatives. Was the evaluation criteria applied correctly and was the final array of alternatives compared appropriately?
13. Have the potential benefits and impacts of each alternative been clearly and adequately presented?
14. Were the engineering, economic, and environmental analyses used for this study consistent with generally accepted methodologies? Why or why not?

Recommended Plan (2)

15. Does the tentatively selected plan meet the study objectives and avoid violating the study constraints?
16. Please comment on the completeness of the tentatively selected plan, i.e. will any additional efforts, measures, or projects be needed to realize the expected benefits?

Dam Safety (3)

17. Has the condition of the project, including the design and construction of the project and appurtenant features, project maintenance, previous remediation, and the dam's performance over time, been clearly described?
18. Is there sufficient information presented to identify, explain, and comment on assumptions that underlie engineering analyses? Why or why not?
19. Are potential life safety issues accurately and adequately described under existing, future without project, and future with project conditions?

Environmental Assessment Questions (2)

20. Have the affected environment and environmental consequences of all alternatives been adequately described? If not, please elaborate.
21. Should any other resources be considered for the affected environment? If yes, please elaborate.

Final Overview Question (1)

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

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Appendix C Organizational Conflict of Interest Forms

C.1 LMI Conflict of Interest Form

Conflicts of Interest Questionnaire

Independent External Peer Review

HERBERT HOOVER DIKE (HHD), FLORIDA
DAM SAFETY MODIFICATION REPORT (DSMR)
AND
ENVIRONMENTAL IMPACT STATEMENT (EIS)

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

NAME OF FIRM: Logistics Management Institute
REPRESENTATIVE'S NAME: Stephanie White
TELEPHONE: 571-766-9923
ADDRESS: 7940 Jones Branch Drive, Tysons, VA 22012
EMAIL ADDRESS: swhite@lmi.org

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

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

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

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

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

YOUR SIGNATURE _____ DATE 22 Jan 2016

C.2 APMI Conflict of Interest Form

Conflicts of Interest Questionnaire

Independent External Peer Review

HERBERT HOOVER DIKE (HHD), FLORIDA
DAM SAFETY MODIFICATION REPORT (DSMR)
AND
ENVIRONMENTAL IMPACT STATEMENT (EIS)

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

NAME OF FIRM: Analysis Planning and Management Institute
REPRESENTATIVE'S NAME: Ahmad Faramarzi
TELEPHONE: 540-321-4888
ADDRESS: 101 E. Culpeper Street, Suite 150 Culpeper, VA 22701
EMAIL ADDRESS: ahmad.faramarzi@apm-inst.org

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

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

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

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

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

Ahmad Faramarzi Digitally signed by Ahmad Faramarzi DN: cn=Ahmad Faramarzi, ou=PM, o=, email=ahmad.faramarzi@apm-inst.org, c=US Date: 2016.01.21 17:20:17 -05'00'

YOUR SIGNATURE 1/21/16 DATE

Appendix D Qualifications of the Independent External Peer Review Panel Members

The summary qualifications for the IEPR panel members (in alphabetical order) are provided below to show their qualifications for this project.

D.1 Mr. Paul Bovitz

Role: Environmental Planning/NEPA Impact Assessment
Affiliation: WorleyParsons Group

Mr. Bovitz is principal consultant with over 30 years' experience as an Environmental Project Manager with expertise in leading interdisciplinary, high-performing teams on national and international projects. He has extensive professional 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, habitats, and taxa. Mr. Bovitz earned his B.S. in Wildlife Biology from Colorado State University, an M.S. in Ecology from Rutgers University, followed by his MBA in Finance from Rutgers University.

