Final Independent External Peer Review Report Princeville, North Carolina Flood Risk Management Feasibility Study Integrated Feasibility Report and Environmental Assessment

Prepared by
Battelle Memorial Institute

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

Contract No. W912HQ-10-D-0002
Task Order: 0064

August 28, 2014

Tar River. Photo credit: National Weather Service

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Executive Summary

PROJECT BACKGROUND AND PURPOSE

The Town of Princeville, North Carolina is the first municipality in the United States incorporated by and for former slaves. Freed slaves were given low-lying land in the Tar River floodplain at the end of the Civil War and eventually incorporated the town in 1885. While the Town of Princeville was built on low ground, the Town of Tarboro is sited on the opposite side of the river on much higher ground. Because of its low-lying location, the Town of Princeville experienced flood damages on numerous occasions since its founding.

Today, the Town of Princeville remains over 97 percent African-American. Approximately 40 percent of the population is over 55 years old. Per capita income for Princeville is approximately $12,600, which is 32.6 percent of the national average of $38,611. The average structure value is $56,600, which is 47 percent of the national average of $119,600. Approximately 2,000 residents are currently exposed to public/life safety issues associated with flood risk.

In 1967, the U.S. Army Corps of Engineers (USACE) constructed a levee along the Tar River to address the frequent and severe flooding. After construction of the levee, the Town of Princeville did not suffer from severe flooding again until 1999, when there was catastrophic flooding as a result of Hurricane Floyd (greater than 0.2-percent-annual-chance flood event), and a loss of nearly all 1,000 residential structures. Floodwaters initially entered the damage area through a number of ungated culverts under a section of U.S. Highway 64. As the flood event worsened, the existing project was then circumvented at its north end and the remaining portions of Town were inundated. Up to 20 feet of water stood in the Town of Princeville for nearly 10 days until river levels subsided enough that the floodwaters could be pumped back into the river. As a result of the catastrophic flooding and the historical significance of the Town of Princeville, President Clinton issued Executive Order 13146, which established a “President’s Council on the Future of Princeville, North Carolina.” The executive order directed the President’s Interagency Council as follows:

> In consideration of Executive Order 12898, “Federal Actions to Address Environmental Justice in Minority Populations and Low-income Populations,” Federal agencies are also required to consider potential disproportional adverse effects or denial of potential benefits of Federal policies and programs to communities such as Princeville.

Numerous heavily damaged structures of historical value were demolished under cleanup requirements and only four structures remain eligible for the National Register of Historic Places and one baptismal site is considered eligible as a Traditional Cultural Property. The Town of Princeville turned down a buyout offer from the Federal Emergency Management Agency (FEMA) because of the adverse social,

economic, and cultural impacts that would likely occur as a result. Many homeowners obtained second mortgages to rebuild.

Numerous Federal agencies including FEMA, the U.S. Department of Housing and Urban Development, the U.S. Small Business Administration, the U.S. Department of Agriculture, and the U.S. Department of Labor provided millions of dollars for recovery and reconstruction of the town.

USACE was authorized to prepare a feasibility study to address flood risk management issues and funds were provided in 2001. USACE and the State of North Carolina signed a feasibility cost sharing agreement in July 2002, and the State of North Carolina has provided matching funding.

The tentatively selected plan (TSP) includes measures to extend the existing levee and raise U.S. Highway 258 and Shiloh Farm Road north of the Town of Princeville to create a barrier to circumvention of the existing levee, as well as ramping residential, farm, and commercial driveways and subdivision streets to meet the new elevation. An earthen “shoulder levee” would be added along the east side of U.S. Highway 64 on the southwest side of the Town of Princeville to prevent overtopping at that location. In addition, the TSP includes modification and raising of the U.S. Highway 64/N.C. Highway 33 interchange, installation of backflow devices (flap gates) to culverts through existing embankments, raising nine structures outside the proposed levee footprint, and implementing interior drainage improvements to ensure proper routing of flow on the back side of the levee system. The TSP also proposes non-structural measures consisting of an updated flood warning and evacuation plan, continued floodplain management and updating of local building and zoning codes, a flood risk management education and communication plan for both the community and local schools, and flood warning measures, all of which were ultimately deemed essential to an adequate flood risk management strategy for the Town of Princeville. The estimated cost of the TSP is $21,096,000.

Independent External Peer Review Process

Independent, objective peer review is regarded as a critical element in ensuring the reliability of scientific analysis. USACE is conducting an Independent External Peer Review (IEPR) of the Princeville, North Carolina Flood Risk Management Feasibility Study Integrated Feasibility Report and Environmental Assessment (hereinafter: Princeville IEPR). As a 501(c)(3) non-profit science and technology organization, Battelle is independent, is free from conflicts of interest (COIs), and meets the requirements for an Outside Eligible Organization (OEO) per guidance described in USACE (2012a). Battelle has experience in establishing and administering peer review panels for USACE and was engaged to coordinate the IEPR of the Princeville. The IEPR was external to the agency and conducted following USACE and Office of Management and Budget (OMB) guidance described in USACE (2012a) and OMB (2004). This final report presents the Final Panel Comments of the IEPR Panel (the Panel). Details regarding the IEPR (including the process for selecting panel members, the panel members’ biographical information and expertise, and the charge submitted to the Panel to guide its review) are presented in appendices.

Based on the technical content of the Princeville review documents and the overall scope of the project, Battelle identified candidates for the Panel in the following key technical areas: civil/structural engineering, geotechnical engineering, hydrologic and hydraulic engineering, biology/ecology, and economics/planning/social effects. Five panel members were selected for the IEPR. USACE was given the list of candidate panel members, but Battelle made the final selection of the Panel.

The Panel received an electronic version of the 730-page Princeville review documents, along with a charge that solicited comments on specific sections of the documents to be reviewed. USACE prepared

the charge questions following guidance provided in USACE (2012a) and OMB (2004), which were included in the draft and final Work Plans.

The USACE Project Delivery Team (PDT) briefed the Panel and Battelle during a kick-off meeting held via teleconference prior to the start of the review to provide the Panel an opportunity to ask questions of USACE and clarify uncertainties. Other than Battelle-facilitated teleconferences, there was no direct communication between the Panel and USACE during the peer review process. The Panel produced individual comments in response to the charge questions.

IEPR panel members reviewed the Princeville documents individually. The panel members then met via teleconference with Battelle to review key technical comments and reach agreement on the Final Panel Comments to be provided to USACE. Each Final Panel Comment was documented using a four-part format consisting of: (1) a comment statement; (2) the basis for the comment; (3) the significance of the comment (high, medium/high, medium, medium/low, or low); and (4) recommendations on how to resolve the comment. Overall, 11 Final Panel Comments were identified and documented. Of these, one was identified as having high significance, three were identified as having medium/high significance, six had a medium significance, and one had medium/low significance.

Results of the Independent External Peer Review

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

Based on the Panel's review, the report is well written and the information logically organized and clearly presented. The Panel noted that the TSP aims to greatly enhance the flood protection provided to the Princeville community, allowing the affected population to remain/return to the floodplain with protection from flooding by events up to the 0.01 annual exceedance probability (AEP) event. Although the economic Cost/Benefit ratio may not be greater than 1.0, the other benefits identified provide substantial justification for this project and that the utilization of existing features is a very cost effective way to improve the system. The Panel did identify several elements of the project that should be clarified or revised.

Geotechnical engineering: Of primary concern was that the geotechnical site characterization and analyses have not been conducted, a pre-requisite for detailed design, so that detailed design can begin immediately following receipt of Pre-construction Engineering Design (PED) funds per USACE guidance. This issue can be resolved by completing investigations, testing, analyses, and design as outlined in ER 1110-2-1150, and conducting geological modeling, topographic characterization, soil profiles and property modeling, seepage analysis, and slope stability and settlement assessments. In addition, USACE should complete the recommended studies presented in Appendix C of the FR/EA. Another important issue is that erosion (via wave action and overtopping), as a failure mode in levee design, is not assessed. This issue can be resolved through the evaluation of the impact of wind-generated wave action, overtopping, and erosion; the development and documentation of an erosion protection scheme to maintain levee integrity and the completion a conceptual design of the selected erosion protection measures in Appendix B. The Fully Funded Cost Estimate should also be revised to incorporate costs of the erosion protection scheme and the current levee costs if they are determined to be underestimated.

Economics/Planning/Social Effects: Of importance to the Panel was that the non-structural measures of the TSP, including residual risk communication and evacuation plans, could not be evaluated because they are not included in the FR/EA. This can be addressed by providing a residual risk communication plan (with an education component and evacuation plan) appropriate for Princeville's population. The Panel also recommends inclusion of a more detailed description of the rationale behind the recommendation of the TSP versus a plan with a higher level of flood risk reduction given that any plan is likely to have a benefit-to-cost ratio less than one. The Panel was also concerned that climate change impacts to the future without-project condition and to the TSP are not adequately described or evaluated per USACE guidance. The can be resolved by evaluating and describing the potential effects of climate change on the TSP using the methods outlined in ECB No. 2014-10; showing whether and how the potential increased upstream flows and potential increased sedimentation in the Tar River were considered in plan formulation; and providing documentation on the impacts of climate change and sedimentation on risks associated with the TSP. In addition, a plan should be provided to communicate to the residents of the Town of Princeville and other stakeholders the risks associated with climate change on the future without-project and future with-project conditions.