Mr. Bovitz is an experienced peer reviewer of USACE ecological restoration plans, environmental impact statements, and feasibility studies. Much of his career has been spent as an EPA and USACE contractor directing ecological investigations of sites requiring environmental restoration. Mr. Bovitz is experienced in NEPA compliance, having completed several EAs, DMMPs, EIS and other NEPA documents, including extensive USACE contracting experience in preparing NEPA compliant feasibility studies for habitat restoration and environmental remediation projects. He has worked nationwide, and for the past five years has been working as lead ecological risk assessor for investigation and cleanup of two contaminated sites at Tyndall AFB in Panama City. He has performed aquatic surveys and ecological risk assessments at several sites, and his NEPA experience includes cumulative impacts analyses. He has served as an IEPR panel member for both ecological issues and NEPA compliance on projects for the US Army Corps of Engineers, including dam safety projects for the Albuquerque, Dallas, St. Louis and New York Districts.

Mr. Bovitz currently serves as acting member of the New Jersey Governor's Science Advisory Board, Ecological Sciences Committee, and formerly served on the Comparative Risk Analysis Panel of the New Jersey Department of Environmental Protection (NJDEP). In July 2014, he served as Chair for a session he organized on "Integrating Ecological Restoration Projects into a Regional Framework" at the Conference for Ecological and Ecosystem Restoration, which focused on regional approaches for coastal restoration projects.

Mr. Bovitz holds the following credentials; Licensed Site Remediation Professional – New Jersey (#586403, 2010), Certified Professional Wetland Scientist – Society of Wetland Scientists, Certified Energy Manager – Association of Energy Engineers (No. 14394; 2009), LEED AP – U.S. Green Building Council and Certification in Green Supply Chain Management – Rutgers University.

D.2 Dr. Ralph Ellis

Role: Civil/Structural/Cost Engineering
Affiliation: University of Florida at Gainesville

Dr. Ellis is currently working as an Associate Professor in the Department of Civil Engineering and Coastal Engineering and conducting research as a Principal Investigator at the University of Florida. He has over 30 years of civil engineering and construction experience. He earned his BS in Civil Engineering, MS of Engineering, and Ph.D. at the University of Florida along with an additional MS in Business Administration at the University at Nova University. He is a registered Professional Engineer through the state of Florida.

As an Associate Professor, he is in charge of teaching graduate and undergraduate courses in Civil Engineering, and performing sponsored research at the national and state levels focusing on civil and construction engineering management. He also has worked closely with the Florida Department of Transportation in both research and industry training initiatives.

Prior to joining the University of Florida, he was president of Hammer Corporation, a construction firm and Director of Projects for the FMI-Hammer Joint Venture. He was responsible for estimating and delivering all design and construction projects including many projects for the US Army Corps of Engineers.

Dr. Ellis was selected to serve as an industry advisor to the US State Department's Bureau of Overseas Building Operations. He was an appointed member to the American Society of Civil Engineer's Committee on Critical Infrastructure. This is a Board of Direction level committee, providing input on national infrastructure renewal issues.

He has served as a member on many Independent External Peer Review and review panels, specifically as an expert in the areas of construction engineering, cost engineering, and civil engineering. A few of the most recent Reviews are the following; External Review of the Tamiami Trail Limited Re-Evaluation Report, Safety Assurance Review (SAR) of the **Site 1 Impoundment, Palm Beach County, Florida and Hurricane Isaac** With and Without 2012 100-Year Hurricane and Storm Damage Risk Reduction System (HSDRRS) Preliminary Technical Assessment Report. In additions Dr. Ellis served on several U.S. Army Corps of Engineers Independent External Peer Reviews (IEPR) of; **Louisiana Water Resources Council (LWRC),** LCA Small Diversion at **Convent/Blind River** Integrated Feasibility Study and Environmental Impact Statement, **Mississippi River Gulf-Outlet** Ecosystem Restoration Plan Feasibility Study and Environmental Impact Statement, Hurricane and Storm Damage Risk Reduction measures for the Federal **NOV Project** and incorporation of the NFL levees into NOV, **Barataria Basin Barrier Shoreline (BBBS**) Restoration Draft Construction Report and Draft Environmental Impact Statement (EIS), **Donaldsonville, Louisiana**, to the Gulf of Mexico, Flood Control – Mississippi River and Tributaries Project Feasibility Scoping Report and Supporting Documentation, Mississippi River and Tributaries, **Morganza to the Gulf of Mexico** Hurricane Protection Project, Louisiana-Post Authorization Change Decision Document, **Three Features of the New Orleans to Venice (NOV)** Hurricane Protection Project in Plaquemines Parish, Louisiana,

He is currently an active member of the American Society of Civil Engineers and the Southeastern Construction Owners and Associates Roundtable. Also, during his years of research he has published over 55 publications transferring research results.