Hydrologic and Hydraulic Engineering: The Panel noted that it cannot be ascertained whether sufficient hydrologic and hydraulic analyses have been conducted on Levee Alignment I due to a lack of detailed description and analysis. USACE can address this issue by confirming whether Levee Alignment I was included in the hydraulic evaluation of alternatives presented in the FR/EA Main Report and Appendix. If Levee Alignment I is included in the hydraulic evaluation, documentation should be provided that clearly describes the effect of Levee Alignment I. If Levee Alignment 1 was not included in the hydraulic evaluation, USACE should perform the hydraulic analysis associated with Levee Alignment I and document the analysis and results.

Biology/Ecology: The Panel noted that conclusions reached in the Environmental Assessment with respect to cumulative effects appear to be based only on issues related to the TSP and do not consider, as required, past, present, and reasonably foreseeable future actions, as required by NEPA. To address this issue, USACE could include a comprehensive list of reasonably forseeable future actions (based on known future projects, planned and proposed projects, and past/predicted regionl and local patters) that may be undertaken in the project area. In addition, the cumulative effects, both adverse and positive, that the TSP may have on those activites can be evaluated based on the list and mitigation measures can be proposed.

Table ES-1. Overview of 11 Final Panel Comments Identified by the Princeville IEPR Panel

No.	Final Panel Comment
High – Significance	
1	Geotechnical site characterization and design analysis have not been conducted per USACE guidance so that detailed design can begin immediately following receipt of Preconstruction Engineering Design (PED) funds.
Medium/High – Significance	
2	It cannot be ascertained whether sufficient hydrologic and hydraulic analyses have been conducted on Levee Alignment I due to a lack of detailed description and analysis.
3	The non-structural measures of the TSP, including residual risk communication and evacuation plans, could not be evaluated because they are not included in the FR/EA.
4	Future without-project condition impacts related to climate change in the project area and on the TSP are not adequately described or evaluated per USACE guidance.
Medium – Significance	
5	Conclusions reached in the Environmental Assessment with respect to cumulative effects appear to be based only on issues related to the TSP and do not consider, as required, past, present, and reasonably foreseeable future actions as required by NEPA.
6	Erosion (via wave action and overtopping), as a failure mode in levee design, is not assessed.
7	The flood wall component of the TSP is not addressed so its expected performance and impact on the total project cost cannot be assessed.
8	The location of the proposed levees along U.S. Highway 64 (Segment 2) is unresolved due to costs and environmental impacts on wetlands.
9	The assumption used in the development of the stage and discharge relationship may not be realistic, and therefore can potentially affect the results of the HEC-RAS model calibration, river flow and stage exceedance probability analysis, and interior drainage analysis.
10	The estimated project costs for PED and construction management are not well supported in the FR/EA, possibly indicating that the cost is overestimated.
Medium/Low – Significance	
11	The adequacy and acceptability of the methods and analyses used to evaluate future with-project conditions cannot be assessed because the information presented in Appendix A lacks sufficient detail.

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LIST OF ACRONYMS

ATR	Agency Technical Review
COI	Conflict of Interest
CPT	Cone Penetration Test
DrChecks	Design Review and Checking System
EC	Engineer Circular
EM	Engineer Manual
ER	Engineer Regulation
ERDC	Engineer Research and Development Center
FEMA	Federal Emergency Management Agency
FR/EA	Feasibility Report/Environmental Assessment
H&H	hydrology and hydraulics
HEC-RAS	Hydrologic Engineering Center-River Analysis System
IEPR	Independent External Peer Review
LiDAR	Light Detection and Ranging
NCDOT	North Carolina Department of Transportation
NEPA	National Environmental Policy Act
NRCS	National Resources Conservation Service
OEO	Outside Eligible Organization
OMB	Office of Management and Budget
PDT	Project Delivery Team
PED	Preconstruction Engineering Design
SAR	Safety Assurance Review
USACE	United States Army Corps of Engineers
USGS	United States Geological Survey
TSP	Tentatively Selected Plan

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1. INTRODUCTION

The Town of Princeville, North Carolina is the first municipality in the United States incorporated by and for former slaves. Freed slaves were given low-lying land in the Tar River floodplain at the end of the Civil War and eventually incorporated the town in 1885. While the Town of Princeville was built on low ground, the Town of Tarboro is sited on the opposite side of the river on much higher ground. Because of its low-lying location, the Town of Princeville experienced flood damages on numerous occasions since its founding.

Today, the Town of Princeville remains over 97 percent African-American. Approximately 40 percent of the population is over 55 years old. Per capita income for Princeville is approximately $12,600, which is 32.6 percent of the national average of $38,611. The average structure value is $56,600, which is 47 percent of the national average of $119,600. Approximately 2,000 residents are currently exposed to public/life safety issues associated with flood risk.

In 1967, the U.S. Army Corps of Engineers (USACE) constructed a levee along the Tar River to address the frequent and severe flooding. After construction of the levee, the Town of Princeville did not suffer from severe flooding again until 1999, when there was catastrophic flooding as a result of Hurricane Floyd (greater than 0.2-percent-annual-chance flood event), and a loss of nearly all 1,000 residential structures. Floodwaters initially entered the damage area through a number of ungated culverts under a section of U.S. Highway 64. As the flood event worsened, the existing project was then circumvented at its north end and the remaining portions of Town were inundated. Up to 20 feet of water stood in the Town of Princeville for nearly 10 days until river levels subsided enough that the floodwaters could be pumped back into the river. As a result of the catastrophic flooding and historical significance of the Town of Princeville, President Clinton issued Executive Order 13146, which established a “President’s Council on the Future of Princeville, North Carolina.” The executive order directed the President’s Interagency Council as follows:

> In consideration of Executive Order 12898, “Federal Actions to Address Environmental Justice in Minority Populations and Low-income Populations,” Federal agencies are also required to consider potential disproportional adverse effects or denial of potential benefits of Federal policies and programs to communities such as Princeville.

Numerous heavily damaged structures of historical value were demolished under cleanup requirements and only four structures remain eligible for the National Register of Historic Places and one baptismal site is considered eligible as a Traditional Cultural Property. The Town of Princeville turned down a buyout offer from the Federal Emergency Management Agency (FEMA) because of the adverse social, economic, and cultural impacts that would likely occur as a result. Many homeowners obtained second mortgages to rebuild.

Numerous Federal agencies including FEMA, the U.S. Department of Housing and Urban Development, the U.S. Small Business Administration, the U.S. Department of Agriculture, and the U.S. Department of Labor provided millions of dollars for recovery and reconstruction of the town.

USACE was authorized to prepare a feasibility study to address flood risk management issues and funds were provided in 2001. USACE and the State of North Carolina signed a feasibility cost sharing agreement in July 2002, and the State of North Carolina has provided matching funding.

The tentatively selected plan (TSP) includes measures to extend the existing levee and raise U.S. Highway 258 and Shiloh Farm Road north of the Town of Princeville to create a barrier to circumvention of the existing levee, as well as ramping residential, farm, and commercial driveways and subdivision streets to meet the new elevation. An earthen “shoulder levee” would be added along the east side of

U.S. Highway 64 on the southwest side of the Town of Princeville to prevent overtopping at that location. In addition, the TSP includes modification and raising of the U.S. Highway 64/N.C. Highway 33 interchange, installation of backflow devices (flap gates) to culverts through existing embankments, raising nine structures outside the proposed levee footprint, and implementing interior drainage improvements to ensure proper routing of flow on the back side of the levee system. The TSP also proposes non-structural measures consisting of an updated flood warning and evacuation plan, continued floodplain management and updating of local building and zoning codes, a flood risk management education and communication plan for both the community and local schools, and flood warning measures, all of which were ultimately deemed essential to an adequate flood risk management strategy for the Town of Princeville. The estimated cost of the TSP is $21,096,000.

Independent, objective peer review is regarded as a critical element in ensuring the reliability of scientific analysis. The objective of the work described here was to conduct an Independent External Peer Review (IEPR) of the Princeville, North Carolina Flood Risk Management Feasibility Study Integrated Feasibility Report and Environmental Assessment (hereinafter: Princeville IEPR) in accordance with procedures described in the Department of the Army, USACE, Engineer Circular (EC) *Civil Works Review* (EC 1165-2-214) (USACE, 2012a) and the Office of Management and Budget (OMB) *Final Information Quality Bulletin for Peer Review* (OMB, 2004). Supplemental guidance on evaluation for conflicts of interest (COIs) was obtained from the *Policy on Committee Composition and Balance and Conflicts of Interest for Committees Used in the Development of Reports* (The National Academies, 2003).

This final report presents the Final Panel Comments of the IEPR Panel (the Panel) on the existing engineering, economic, environmental, and plan formulation analyses contained in the Princeville IEPR documents (Section 4). Appendix A describes in detail how the IEPR was planned and conducted. Appendix B provides biographical information on the IEPR panel members and describes the method Battelle followed to select them. Appendix C presents the final charge to the IEPR panel members for their use during the review; the final charge was submitted to USACE on June 16, 2014.

2. PURPOSE OF THE IEPR

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

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

In this case, the IEPR of the Princeville Flood Risk Management Feasibility Study Integrated Feasibility Report and Environmental Assessment (FR/EA) was conducted and managed using contract support from Battelle, which is an Outside Eligible Organization (OEO) (as defined by EC 1165-2-214 [USACE, 2012a]). Battelle, a 501(c)(3) organization under the U.S. Internal Revenue Code, has experience conducting IEPRs for USACE.

3. METHODS FOR CONDUCTING THE IEPR

The methods used to conduct the IEPR are briefly described in this section; a detailed description can be found in Appendix A. Table 1 presents the major milestones and deliverables of the Princeville IEPR. Due dates for milestones and deliverables are based on the award/effective date of May 19, 2014. Note that

the work items listed under Task 6 occur after the submission of this report. Battelle anticipates submitting the pdf printout of the USACE's Design Review and Checking System (DrChecks) project file (the final deliverable) on September 29, 2014. The actual date for contract end will depend on the date that all activities for this IEPR, including Civil Works Review Board (CWRB) preparation and participation, are conducted.

Table 1. Major Milestones and Deliverables of the Princeville IEPR

Task	Action	Due Date
1	Award/Effective Date	5/19/2014
	Review documents available	5/30/2014
2	Battelle submits list of selected panel members	6/5/2014
	USACE confirms the panel members have no COI	6/9/2014
3	Battelle convenes kick-off meeting with USACE	5/27/2014
	Battelle convenes kick-off meeting with USACE and panel members	6/18/2014
4	Battelle sends review documents to Panel	6/18/2014
	Panel members complete their individual reviews	7/24/2014
	Panel members provide draft Final Panel Comments to Battelle	8/11/2014
5	Battelle submits Final IEPR Report to USACE	8/25/2014
6	Battelle convenes Comment-Response Teleconference with panel members and USACE	9/16/2014
	Battelle submits PDF printout of DrChecks project file to USACE	9/29/2014
	Contract End/Delivery Date	6/30/2015

Battelle identified, screened, and selected five panel members to participate in the IEPR based on their expertise in the following disciplines: civil/structural engineering, geotechnical engineering, hydrologic and hydraulic engineering, biology/ecology, and economics/planning/social effects. The Panel reviewed the Princeville document and produced 11 Final Panel Comments in response to 36 charge questions provided by USACE for the review. This charge included two questions added by Battelle that sought summary information from the IEPR Panel. Battelle instructed the Panel to develop the Final Panel Comments using a standardized four-part structure:

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

Battelle reviewed all Final Panel Comments for accuracy, adherence to USACE guidance (EC 1165-2-214, Appendix D), and completeness prior to determining that they were final and suitable for inclusion in the Final IEPR Report. There was no direct communication between the Panel and USACE during the

preparation of the Final Panel Comments. The Panel's findings are summarized in Section 4.1; the Final Panel Comments are presented in full in Section 4.2.

4. RESULTS OF THE IEPR

This section presents the results of the IEPR. A summary of the Panel's findings and the full text of the Final Panel Comments are provided.

4.1 Summary of Final Panel Comments

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

Based on the Panel's review, the report is well written and the information logically organized and clearly presented. The Panel noted that the selected project aims to greatly enhance the flood protection provided to the Princeville community, allowing the affected population to remain/return to the floodplain with protection from flooding by events up to the 0.01 annual exceedance probability (AEP) event. Although the economic Cost/Benefit ratio may not be greater than 1.0, the other benefits identified provide substantial justification for this project and that the utilization of existing features is a very cost effective way to improve the system. The Panel did identify several elements of the project that should be clarified or revised.

Geotechnical engineering: Of primary concern was that the geotechnical site characterization and analyses have not been conducted, a pre-requisite for detailed design, so that detailed design can begin immediately following receipt of Pre-construction Engineering Design (PED) funds per USACE guidance. This issue can be resolved by completing investigations, testing, analyses, and design as outlined in ER 1110-2-1150, and conducting geological modeling, topographic characterization, soil profiles and property modeling, seepage analysis, and slope stability and settlement assessments. In addition, USACE should complete the recommended studies presented in Appendix C of the FR/EA. Another important issue is that erosion (via wave action and overtopping), as a failure mode in levee design, is not assessed. This issue can be resolved through the evaluation of the impact of wind-generated wave action, overtopping, and erosion; the development and documentation of an erosion protection scheme to maintain levee integrity and the completion a conceptual design of the selected erosion protection measures in Appendix B. The Fully Funded Cost Estimate should also be revised to incorporate costs of the erosion protection scheme and the current levee costs if they are determined to be underestimated.

Economics/Planning/Social Effects: Of importance to the Panel was that the non-structural components of the TSP, including residual risk communication and evacuation plans, could not be evaluated because they are not included in the report. This can be addressed by providing a residual risk communication plan (with an education component and evacuation plan) appropriate for Princeville's population. The Panel also recommends inclusion of a more detailed description of the rationale behind the recommendation of the TSP versus a plan with a higher level of flood risk reduction given that any plan is likely to have a benefit-to-cost ratio less than one. The Panel was also concerned that climate change impacts to the future without-project condition and to the TSP are not adequately described or evaluated per USACE guidance. The can be resolved by evaluating and describing the potential effects of climate change on the TSP using the methods outlined in ECB No. 2014-10; showing whether and how the potential increased upstream flows and potential increased sedimentation in the Tar River were considered in plan formulation; and providing documentation on the impacts of climate change and sedimentation on risks associated with the TSP. In addition, a plan should be provided to communicate to

the residents of the Town of Princeville and other stakeholders the risks associated with climate change on the future without-project and future with-project conditions.

Hydrologic and Hydraulic Engineering: The Panel noted that it cannot be ascertained whether sufficient hydrologic and hydraulic analyses have been conducted on Levee Alignment I due to a lack of detailed description and analysis. USACE can address this issue by confirming whether Levee Alignment I was included in the hydraulic evaluation of alternatives presented in the FR/EA Main Report and Appendix. If Levee Alignment I is included in the hydraulic evaluation, documentation should be provided that clearly describes the effect of Levee Alignment I. If Levee Alignment 1 was not included in the hydraulic evaluation, USACE should perform the hydraulic analysis associated with Levee Alignment I and document the analysis and results.

Biology/Ecology: The Panel noted that conclusions reached in the Environmental Assessment with respect to cumulative effects appear to be based only on issues related to the TSP and do not consider, as required, past, present, and reasonably foreseeable future actions, as required by NEPA. To address this issue, USACE could include a comprehensive list of reasonably forseeable future actions (based on known future projects, planned and proposed projects, and past/predicted regionl and local patters) that may be undertaken in the project area. In addition, the cumulative effects, both adverse and positive, that the TSP may have on those activites can be evaluated based on the list and mitigation measures can be proposed.

4.2 Final Panel Comments

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

Final Panel Comment 1

Geotechnical site characterization and design analysis has not been conducted per USACE guidance so that detailed design can begin immediately following receipt of Preconstruction Engineering Design (PED) funds.

Basis for Comment

Engineer Regulation (ER) 1110-2-1150 (USACE, 1999) requires that "[s]ufficient engineering and design are performed to enable refinement of the project features, prepare the baseline cost estimate, develop a design and construction schedule, and allow detailed design on the selected plan to begin immediately following receipt of the PED funds."

The Princeville Integrated Feasibility Report/Environmental Assessment (FR/EA, p.117) notes that

> "Geotechnical investigations of the Alignment I feature have not yet been performed, but will be done in the PED Phase. Prior to construction, further geotechnical investigations are recommended to include additional drilling, laboratory testing and analysis along the alignment of the Selected Plan to define the subsurface conditions and strength parameters of the foundations. A determination should be made of required and available quantities of suitable borrow material and investigate new or expanded borrow areas if required."

The engineering completed as part of the FR/EA does not satisfy the requirements for a feasibility report (USACE, 1999). The additional work recommended in Appendix C (pp. C4-C5) could reveal significant issues that have substantial impact on the project design, cost, and schedule. The requirements not satisfied include: development of a geologic model, development of a topographic model, characterization of soil profile and soil properties along the project reach, seepage analyses along the project reach, slope stability analyses along the project reach, and settlement analyses along the project reach.

Geologic Model. A geologic model, as outlined in Engineer Manual (EM) 1110-2-1913 (USACE, 2000b) and ER 1110-2-1150 (USACE, 1999), has not been presented, resulting in significant uncertainties regarding foundation conditions. Geologic models provide a basis for development of regional stratigraphy. The regional stratigraphy aids in interpolating and extrapolating between soil borings and Cone Penetration Tests (CPTs) to generate soil profiles for geotechnical analyses, which allow for the refinement of project features.

Topography. Topography is required to characterize levee geometry (slopes, crest elevations, etc.). Appendix C (p. 7) indicates that "[t]opographical surveys were not available at the time of modeling." However, Appendix A (p. 2-2) refers to topographic data from LiDAR (Light Detection and Ranging) surveys in the area. Use of the topographic model should enable a refined evaluation of levee crest widths, crest elevations, and levee side slopes to confirm/refute assumed existing conditions geometry. The current geotechnical evaluations are based on select repair sites (Appendix C, p. 10), however, the topographical data may indicate that other sections of the levee are not in compliance with the 'design' geometry. The lack of topography in the geotechnical analysis results in significant uncertainty regarding levee configurations and site grades, which affects the configuration and refinement of project features as required by ER 1110-2-1150 (USACE, 1999). The Panel also notes that LiDAR-generated topography may have accuracies outside the tolerances established by EM 1110-1-1005 (USACE, 2007).

Soil Profile and Properties. The overall soil profile and properties model for the project is incomplete. Soil profiles and properties are developed for four locations along the existing levee [Segment 3], but not for Segments 1, 2, or 4. The soil profile developed for Segment 3 is based on 'as-builts' following Hurricane Floyd in 1999 (Appendix C, p. 7). No testing of hydraulic conductivity characteristics was

performed of in situ soils along the proposed alignments. Rather, a combination of testing results of potential borrow and 'experience' with similar soils is relied upon (Appendix C, p. 6; Appendix C, p. 8).