D.3 Mr. Charles Hutton

Role: Structural Engineering *and* Structural Engineering
Affiliation: Independent Consultant

Mr. Hutton is a civil/structural engineer with 48 years of experience in the design and management of water resource projects involving dams, hydraulic structures, hydropower, pumping plants, and water conveyance facilities in Asia, Africa, Latin America, Middle East and the United States. He achieved his professional engineer registration in 1981 in Colorado. Mr. Hutton's expertise includes preparing feasibility studies, designs, drawings, and specifications for RCC, gravity and arch dams, hydropower plants, pumping plants, pipelines, canals and hydraulic structures; performing dam safety inspections; conducting condition assessments of existing dams, hydropower facilities and water conveyance systems; developing designs for rehabilitation; technical review; failure mode analysis and risk assessment of large complex systems; project management and construction management.

He received his MSCE and BSCE in Structural Engineering from Purdue University, completed graduate studies in Water Resource Engineering at the University of Colorado, Risk Assessment Methodology for Dams (RAM-DSM) through the Corps of Engineers, and Potential Failure Mode Analysis through the Federal Energy Regulatory Commission.

Mr. Hutton has completed training for the Sandia National Laboratories Risk Assessment Methodology for Dams (RAM-D) and performed vulnerability and risk assessments for several concrete and earth dams and their appurtenant facilities. He also has completed training for the Federal Energy Regulatory Commission (FERC) Dam Safety Performance Monitoring Program and Potential Failure Mode Analysis methodology and has been involved in many projects that required application of this methodology. He has served as a FERC qualified independent consultant for the safety inspection of numerous licensed dam and hydroelectric projects. Mr. Hutton has also been the structural engineer panel member and reviewer for four Corps of Engineers Independent External Peer Review (IEPR) projects.

His long-term overseas assignments include Vietnam, Philippines, Malaysia and Peru, with short-term assignments in Cambodia, Zambia, Iceland, Jordan, Indonesia and Ecuador. In addition, he has worked on projects in the Dominican Republic, Turkey, Nicaragua, Guyana, Lebanon and Puerto Rico.

Mr. Hutton has served on multiple Independent External Peer Review Panels. Some examples are:

* Addicks and Barker Dam Safety Assurance Program IEPR, Texas

* Fort Peck Dam Spillway Stilling Basin Emergency Repair Project, Montana Rough River Dam Safety Assurance Program IEPR, Kentucky

* Isabella Dam Seismic Evaluation, California Bluestone Dam Safety Assurance Program IEPR, West Virginia Dover Dam Safety Assurance Program IEPR, Ohio San Gabriel Dam and Hydroelectric Project Potential Failure Mode Analysis, California

* Barker Dam and Hydroelectric Project Potential Failure Mode Analysis, Colorado

He is the author or co-author of thirteen technical papers presented at national conferences, seminars and workshops and published in national engineering publications. In addition to his strong technical background in water resource engineering, he has been a successful project team leader and technical designer and/or reviewer on domestic and international water resource projects. He also has conducted seminars on dam design, dam safety engineering and construction inspection. Mr. Hutton is a member of the American Society of Civil Engineers, United States Society of Dams, and the Association of State Dam Safety Officials.