Soil borings are concentrated at the crest and toe of the levee alignment. This requires extrapolation to the waterside and landside extents of the analysis sections. The extrapolation has significant uncertainty unless based on a validated regional geologic model.

Limited geotechnical laboratory testing was conducted for the project limits. The FR/EA provides minimal in situ unit weight data, and no information on either testing of hydraulic conductivity of in situ soils (testing of reconstituted borrow material soils), or undrained testing of cohesive materials.

Based on the LiDAR data and National Resources Conservation Service (NRCS) soil survey maps, there appear to be a number of historic stream courses. EM 1110-1-1904 (USACE, 1990) notes that meander loops and cutoffs are "soils that fill abandoned waterways" and tend to be "weak and highly compressible. The depth of these soils should be determined early in design to allow time for development of suitable measures for treating the soil or accommodating settlement."

Seepage. The assumed "critical" profiles (Appendix C, p. 7), which are the same locations as selected for the seepage analyses, are based on overtopping.

Seep/W model information presented is limited to a graphical plot of the seepage section. No input parameters are explicitly identified (i.e., hydraulic conductivity). The text refers to calibration analyses, but these are not included in the documentation. Two evaluation metrics are reported: exit gradient and uplift pressure (Appendix C, p. 7). Results are reported in Table 6. The seepage analyses assume a tolerable seepage gradient of 0.3 to 0.8 based on blanket materials with a unit weight of 115 pcf (Appendix C, p. 7). Unit weights of the landside blanket materials and analyses for uplift pressures are not presented.

Slope Stability. The slope stability analysis does not look at the stability of new levee sections constructed mostly of sand. The lack of stability analysis led the District to assume 3H:1V side slopes for these new levee sections, which may be inadequate for the steady-seepage stability case. The levee cross section selected for design of new levee sections (including new shoulder or roadside levees) is inconsistent across the project as compared to the existing levee to be improved. The existing levee has a levee slope of 3H:1V on river side and 2.5H:1V on the landside (protected side) of the levee. New levee sections will be 3H:1V on both sides, which is generally consistent with recommendations for minimum slopes for mowing purposes. However, the new levees are not evaluated with any slope stability analyses and are proposed for construction using SP or SP-SC soil type materials.

The assumed "critical" profiles (Appendix C, p. 7), which are the same locations as selected for the seepage analyses, are based on overtopping, not necessarily on 'critical' seepage locations.

The sudden draw down analyses refer to a minimum acceptable factor of safety of 1.0 (Appendix C, p. 9). EM 1110-2-1913 (USACE, 2000b) calls for a three-phase evaluation of stability (Table 6-1a). EM 1110-2-1902 (USACE, 2003) notes (p. 2-11) that "Sudden drawdown stability computations are performed in conditions when the water level adjacent to the slope is lowered rapidly. For analysis purposes, it is assumed that drawdown is very fast, and no drainage occurs in material with low permeability; thus the term "sudden" drawdown. Materials with permeabilities of greater than 10^{-4} cm/sec can be assumed to drain during drawdown, and drained strengths are used for these materials."

Settlement. A qualitative assessment determined that significant settlements are not anticipated. Future studies may locate areas susceptible to settlement with levee construction, so assumptions would need to be reviewed at that time. As indicated in Appendix C (pp. 12-13), as a comprehensive geologic and geotechnical model is developed of the project area, soft/loose subsurface soils subject to appreciable settlement when loaded may be encountered, at which time these locations should be evaluated for

settlement.

The geotechnical evaluation presented is limited to an evaluation of the existing levee reach (~8,700 ft). It does not address the highway embankments, new levee alignments, new seepage berms, foundations, or new structural features (floodwalls), which span ~ 33,500 ft of the flood protection system. This results in more than 74% of the system being unassessed from a geotechnical standpoint (~12,300 ft of unassessed roadway embankment and 11,200 ft of unassessed new flood embankment). The FR/EA highlights the need for significant additional geotechnical studies and analyses.

Significance – High

The lack of geotechnical site characterization (geologic model, topography, soil profiles, and materials properties) and geotechnical analyses (seepage, slope stability, settlement, etc.), as required by ER 1110-2-1150 (USACE, 1999), affects the complete analysis of the alternatives (including cost and schedule), the potential environmental impacts, and ultimately, the project design.

Recommendations for Resolution

1. Complete investigations, testing, analyses, and design as outlined in ER 1110-2-1150 (USACE, 1999) and EM-1110-2-1913 (USACE, 2000b) to allow refinement of project features.
2. Develop a geologic model as outlined in EM 1110-2-1913 (USACE, 2000b) and ER 1110-2-1150 (USACE, 1999) and correlate the presented NRCS Soil Survey Map. Couple the geologic model with the historic channel analysis (Appendix C, p. 13, item 14i).
3. Explore (soil borings, CPTs, etc.), lateral extents of cohesionless deposits so they can be accurately mapped and evaluated in both seepage and slope stability analyses.
4. Select seepage (Seep/W) analysis locations from the geologic model, accounting for abandoned channel locations, levee geometry, and in situ foundation soils (which vary across the project area).
5. Use a consistent datum for the project design and analysis. The geotechnical work references NGVD29 datum (Appendix C, p. 10). The H&H work references the NAVD 88 datum (Appendix A, p. 1-2.)
6. Develop a topographic model for use in geotechnical evaluation that is suitable for engineering analysis and design (EM 1110-1-1005; USACE 2007), as recommended by ER 1110-2-1150 (USACE, 1999).
7. Identify and evaluate all embankment encroachment locations (such as 35.894960N; 77.515555W, WGS1984).
8. Test in situ soils along the levee alignment to verify the estimated range of material properties, including hydraulic conductivity.
9. Report actual values used in analyses. A range of soil properties is described in Appendix C, p. 5. If a suite of values was used, then this should be described and noted. If “probabilistic” or sensitivity analyses were completed, indicate the analyses and results.
10. Differentiate levee fill from native soils. The soil profiles shown in Seep/W and Slope/W (no generalized soil stratigraphic sections were presented) indicate that the levee embankment materials are assigned similar soil properties as the underlying (native) foundation soils. The levee embankment soils may not have similar soil properties as a result of anthropogenic effects during construction (e.g., compaction).
11. Evaluate and account for any change as a result of embankment loading and incorporate in use of soil properties from the 1964 geotechnical exploration program. Soil borings performed for the original levee alignment (CS series) were performed prior to construction of the existing levee. Some consolidation and strength improvement may have occurred.

12. Define lateral extents of cohesionless deposits (via borings, CPTS, etc.) so they can be accurately mapped and evaluated in both seepage and slope stability analyses.
13. Use the anticipated flood hydrograph to analyze how pore pressures respond and propagate throughout the levee and foundation section, especially in historic channel deposits.
14. Select seepage-related critical sections based on historic observed seeps and/or sand boils on the protected side of the levee with elevated water levels on the flood side, resulting in a hydraulic gradient through the levee and under the levee, through the levee foundation soils, and/or locations that coincide with pervious zones (such as abandoned stream courses) that traverse through the levee foundation footprint.
15. Evaluate both shallow and deep-seated stability on flood- and protected-sides of the levee. Defined slip surfaces (Appendix C, Figures 21-29) did not appear consistent with regards to exploration of shallow and deep-seated failures.
16. Evaluate the three recommended shear strength configurations (per EM 1110-2-1902; USACE, 2003) for sudden draw down analyses.
17. Use feasibility-stage side slopes of 5H:1V as recommended in EM 1110-2-1913 (USACE, 2000b) in areas where no slope stability analyses have been completed.
18. Complete recommended studies presented in ER 1110-2-1150, Appendix C, pp. C4-C5 (USACE 1999) and EM 1110-2-1913 (USACE 2000b).

Literature Cited:

USACE (1990). Engineering and Design—Settlement Analysis. Engineer Manual (EM) 1110-1-1904. Department of the Army, U.S. Army Corps of Engineers, Washington, D.C. September 30.

USACE (1999). Engineering and Design—Plans and Specifications for Civil Works Projects. Engineer Regulation (ER) 1110-2-1150. Department of the Army, U.S. Army Corps of Engineers, Washington, D.C. August 31.

USACE (2000b). Engineering and Design—Design and Construction of Levees. Engineer Manual (EM) 1110-2-1913. Department of the Army, U.S. Army Corps of Engineers, Washington, D.C. April 30.

USACE (2003). Engineering and Design—Slope Stability. Engineer Manual (EM) 1110-2-1902. Department of the Army, U.S. Army Corps of Engineers, Washington, D.C. October 31.

USACE (2007). Engineering and Design—Control and Topographic Surveying. Engineer Manual (EM) 1110-1-1005. Department of the Army, U.S. Army Corps of Engineers, Washington, D.C. January 1.

Final Panel Comment 2

It cannot be ascertained whether sufficient hydrologic and hydraulic analyses have been conducted on Levee Alignment I due to a lack of detailed description and analysis.

Basis for Comment

It appears that Levee Alignment I was not included in the hydrological and hydraulic analyses and model reviewed by the Hydrological Engineering Center (HEC). The FR/EA states the HEC review occurred in late 2009 (p. 129): "HEC performed an independent review of the HEC-RAS model. Model runs for Alignment I (the TSP) have not yet been reviewed with the new alignment, but will be reviewed by the Center for Flood Risk Reduction during on-going internal review processes."

The FR/EA also states (p.152) that a meeting occurred on August 3, 2010 in the Town of Princeville with the representatives of the Raleigh Regulatory Field Office and Tar River Riparian Buffer Rules (North Carolina Division of Water Resources, Aquifer Protection Section). The purpose of this meeting was to walk and inspect the levee extension alternatives and the proposed 32-acre borrow area. The FR/EA notes (p. 152) that "the eastern extension of the existing levee, Alignment I, was not inspected because that alignment was more completely developed later in the study."

Given the dates of the HEC review (late 2009) and the Princeville meeting (August 3, 2010), it appears that Levee Alignment I was not included in the HEC review of model and analyses.

Significance – Medium/High

The absence of Levee Alignment I, an important plan feature of the TSP, in the hydraulic analyses results in an inaccurate evaluation of the flooding, financial, and safety risks associated with the TSP.

Recommendations for Resolution

1. Confirm whether Levee Alignment I was included in the hydraulic evaluation of alternatives presented in the FR/EA Main Report and Appendix A (Hydrology and Hydraulics).
2. Provide documentation in the report that clearly describes the effect of Levee Alignment I if it is already included in the hydraulic evaluation of alternatives.
3. Perform the hydraulic analysis associated with Levee Alignment I and document the analysis and results in the report if they are not yet included in the hydraulic evaluation of alternatives.

Final Panel Comment 3

The non-structural measures of the TSP, including residual risk communication and evacuation plans, could not be evaluated because they are not included in the FR/EA.

Basis for Comment

Although the FR/EA mentions flood warning and evacuation in several places, the Panel was unable to evaluate the non-structural measures of the TSP because no detail was provided. The FR/EA mentions in Table 5.2 that Flood Warning and Evacuation will be updated as part of the on-going State and local efforts but it doesn't indicate how the updates will be made and what they will include. Section 5.2.1 states that "The FEMA Warning and Evacuation Plan would be coordinated with the Town, County, State and Federal agencies for establishment of communications and responsibilities for accomplishment of preparatory actions," but an outline or summary of what would be in the plan is not provided. It is apparent that the non-structural components of the TSP have been considered but the level of detail provided for these critical non-structural components is minimal in comparison to the descriptions of the structural components. These non-structural components are critical to the TSP, and should be described in more detail in the FR/EA.

Residents must fully understand that the project, once implemented, would not protect them or their property from another event similar to, or worse than, Hurricane Floyd. Current and future residents must be fully informed of the limits of the protection provided by the TSP to prevent them from having a false sense of security. Failure to do so would result in severe, adverse socio-economic effects.

Special steps beyond those normally implemented to communicate residual risk and evacuation plans to residents are required for this project, for example, evacuation plans that include consideration of the project area's demographics and available transportation, and communication methods most likely to be effective specifically for the Princeville population.

The nation determined that the Town of Princeville is historically significant and to the extent practicable should be protected from future floods. The remedy put forward in the TSP may not be adequate. The Panel was unable to evaluate if a plan that provided a greater level of flood risk reduction could or should be selected and what the attendant induced flood risks to nearby populations would be.

These points may have been considered in detail by USACE, but they are not clearly communicated in the FR/EA.

Significance – Medium/High

The TSP is affected by the lack of development or description of its non-structural elements: communication of risk, education, and the evacuation of the vulnerable population of the Town of Princeville in the event of a storm that exceeds the level of protection being provided.

Recommendations for Resolution

1. Develop and provide a residual risk communication plan (with an education component and evacuation plan) developed specifically for the Town of Princeville and its vulnerable population.
2. Consider and include in the plan the area demographics and specific communication methods appropriate for Princeville's population.
3. Describe more fully the rationale behind recommendation of the TSP versus a plan with a higher level of flood risk reduction given that any plan is likely to have a benefit-to-cost ratio less than one.

4. Describe in more detail the potential for induced flooding in nearby communities if a higher level of protection were to be provided for the Town of Princeville.

Final Panel Comment 4

Future without-project condition impacts related to climate change in the project area and on the TSP are not adequately described or evaluated per USACE guidance.

Basis for Comment

The potential effects of climate change on the TSP are not considered in accordance with USACE guidance. Documentation and guidance issued by USACE over the past three years, and most recently on May 2, 2014 (USACE, 2014), state the agency's intention to consider climate change as part of the planning process, include:

> "Climate change impacts affect water availability, water demand, water quality, stormwater and wastewater infrastructure, flood and coastal storm infrastructure, wildland fires, ecosystem functioning, coastal zone functioning, navigation, and energy production and demand. All of these factors affect the water resources projects operated by the Corps and its non-Federal sponsors. Many of these were designed and constructed before climate change was recognized as a potential influence.
>
> "The entire portfolio of USACE Civil Works water resources infrastructure and programs, existing and proposed, could be affected by climate change and adaptation to climate change. This affects design and operational assumptions about resource supplies, system demands or performance requirements, and operational constraints. Both droughts and floods can affect the operations of these projects. Numerous regulatory decisions made by USACE will need to be informed by climate change impacts and adaptation considerations throughout the U.S., especially in western states.
>
> "In response to growing body of evidence about climate impacts to our missions and operations, we published a foundational report with other water resources agencies: Climate Change and Water Resources Management: A Federal Perspective. Since that time, we have developed a governance structure to support mainstreaming adaptation by establishing an overarching USACE Climate Change Adaptation Policy Statement and a Climate Change Adaptation Steering Council. This policy requires USACE to mainstream climate change adaptation in all activities to help enhance the resilience of our built and natural water-resource infrastructure and reduce its potential vulnerabilities to the effects of climate change and variability." (Brekke et al., 2009)

USACE put forward guidance on the following qualitative methodology for assessing climate change, effectively immediately (USACE, 2014):

> "Phase I. An initial screening-level qualitative analysis will be completed to identify whether climate change is relevant to the project goals or design in accordance with SMART Planning (i.e., are important hydrologic variables altered by climate change).
>
> "Phase II. If climate change is relevant to the project goals or designs, an evaluation is made of information gathered about impacts to the important hydrologic variables and the underlying physical processes such as changes in processes governing rainfall runoff or snowmelt. The information should be used to help identify opportunities to reduce potential vulnerabilities and increase resilience as a part of the project's authorized operations and also identify any caveats or particular issues associated with the data (e.g., different literature sources may project different outcomes). The information gathered in Phase II can be included either in risk registers or separately in a manner consistent with risk characterization in planning and design studies, depending on the project phase."

Climate change can result in larger rainfall events, creating larger floods that occur more frequently. Associated river sedimentation elevates flood levels and causes even smaller flooding events than are experienced today to flow outside the river channel. Potential increases in upstream flow due to climate change and/or sedimentation may make the TSP inadequate to protect with 95% assurance against a future 1% annual exceedance probability (AEP) flood. The risks and uncertainties associated with climate change and Tar River sedimentation have not been considered, and the assumption that the study area's hydrology will not change for future without-project conditions is not reasonable. The likelihood of increased upstream flows and increased sedimentation resulting from climate change may result in a lower level of protection than the TSP states it will provide.

Significance – Medium/High

Without addressing the potential effects of climate change in the documentation, the FR/EA may not comply with USACE policy, and the residual risk and uncertainty associated with increased upstream flows may be understated.

Recommendations for Resolution

1. Evaluate and describe the potential effects of climate change on the TSP using the methods outlined in ECB No. 2014-10 (USACE, 2014)
2. Bound the uncertainty of climate change impacts by 'worst-case,' 'best-case,' and 'expected' scenarios to capture the magnitude of potential impacts on the project as a result of the spectrum of climate change potential influence on project hazards.
3. Show whether and how the potential increased upstream flows and potential increased sedimentation in the Tar River were considered in plan formulation.
4. Provide documentation on the impacts of climate change and sedimentation on risks associated with the TSP.
5. Revise the documentation to include this information.
6. Provide a plan to communicate to the residents of the Town of Princeville and other stakeholders the risks associated with climate change on the future without-project and future with-project conditions. Such communications should include potential downgrading of the level of flood protection from the TSP as a result of increased upstream river flow from climate change.

Literature Cited:

Brekke, L.D., Kiang, J.E., Olsen, J.R., Pulwarty, R.S., Raff, D.A., Turnipseed, D.P., Webb, R.S., and White, K.D. (2009). Climate change and water resources management—A federal perspective: U.S. Geological Survey Circular 1331, 65 pp. (Also available online at http://pubs.usgs.gov/circ/1331/.)

USACE (2014). Guidance for Incorporating Climate Change Impacts to Inland Hydrology in Civil Works Studies, Designs, and Projects. Engineering and Construction Bulletin (ECB) No. 2014-10. U.S. Army Corps of Engineers. May 2.

Final Panel Comment 5

Conclusions reached in the Environmental Assessment with respect to cumulative effects appear to be based only on issues related to the TSP and do not consider, as required, past, present, and reasonably foreseeable future actions as required by NEPA.

Basis for Comment

Cumulative effects are defined by Code of Federal Regulations Title 40 Part 1508.7 as: "The impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such actions." Cumulative impacts can result from individually minor, but collectively significant, actions performed by other agencies or individuals taking place over a period of time.

The Environmental Assessment considers a limited range of cumulative effects related directly to the TSP, but does not consider broader past, present, and future actions. The cumulative effects analysis mandated by the National Environmental Policy Act (NEPA) requires a more comprehensive "hard look" inclusive of actions that may be undertaken by others.