D.4 Mr. Larry Kilgo

Role: Economics/Planning
Affiliation: Independent consultant

Mr. Kilgo has over 30 years of experience in Economic Analysis and Water Resources Planning serving as a Senior Economist with the US Army Corps of Engineers through the U.S. Army Engineer Division. His responsibilities included leading the Economic and Social Analysis Community of Practice in the Mississippi Valley Division, guiding professional development of the economic workforce, and managing the quality of economic and financial analysis conducted. He led the Economic evaluations that supported authorization of Morganza-to-the-Gulf Hurricane Risk Reduction Project located in Terrebonne and Lafourche Parish, Louisiana. Also economic and financial evaluations were prepared for Fargo Moorhead Metropolitan Area Flood Risk Reduction Project, located in North Dakota and Minnesota, and the Cedar Rapids Metropolitan Area Flood Risk Reduction Project, located in Iowa.. Authorization will be accomplished with the next Water Resources Development Act to be passed by Congress.

Mr. Kilgo also served as Chief, Environmental and Economic Analysis Branch, where his duties included supervising and directing the activities of biologists, archaeologists, economists, technicians, and support personnel. He personally executed a $3 million budget to consider economic and environmental impacts of water resource improvement. Mr. Kilgo directed prioritization and development of the Mississippi Valley Division's Flood and Coastal Storm Damage Reduction Budget.

He has served as an Economist/International and Interagency Support Services Program Manager and Regional Economist through the U.S. Army Engineer Division and District in Vicksburg, MS. Mr. Kilgo's duties included leading the Mississippi Valley Division, interdisciplinary team assigned to identify impacts on Mississippi River Resources that would result from modified operation of the Missouri River Reservoirs. He provided quality assurance and technical review of economic evaluations supporting water resources investment recommendations.

Mr. Kilgo earned his MS in Agricultural Business at the College of Life Sciences at Mississippi State University and completed an intensive Army Leadership Development Program in Washington. He also earned multiple Profession Development Course certifications such as: Forecasting Techniques, Instructional Methods, Social Impact Analysis, Regional Economic Development, and Environmental Benefit Evaluation

Through the years, Mr. Kilgo has received much recognition for the tremendous amount of input and dedication he put into his work. Among those honors are the 1994 Earnest P. Blakenship Engineer and

Scientist Award, 2006 Commander's Award for Civilian Service, presented by Brigadier General Robert Crear and the 2000 Commanders Award for Civilian Service, presented by Lieutenant General Joe Ballard.

Mr. Kilgo has served in many community service projects, including being Past President and board member for Vicksburg Y's Men Club, Past Treasurer Vicksburg Alliance, Co-Chairman of the first Youth Leadership Vicksburg Program with the Vicksburg Chamber of Commerce, Sunday School Superintendent (five years), Instructor Mississippi River Course (Economic Analysis) Vicksburg High School, and Instructor "Principles of Economics" Vicksburg High School Academic Decathlon Team.

D.5 Mr. William Smith

Role: Hydrology and Hydraulic (H&H) Engineering *and* Water Resource Planning
Affiliation: Hydropower International Services Inter-National Consultancy, LLC

Mr. Smith has over 41 years of experience as a hydrologist. He has used this expertise on many hydroelectric, water resource development, and storm water/floodplain projects.

Mr. Smith received his Bachelor of Science in Civil Engineering from the University of Missouri (Rolla) in 1974, his AAS in Mechanical Technology from S.U.N.Y. at Morrisville in 1968, and became a Certified Floodplain Manager in 2004. He is a registered Civil Engineering in Oklahoma, Arkansas, Kansas, Missouri, Colorado, and Wyoming.

Mr. Smith was President of the National Hydropower Association (NHA) from 1988-1989 and was an active member of NHA's Board of Directors for over five years (1984-1989). He served as Vice President, Creator, and Chairman of both the FERC Committee and the International Committee. Mr. Smith was chosen to represent the National Hydropower Association as a technical specialist on CORECT Trade Missions to the Caribbean Basin (1987), to the Pacific Rim (1990, 1991, and 1993) and to Panama (1994).