Perceived protection from flood risk could also result in a misunderstanding on the part of Princeville residents that they are fully protected, potentially resulting in the unintended consequence of greater loss of life and property without long-term support for the non-structural elements of the TSP (risk communication, education, and evacuation). This is a potentially very significant and adverse socioeconomic cumulative effect.

The broader cumulative effects analysis requires some envisioning of future actions that may be undertaken in the project area unrelated to, but affected by, the project. It also includes anticipating activities that may be undertaken in the future that could be adverse to the project.

Significance – Medium

The cumulative effects analysis and documentation put forward in the FR/EA do not provide the detail required to comply with NEPA.

Recommendations for Resolution

1. Include a comprehensive list of reasonably foreseeable future actions (based on known future projects, planned and proposed projects, and past/predicted regional and local patterns) that may be undertaken in the project area.
2. Forecast and describe the cumulative effects, both adverse and positive, that the TSP may have on those activities, as well as the potential effects that those activities may have on the TSP itself. In particular, give attention to socioeconomic effects associated with residual risk and potential induced flooding.
3. Describe any anticipated measures to mitigate adverse cumulative effects, including those that may be adverse to the project and to the vulnerable population of the Town of Princeville.

Final Panel Comment 6

Erosion (via wave action and overtopping), as a failure mode in levee design, is not assessed.

Basis for Comment

The Geotechnical Appendix notes that during the Hurricane Floyd flood event, multiple sections of the existing levee system were overtopped and some of these were damaged by erosion as a result of overtopping. Existing and proposed levee sections will be constructed primarily from poorly graded sand (SP), which is highly erodible, especially prior to the development of a viable turf cover.

ER 1110-2-1150 (USACE, 1999) requires that "[s]ufficient engineering and design are performed to enable refinement of the project features, prepare the baseline cost estimate, develop a design and construction schedule, and allow detailed design on the Selected Plan to begin immediately following receipt of the PED funds."

Figure 3.1 (FR/EA, p. 48) shows that as much as 6 ft of ponded water on the outboard face of the levees along N.C. 111 (Segment 4) may be encountered at the 1% chance flood event. The land use in the area to the north of Segment 4 appears to be primarily agricultural, which provides a setting of significant fetch for wind-generated waves that have the potential to overtop and erode the levee. Due to the land use and estimated inundation depths, the potential for wave-induced erosion therefore also exists.

The performance of the levee system could be compromised unless erosion control measures are included in the design of the TSP.

Significance – Medium

Wave-action and overtopping erosion are potential failure modes for earthen levees; omitting their evaluation may affect the safety and reliability of the levee system.

Recommendations for Resolution

1. Evaluate the impact of wind-generated wave action, overtopping, and erosion in accordance with USACE (2012b).
2. Develop an erosion protection scheme to maintain levee integrity and document the selected erosion protection scheme in the FR/EA if erosion evaluation conducted in Recommendation 1 finds unacceptable erosion.
3. Complete a conceptual design of the selected erosion protection measures in Appendix B.
4. Revise the Fully Funded Cost Estimate as necessary to incorporate costs of any included erosion protection scheme.
5. Revise the fully funded cost estimate for the TSP if (after further review) it is determined that the current levee costs are underestimated.

Literature Cited:

USACE (1999). Engineering and Design—Plans and Specifications for Civil Works Projects. Engineer Regulation (ER) 1110-2-1150. Department of the Army, U.S. Army Corps of Engineers, Washington, D.C. August 31.

USACE (2012b). Hurricane and Storm Damage Risk Reduction System Design Guidelines. Interim. New Orleans District Engineering Division, with Revisions through June 2012.
Available from:
http://www.mvn.usace.army.mil/Portals/56/docs/engineering/HurrGuide/EntireDocument.pdf.

Final Panel Comment 7

The flood wall component of the TSP is not addressed so its expected performance and impact on the total project cost cannot be assessed.

Basis for Comment

Although a short section of flood wall is proposed as part of the TSP, the geotechnical evaluation has focused primarily on the design of levees. The flood wall section of the TSP is small when compared to the adjacent levee sections, but exerts an outsize risk in the flood protection system because of the complicated transition from flood wall to levee. Floodwall failures at the transitions between flood walls and levee embankments have been a significant cause of levee system failures. EM 1110-2-2502 (USACE, 1989) provides guidance for evaluating such systems.

Even though the overall cost implications of this omission may be small due to the small cost contribution from the flood wall element, some limited design for the flood wall as part of the Feasibility Study is required to ensure any costs are captured in the Cost Engineering Appendix.

Significance – Medium

The lack of a design for the flood wall component in the TSP may impact performance and result in an increase in the total project cost.

Recommendations for Resolution

1. Develop a preliminary flood wall design as part of the revised FR/EA.
2. Prepare a flood wall design detail in Appendix B with appropriate dimensions.
3. Prepare a design detail of the flood wall to levee section transitions in Appendix B.
4. Revise the total project cost estimate to include the new flood wall cost, if necessary.

Literature Cited:

USACE (1989). Engineering and Design—Retaining and Flood Walls. Engineering Manual (EM) 1110-2-2502. Department of the Army, U.S. Army Corps of Engineers, Washington, D.C. September 29.

Final Panel Comment 8

The location of the proposed levees along U.S. Highway 64 (Segment 2) is unresolved due to costs and environmental impacts on wetlands.

Basis for Comment

The placement of the proposed levees along U.S. Highway 64 appears still unresolved based on ongoing coordination between North Carolina Department of Transportation (NCDOT) and USACE to address the NCDOT preference to build the levee on the west side of the proposed U.S. 64 roadside to protect U.S. 64 as an evacuation route. This unresolved issue of levee location may increase the project's financial and environmental risks because USACE deemed levee construction west of U.S. 64 as too costly and that it would have a large environmental impact on wetlands. If the levee is constructed on the west side of U.S. 64, the project costs could increase significantly.

Based on information in the FR/EA (p. 69), USACE staff met with representatives of NCDOT on February 28, 2014 to walk through proposed project features and implementation requirements, and exchange information. The NCDOT staff had numerous clarifying questions/comments about plan formulation and on-the-ground impacts on local and regional transportation routes. The Panel understands that among these comments is the NCDOT preference that the proposed levees be placed on the west side of the U.S. 64 roadway to protect the U.S. 64 hurricane evacuation route. The FR/EA further states (p. 69) that USACE is "committed to working closely with NCDOT staff to ensure project implementation requirements are carefully coordinated between both agencies" and that "ongoing coordination between NCDOT and the Corps will address NCDOT feedback on the proposed roadside levee adjacent to U.S. 64 on the west side of the project, and potential alteration of the levee location to reduce residual flood effects to the existing hurricane evacuation route."

Based on the above USACE statements, the Panel believes the location of the levees adjacent to the proposed U.S. 64 alignment appears unresolved.

Significance – Medium

The unresolved location of the levee adjacent to the U.S. 64 roadway at this stage of the study may increase the financial and environmental risks associated with the project.

Recommendations for Resolution

1. Document in the report the understanding between USACE and NCDOT on the location of the levee adjacent to the U.S. 64 roadway.
2. Provide the mechanism to address the NCDOT feedback on the proposed roadside levee adjacent to the U.S. 64 roadway on the west side of the project.
3. Document the additional cost, financial risk, and environmental risk associated with this plan alteration if USACE still considers locating the levee adjacent to U.S. 64 on the west side of the U.S. 64 roadway.

Final Panel Comment 9

The assumption used in the development of the stage and discharge relationship may not be realistic, and therefore can potentially affect the results of the HEC-RAS model calibration, river flow and stage exceedance probability analysis, and interior drainage analysis.

Basis for Comment

Assuming a stable river bed when bed erosion has actually occurred leads to underestimation of flood stages (i.e., lower flood stages) and conversely leads to overestimation of flood stages (i.e., higher flood stages) when bed deposition has actually occurred. In addition, levees can elevate flood stages at a river cross section by preventing the flood from spilling over to adjacent floodplains and confining the flood within the levee system. Thus, conversion of measured discharges (Q) to an equivalent stage (h) can err depending on erosion or deposition patterns and levee construction at a selected river cross section. Assuming a stable bed and cross section, the study developed a Q-h curve that was applied to support model calibration, estimate flow and stage exceedance probability, and analyze interior drainage.

In Appendix A (p. 8-4), the Panel understands that the plotting of the Tar River measured discharge (Q) and measured stage (h) from 1994 to 2008 measurements provided the stage-discharge relationship at the U.S. Geological Survey Station (USGS) 02083500 (Tar River at Tarboro, North Carolina). The Q-h curve development appears to have implicitly assumed a stable river bed, i.e., no river bed deposition and erosion since 1931. Furthermore, the measured discharge data span periods before and after construction of the Princeville levee. The levee construction could influence the discharge-stage relationship by 'narrowing' the discharge area at the location of the gage station by confining the flood within the levees until levees are overtopped. Given the discharge measurement in 1931 to 2008 and levee construction in 1967, the developed Q-h curve was then used to calculate the river stage for the period 1931 to 2008 even when the hydraulic conditions in the river could have reflected different Q-h curves as river bed erodes/accretes and cross section was narrowed by levee construction.