Mr. Smith has been involved in many hydropower projects both domestic and international, including: Arkansas River Lock and Dam Nos. 2-6, 9, and 13; Mississippi River Locks and Dams; Red River Lock and Dam Nos. 1 and 2; Lake Eucha Dam; W.D. Mayo Lock and Dam, Jiguey-Aguate Dams - Dominican Republic, Hidro Jones Dam - Guatemala. He has also worked on dam design projects including: Phillips Refinery Stormwater Project; River Parks Low Water Dam, Caney River Water Supply Intake Dam, and the Arkansas River Corridor Study. Dam safety projects include Chimney Rock Dam, Robert S. Kerr Dam, Pensacola Dam, Warrenton Dam, Lee Creek Dam (Ft Smith), New Dam/Lake Project in Okmulgee County, Oklahoma, and Mosul Dam - Iraq. Mr. Smith is a FERC Part 12D Independent Consultant and a FERC Trained PFMA Facilitator.

Mr. Smith was presented the 1996 Newsmaker Award from Engineering News Record and was listed in International Who's Who of Professionals in 1995. Mr. Smith was awarded the Kenneth Henwood Lifetime Achievement Award from the National Hydropower Association in April 2008. In September 2009, he was awarded the Charles Don Ellison Memorial Award from the Oklahoma Floodplain Managers Association in recognition of long-term contributions of leadership and support to the advancement of floodplain management in Oklahoma. In November 2009, Mr. Smith was recognized by the International Water Power & Dam Construction's list as one of the 60 most influential people who have helped shape the course of the global hydropower and dam business in the world over the past 60 years.

He is the current Past Chair of the Oklahoma Floodplain Managers Association (2008-2009), and was previously Chair (2007-2008), Vice Chair (2006-2007) and Mitigation Committee Chair (2004-2006). Smith is also currently the coordinator of the OFMA Disaster Response Team (DRT) which provides support to communities, counties, and Indian Tribes in Oklahoma during disasters affecting the Special Flood Hazard Area.

Mr. Smith has two recent publications: Remediating a Scour Hole Beneath the Dam No. 2 Powerhouse" Civil Structures, Hydro Review, April 2005, and "Stroking the Compulsion – Workaholism", Authorhouse, 2007 OFMA Disaster Response Team (DRT) Program, October 2008.

He has also participated in the following workshop presentations:

- "Hydrology 101", Oklahoma Floodplain Managers Association, Training Session, Fall Conference 2005
- "OFMA Basic Training for Floodplain Administrators", Oklahoma Floodplain Managers Association, Statewide Training Course, 2005-2007
- Facilitator – "Managing the NFIP in Oklahoma" – August 27-Sept. 1, 2006, on behalf of OWRB and Oklahoma Floodplain Managers Association.
- "Hydraulics 101", Oklahoma Floodplain Managers Association, Training Session, 202 Workshops – Periodic throughout each year.
- "Hydrology and Hydraulics 202", Oklahoma Floodplain Managers Association, Training Session, 202 Workshops – Periodic throughout each year.
- "Hydrology and Hydraulics for Map Mod", Oklahoma Floodplain Managers Association, Training Session, Advanced Workshops – Periodic throughout each year.
- "Disaster Response Team (DRT) Program" – Oklahoma Floodplain Managers Association, Special Project – In Progress (Presented at 2008 OFMA Annual Conference and to be presented as ASFPM National Conference in Orlando – June 2009)

Mr. Smith's awards include:

- 1996 Newsmaker Award from Engineering News Record International Who's Who of Professionals in 1995.
- Kenneth Henwood Lifetime Achievement Award – 2008 – National Hydropower Association
- Charles Don Ellison Memorial Award – 2009 – Oklahoma Floodplain Managers Association
- International Water Power & Dam Construction – 2009 – Recognized as one of the 60 most influential people who have helped shape the course of the global hydropower and dam business in the world over the past 60 years.

D.6 Mr. Douglas Spaulding

Role: Geotechnical Engineering *and* Engineering Geology
Affiliation: Independent Consultant

Mr. Spaulding is a registered engineer with over 40 years of experience specializing in geotechnical design, local flood protection, dam inspection, dam rehabilitation, Part 12 inspections, and PMFA facilitation. He holds an M.S.C.E in Geotechnical Engineering from Purdue University and a B.S.C.E from Valparaiso University. He is affiliated with the American Society of Civil Engineers, Minnesota Geotechnical

Society, Society of American Military Engineers; a member of the American Arbitration Association, and on the Construction Claims Panel, Minneapolis, MN.

He served 10 years with the US Army Corps of Engineers, which included serving as Chief of the Levee Design Section and Program Manager for the National Dam Safety Program in Wisconsin and Minnesota. Duties included project management, feasibility and siting studies, economic analyses, regulatory coordination, and management of final design for flood control and navigation structures.

Mr. Spaulding has served on several independent peer reviews including:

- Currently serving on FERC Board of Consultants for the design of the 24 W Lake Livingston Hydroelectric Project in Texas
- Currently serving on the FERC Board of Consultants for the design of the 400 MW Gordon Butte pumped storage project.

- Served as geotechnical representative on External Peer Review to evaluate the Corps of Engineers $190 million seepage control upgrade project in East St. Louis Mo. Evaluation included review design for relief wells, slurry trenches and seepage berms
- Fargo Moorhead Flood Control Project - Served on IEPR panel to review Corps of Engineers feasibility study for flood protection for the Fargo Moorhead area. Alternatives plans included levees, floodwalls and two diversion alternatives. The recommended diversion plan involves a 35 mile long channel with an estimated cost of $1.3 billion.
- Evaluation of Levee Cracking - Geotechnical Engineer for study and evaluation of the cause of cracking in Corps of Engineers earth levees located throughout the Red River of the North. Investigations include literature review, field inspection, subsurface investigations and evaluation of potential causes of cracking.
- Eau Pleine Dam, Mosinee Wisconsin - This project was part of a program to upgrade the discharge capacity and increase the stability of the downstream embankment slopes. Project included the use of transient finite element analyses to evaluate the potential for sudden drawdown failures and stability analyses to determine the configuration of a sloping drain and stability berm section.
- Byllesby Dam, Dakota County MN - Studies at the Lake Byllesby Dam included stability of Ambursen Dam and the rock spillway. This included core holes to identify the character of bedrock at depth and recommendations regarding potential remediation. The work at Byllesby Dam included a sensitivity study to evaluate potential for sliding along the bedrock/concrete contact using “CSLIDE”.
- Breckenridge Flood Control Stage 1 - The project involved design of 7-mile long, 20-foot deep flood diversion channel in western Minnesota. Services included evaluation of stability and utilization of clay fill material. The value engineering study on project resulted in $1.5 million cost savings.
- Seneca Falls Hydroelectric Project, Seneca Falls, New York Seneca Falls project included stability analysis using a sensitivity analysis for this 50-foot high gravity structure and implementation of an exploration program to investigate soluble voids and foundation of powerhouse. Onsite work included dye testing, preliminary grout testing and down the hole photography.
- Served as FERC approved independent consultant on over 60 Part 12 inspections for projects located nationwide.
- Lorella Pumped Storage Project-Served as project manager for the development of the preliminary design of this $1 billion pumped storage project. Design included an underground powerhouse and evaluation of 80 foot high embankments founded on soft clay deposits in addition to design of a 170

foot high rock fill dam. The upper reservoir utilized an asphaltic concrete membrane to control seepage and reservoir losses in the upper portion of this project.