Figure 5-6 (Appendix A, p. 5-9) shows the Q-h plot from the measured discharge and measured stage, HEC-RAS (Hydrologic Engineering Center-River Analysis System) model rating curve, and the rating curves from HEC-RAS models with high and low Manning's n values. The Panel understands that the stage for periods prior to 1994 was calculated from the Q-h curve of the measured discharge and measured stage. The Panel believes that Figure 5-6 is presented to support the HEC-RAS model verification and show the sensitivity of the HEC-RAS model calculated stage with the use of different Manning's n bed friction values. However, if the Q-h curve is inaccurate, then the HEC-RAS model verification and model sensitivity analyses could change if due consideration was given to changes in bed elevation and river cross section.

The Panel understands that the developed Q-h curve was extensively used in the estimation of the river stage for different river discharges in the Exterior Stage Analysis Section (Appendix A, p. 8-4). Figures 8-1, 8-2, and 8-3, and Tables 8-1, 8-2, and 8-3 (Appendix A) appear to have been directly or indirectly produced using the developed Q-h curve. Also, the Panel understands that the developed Q-h curve was extensively used in the estimation of the river stage in the annual frequency curve (Appendix A, Table 4-4, p. 4-5). However, if the Q-h curve is inaccurate, then the estimation of the river stage in the annual frequency curve could change if due consideration was given to changes in bed elevation and river cross section.

Changes in the developed Q-h curve can (a) weaken or undermine the HEC-RAS model calibration and verification, (b) make the results of the analysis of model sensitivity to Manning's n questionable if historical river bed vertical movement is larger than the exhibited model sensitivity (i.e., 2 - 3 ft change in model calculated stage), and (c) alter the estimated stages in the annual frequency curve.

Significance – Medium

Inaccuracy in the development of the stage and discharge relationship can potentially change the results of the hydrologic and hydraulic analyses.

Recommendations for Resolution

1. Provide documentation on the historical bed elevation of Tar River at the U.S. Geological Survey gage station at the Main Street Bridge (USGS 02083500 Tar River at Tarboro, North Carolina).
2. Provide detailed description of estimation of the stage and elevation data in Table 4-4 in Appendix A. Provide detailed description of the sources of plotted discharges and stages in Figure 5-6 in Appendix A.
3. Evaluate the effect of changes in bed elevation at the Main Street Bridge (USGS 02083500 Tar River at Tarboro, North Carolina) on the stage-discharge relationship.
4. Evaluate impact on the 1931–2008 estimated stage-discharge relationship by accounting for effects on stage as a result of the construction of the Princeville levee.
5. Evaluate the effect of changes in stage-discharge relationship on HEC-RAS model calibration, model verification, and model sensitivity to bed friction.
6. Evaluate the effect of changes in stage-discharge relationship on estimated stages in the annual frequency curve.

Final Panel Comment 10

The estimated project costs for PED and construction management are not well supported in the FR/EA, possibly indicating that the cost is overestimated.

Basis for Comment

The fully funded cost estimate includes construction and land acquisition costs of $13,434,000. The proposed amount of PED is $5,286,000, which is 39.35% of the total cost (including real estate), while the construction management amount is $2,376,000 or about 17.69% of the total cost. Both of these percentages appear high when compared to similar projects conducted by USACE and in the private sector.

Private sector projects may use a percentage of 10 to 20% of the total construction cost to estimate the design and construction management cost. Other USACE projects typically use 10 to 15% of the total construction cost. If the real estate costs are excluded, the two percentages are even higher. The Panel understands that a 35% factor of safety is included due to project uncertainties and risks, but even excluding this factor, the costs appear high. The Panel also understands that the PED costs could be justifiably higher due to inclusion of planned geotechnical explorations, but this is not clear in the FR/EA or Appendix D.

Significance – Medium

PED and construction management costs are a very high percentage of the overall construction cost estimate.

Recommendations for Resolution

1. Provide further documentation and support for the high PED and construction management cost estimates in Appendix D.
2. Provide further details regarding geotechnical explorations planned as part of PED and break out those costs separately in Appendix D.
3. Revise the cost estimates for PED and construction management if, after further review, it is determined that the costs are overestimated.

Final Panel Comment 11

The adequacy and acceptability of the methods and analyses used to evaluate future with-project conditions cannot be assessed because the information presented in Appendix A lacks sufficient detail.

Basis for Comment

Although Appendix A contains extensive analyses of the results for the evaluation of future with-project conditions, they are difficult to follow because the methodologies and results of the analyses are not presented in sufficient detail. In various sections of Appendix A, the text is missing descriptions of procedures and does not provide details on how results of one analysis are used in succeeding analyses. In addition, the thought processes associated with the hydraulic analyses that led to the various findings and conclusions for each of the alternatives are not presented in detail.

For example, Tables 8.1 and 8.3 and Figure 8.3 (Internal Drainage Section) and Table 7.4 (Pump Stations) do not provide enough detail to allow the reader to easily follow the methodology and understand the results that are presented.

Also, Appendix A does not identify, explain, and comment on the assumptions that support the hydrologic and hydraulic engineering analyses. Finally, the document lacks detailed discussions of analytical methods and results required for evaluation of future with-project conditions.

A lack of detailed discussions of analytical methods and results for the evaluation of future with project conditions leads to misunderstanding of the hydrologic and hydraulic analysis, makes it difficult for the reader to follow the discussion in the report, and provides poor documentation of the results of the analysis.

Significance – Medium/Low

A more detailed discussions of the extensive analyses in Appendix A will improve the overall documentation of the hydrology and hydraulic analysis.

Recommendations for Resolution

1. Provide detailed discussions of the analytical methods and results for the evaluation of future with-project conditions in Appendix A.
2. Provide the details of the hydraulic analyses decision process that led to the findings and conclusions for each alternative in Appendix A.

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APPENDIX A

IEPR Process for the Princeville Project

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

Table A-1 presents the schedule followed in executing the Princeville, North Carolina Flood Risk Management Feasibility Study Integrated Feasibility Report and Environmental Assessment Independent External Peer Review (hereinafter: Princeville IEPR). Due dates for milestones and deliverables are based on the award/effective date of May 19, 2014. The review documents were provided by U.S. Army Corps of Engineers (USACE) on May 19, 2014. Note that the work items listed under Task 6 occur after the submission of this report. Battelle will enter the 11 Final Panel Comments developed by the Panel into USACE's Design Review and Checking System (DrChecks), a Web-based software system for documenting and sharing comments on reports and design documents, so that USACE can review and respond to them. USACE will provide responses (Evaluator Responses) to the Final Panel Comments, and the Panel will respond (BackCheck Responses) to the Evaluator Responses. All USACE and Panel responses will be documented by Battelle. Battelle will provide USACE and the Panel a pdf printout of all DrChecks entries, through comment closeout, as a final deliverable and record of the IEPR results.

Table A-1. Princeville IEPR Complete Schedule

Task	Action	Due Date	Running Working Days
1	Award/Effective Date	5/19/2014	0
	Review documents available	5/30/2014	8
	Battelle submits draft Work Plan*	5/29/2014	7
	USACE provides comments on draft Work Plan	6/3/2014	10
	Battelle submits final Work Plan*	6/16/2014	19
2	Battelle requests input from USACE on the conflict of interest (COI) questionnaire	5/20/2014	1
	USACE provides comments on COI questionnaire	5/23/2014	4
	Battelle submits list of selected panel members*	6/5/2014	12
	USACE confirms the panel members have no COI	6/9/2014	14
	Battelle completes subcontracts for panel members	6/16/2014	19
3	Battelle convenes kick-off meeting with USACE	5/27/2014	5
	Battelle sends review documents to panel members	6/16/2014	19
	Battelle convenes kick-off meeting with panel members	6/18/2014	21
	Battelle convenes kick-off meeting with USACE and panel members	6/18/2014	21
	Battelle convenes mid-review teleconference for panel members to ask clarifying questions of USACE	7/21/2014	43
	Civil Works Review Board Meeting	4/2015	
4	Panel members complete their individual reviews	7/24/2014	46
	Battelle provides panel members with talking points for Panel Review Teleconference	7/28/2014	48
	Battelle convenes Panel Review Teleconference	8/1/2014	49

Task	Action	Due Date	Running Working Days
	Battelle provides Final Panel Comment templates and instructions to panel members	8/5/2014	50
	Panel members provide draft Final Panel Comments to Battelle	8/11/2014	55
	Battelle provides feedback to panel members on draft Final Panel Comments; panel members revise Final Panel Comments	8/11 - 8/18/2014	
	Panel finalizes Final Panel Comments	8/19/2014	62
5	Battelle provides Final IEPR Report to panel members for review	8/20/2014	64
	Panel members provide comments on Final IEPR Report	8/21/2014	65
	Battelle submits Final IEPR Report to USACE*	**8/25/2014**	67
6	Battelle inputs Final Panel Comments to the Design Review and Checking System (DrChecks) and provides Final Panel Comment response template to USACE	8/26/2014	69
	Battelle convenes teleconference with USACE to review the Post-Final Panel Comment Response Process	8/26/2014	69
	Battelle convenes teleconference with Panel to review the Post-Final Panel Comment Response Process	8/26/2014	69
	USACE provides draft Project Delivery Team (PDT) Evaluator Responses to Battelle	9/5/2014	76
	Battelle provides the panel members the draft PDT Evaluator Responses	9/8/2014	77
	Panel members provide Battelle with draft BackCheck Responses	9/11/2014	80
	Battelle convenes teleconference with panel members to discuss draft BackCheck Responses	9/12/2014	81
	Battelle convenes Comment-Response Teleconference with panel members and USACE	9/16/2014	83
	USACE inputs final PDT Evaluator Responses to DrChecks	9/22/2014	87
	Battelle provides final PDT Evaluator Responses to panel members	9/23/2014	88
	Panel members provide Battelle with final BackCheck Responses	9/25/2014	90
	Battelle inputs the panel members' final BackCheck Responses to DrChecks	9/26/2014	91
	Battelle submits pdf printout of DrChecks project file*	9/29/2014	92
	Contract End/Delivery Date	6/30/2015	

At the beginning of the Period of Performance for the Princeville IEPR, Battelle held a kick-off meeting with USACE to review the preliminary/suggested schedule, discuss the IEPR process, and address any questions regarding the scope (e.g., clarify expertise areas needed for panel members). Any revisions to the schedule were submitted as part of the final Work Plan. In addition, 36 charge questions were provided by USACE and included in the draft and final Work Plans. Battelle added two questions that seek summary information from the IEPR Panel. The final charge also included general guidance for the Panel on the conduct of the peer review (provided in Appendix C of this final report).