- Baldhill Dam-Evaluation of project alternatives to increase the spillway capacity at the Corps of Engineers Baldhill Dam. Project included preliminary structural and geotechnical design, earthwork layout and quantity estimates. Also responsible for design of remedial measures to stop earth movements in the discharge channel area.
- Highway 75 Dam-Developed geotechnical and civil designs for the Corps of Engineers Highway 75 Dam near Odessa, Minnesota. Design elements for this 3.5 mile long structure included embankments, outlet channels, two outlet works and related access roads and other features. Project included stability evaluation for 25 foot high dam founded on soft clay.
- High Falls Embankment Stabilization, Crivitz Wisconsin. Project required design of a downstream berm to increase the embankment stability and to provide a seepage control system for emerging seepage.

Mr. Spaulding was responsible for development and implementation of training programs for operators at both the Corps of Engineers dams (1981 to 2011) and electric utility owned structures (1995 & 2008). Training included program on identification of potential harmful conditions. He is an approved facilitator for the FERC's Potential Failure Mode Analysis (PFMA) program and has served as facilitator for PFMA evaluations on 45 projects in a nine state area. He has served on the "Development of the Lower St. Anthony Falls Hydroelectric Project" HydroVision (2010), and "Computing Sliding Factors of Safety for Concrete Structures" HydroVision (2004).

Bibliography

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Department of the Army, USACE Engineer Circular (EC) No. 1165-2-214, *Civil Works Review*, dated 15 December 2012.

Glossary of Selected Terms and Acronyms

The following is a glossary of selected terms and acronyms, some with descriptions.

Press "Ctrl+(Letter)" to jump to respective glossary section.

A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U | V | W | X | Y | Z

Symbols & Numerical

~ ..... about
%..... percent

A

AAS..... Associate of Arts
ADM ..... Agency Decision Milestone
APMI..... Analysis Planning and Management Institute, www.APM-Inst.org
ASFPM..... Association of Floodplain Manager Program

B

BS ..... Bachelor of Science

C

CBRNE..... Chemical, Biological, Radiological, Nuclear, and High Yield Explosive
CCP ..... Certified Compensation Professional
COI..... Conflict of Interest

D

DEIS..... Draft Environmental Impact Statement
DPR..... Detailed Project Report
DSAC..... Dam Safety Action Class
DSMS..... Dam Safety Modification Study

E

EA ..... Environmental Assessment
EAA..... Everglades Agriculture Area
EC ..... Engineers Circular (USACE)
EIS..... Environmental Impact Statement
EP ..... Engineering Pamphlet (USACE)
ER ..... Engineering Regulation (USACE)

F

FERC ..... Federal Energy Regulatory Commission
FWAC..... Future Without Action conditions

G

H

HEC..... Hydrologic Engineering Center
HHD..... Herbert Hoover Dike
HQ ..... Headquarters

I

IEPR ..... Independent External Peer Review

J

K

L

LMI ..... Logistics Management Institute, www.LMI.org

M

MSCE..... Master for Science in Civil Engineering
MRM ..... Minimum Requirements Matrix
MSE ..... Master of Science in Engineering

N

NAS..... National Academy of Sciences; www.NAS.edu
NED ..... National Economic Development
NEPA..... National Environmental Policy Act
NFIP ..... National Flood Insurance Program
NHA..... National Hydropower Association
NOA ..... notice of award

O

OFMA ..... Oklahoma Floodplain Managers Association
OMB..... Office of Management and Budget

P

PDT ..... Product Delivery Team
PE ..... Professional Engineer
PFMA..... Potential Failure Mode Analysis
PM ..... Program Manager
PMP ..... Project Management Professional
PWS ..... Performance Work Statement

Q

R

Risk Analysis ..... An approach to evaluation and decision making that explicitly and, to the extent practical, analytically incorporates considerations of risk and uncertainty in a flood damage reduction study (ER 1105-2-101).
Risk ..... The measure of the probability and severity of undesirable consequences. Risk = (Frequency of an event) x (Probability of occurrence) x (Consequences) (EC 1110-2-6067).
RMP ..... Risk Management Professional

S

SME ..... subject matter expert

T

TBD ..... To Be Determined

TO.....Task Order
TSP.....Tentatively Selected Plan

U

USACE.....U.S. Army Corps of Engineers

V

W

X

Z

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