Prior to beginning their review and within seven days of their subcontracts being finalized, all members of the Panel attended a kick-off meeting via teleconference planned and facilitated by Battelle in order to review the IEPR process, the schedule, communication procedures, and other pertinent information for the Panel. Battelle planned and facilitated a second kick-off meeting via teleconference during which USACE presented project details to the Panel. Before the meetings, the IEPR Panel received an electronic version of the final charge as well as the Princeville review documents and reference materials listed below. The documents and files in bold font were provided for review; the other documents were provided for reference or supplemental information only.

- **Integrated Feasibility Study Report and Environmental Assessment (300 pages)**
- **Hydrology and Hydraulics (120 pages)**
- **Design (25 pages)**
- **Geotechnical (35 pages plus 223 pages of figures, boring logs, models, etc)**
- **Cost Engineering (30 pages)**
- **Real Estate (30 pages)**
- **Economics (40 pages)**
- **Other Social Effects (100 pages)**
- **Public Comments (50 pages)**
- USACE guidance *Civil Works Review* (EC 1165-2-214,15 December 2012)
- Office of Management and Budget's *Final Information Quality Bulletin for Peer Review* (December 16, 2004).

About halfway through the review of the Princeville IEPR documents, a teleconference was held with USACE, the Panel, and Battelle so that USACE could answer any questions the Panel had concerning either the review documents or the project. Prior to this teleconference, Battelle submitted 24 panel member questions to USACE. USACE was able to provide responses to all of the questions during the teleconference or in writing on July 25.

In addition, throughout the review period, USACE provided documents at the request of panel members. These documents were provided to Battelle and then sent to the Panel as additional information only and were not part of the official review. A list of these additional documents requested by the Panel is provided below.

- Princeville, NC FRM Integrated FR and EA Tab 1: Study Issue Checklist
- Princeville, NC FRM Integrated FR and EA Tab 2: Status of Environmental Compliance
- Princeville, NC FRM Integrated FR and EA Tab 3: Status of Peer Review (ATR Summary)
- Princeville, NC FRM Integrated FR and EA Tab 4: Legal Review

- Princeville, NC FRM Integrated FR and EA Tab 5: Status of Engineering Activities
- Princeville, NC FRM Integrated FR and EA Tab 6: Schedule
- Princeville, NC FRM Integrated FR and EA Tab 7: PGM Memo
- Princeville, NC FRM Integrated FR and EA Tab 8: PGM Compliance Memo
- Princeville, NC FRM Integrated FR and EA Tab 9: Exception Memo

A.2 Review of Individual Comments

The Panel was instructed to address the charge questions/discussion points within a charge question response table provided by Battelle. At the end of the review period, the Panel produced individual comments in response to the charge questions/discussion points. Battelle reviewed the comments to identify overall recurring themes, areas of potential conflict, and other overall impressions. At the end of the review, Battelle summarized the individual comments in a preliminary list of 19 overall comments and discussion points. Each panel member's individual comments were shared with the full Panel in a merged individual comments table.

A.3 IEPR Panel Teleconference

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

The Panel also discussed responses to a charge question where there appeared to be disagreement among panel members. The conflicting comments were resolved based on the professional judgment of the Panel, determined not to be conflicting, and incorporated into a Final Panel Comment that had already developed.

At the end of these discussions, the Panel identified 12 comments and discussion points that should be brought forward as Final Panel Comments.

A.4 Preparation of Final Panel Comments

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

- Lead Responsibility: For each Final Panel Comment, one Panel member was identified as the lead author responsible for coordinating the development of the Final Panel Comment and submitting it to Battelle. Battelle modified lead assignments at the direction of the Panel. To assist each lead in the development of the Final Panel Comments, Battelle distributed the merged

individual comments table, a summary detailing each draft final comment statement, an example Final Panel Comment following the four-part structure described below, and templates for the preparation of each Final Panel Comment.

- Directive to the Lead: Each lead was encouraged to communicate directly with the other panel member as needed and to contribute to a particular Final Panel Comment. If a significant comment was identified that was not covered by one of the original Final Panel Comments, the appropriate lead was instructed to draft a new Final Panel Comment.
- Format for Final Panel Comments: Each Final Panel Comment was presented as part of a four-part structure:
  1. Comment Statement (succinct summary statement of concern)
  2. Basis for Comment (details regarding the concern)
  3. Significance (high, medium/high, medium, medium/low, and low; see description below)
  4. Recommendation(s) for Resolution (see description below).
- Criteria for Significance: The following were used as criteria for assigning a significance level to each Final Panel Comment:
  1. **High:** Describes a fundamental issue with the project that affects the current recommendation or justification of the project, and which will affect its future success, if the project moves forward without the issue being addressed. Comments rated as high indicate that the Panel determined that the current methods, models, and/or analyses contain a "showstopper" issue.
  2. **Medium/High:** Describes a potential fundamental issue with the project, which has not been evaluated at a level appropriate to this stage in the Planning process. Comments rated as medium/high indicate that the Panel analyzed or assessed the methods, models, and/or analyses available at this stage in the Planning process and has determined that if the issue is not addressed, it could lead to a "showstopper" issue.
  3. **Medium:** Describes an issue with the project, which does not align with the currently assessed level of risk assigned at this stage in the Planning process. Comments rated as medium indicate that, based on the information provided, the Panel identified an issue that would raise the risk level if the issue is not appropriately addressed.
  4. **Medium/Low:** Affects the completeness of the report at this time in describing the project, but will not affect the recommendation or justification of the project. Comments rated as medium/low indicate that the Panel does not currently have sufficient information to analyze or assess the methods, models, or analyses.
  5. **Low:** Affects the understanding or accuracy of the project as described in the report, but will not affect the recommendation or justification of the project. Comments rated as low indicate that the Panel identified information that was mislabeled or incorrect or that certain data or report section(s) were not clearly described or presented.
- Guidelines for Developing Recommendations: The recommendation section was to include specific actions that USACE should consider to resolve the Final Panel Comment (e.g., suggestions on how and where to incorporate data into the analysis, how and where to address insufficiencies, areas where additional documentation is needed).

Battelle reviewed and edited the Final Panel Comments for clarity, consistency with the comment statement, and adherence to guidance on the Panel's overall charge, which included ensuring that there were no comments regarding either the appropriateness of the selected alternative or USACE policy. During the Final Panel Comment development process, the Panel determined that one of the Final Panel Comments could be merged into another Final Panel Comment; therefore, the total Final Panel Comment count was reduced to 11.

At the end of this process, 11 Final Panel Comments were prepared and assembled. There was no direct communication between the Panel and USACE during the preparation of the Final Panel Comments. The Final Panel Comments are presented in the main report.

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APPENDIX B

Identification and Selection of IEPR Panel Members for the Princeville Project

B.1 Panel Identification

The candidates for the Princeville, North Carolina Flood Risk Management Feasibility Study Integrated Feasibility Report and Environmental Assessment (hereinafter: Princeville IEPR) Panel were evaluated based on their technical expertise in the following key areas: civil/structural engineering, geotechnical engineering, hydrologic and hydraulic engineering, biology/ecology, and economics/planning/social effects. These areas correspond to the technical content of the Princeville IEPR review documents and overall scope of the Princeville project.

To identify candidate panel members, Battelle reviewed the credentials of the experts in Battelle's Peer Reviewer Database, sought recommendations from colleagues, contacted former panel members, and conducted targeted Internet searches. Battelle evaluated these candidate panel members in terms of their technical expertise and potential conflicts of interest (COIs). Of these candidates, Battelle chose the most qualified individuals, confirmed their interest and availability, and ultimately selected five experts for the final Panel.

The five selected reviewers constituted the final Panel. The remaining candidates were not proposed for a variety of reasons, including lack of availability, disclosed COIs, or lack of the precise technical expertise required.

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

- Previous and/or current involvement by you or your firm[2] in the Princeville, North Carolina Flood Risk Management Feasibility Study Integrated Feasibility Report and Environmental Assessment.
- Previous and/or current involvement by you or your firm[2] in flood damage reduction studies for the Town of Princeville, Town of Tarboro, or Edgecombe County North Carolina.

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

[2] Note: Includes any joint ventures in which your firm is involved and if your firm serves as a prime or as a subcontractor to a prime.

- Previous and/or current involvement by you or your firm[2] in the analyses, or conceptual or actual design, construction, or operation and maintenance of any projects in the Princeville, North Carolina vicinity.
- Current employment by the U.S. Army Corps of Engineers (USACE).
- Previous and/or current involvement with paid or unpaid expert testimony for the Town of Princeville, Town of Tarboro, or Edgecombe County related to flood issues or public works projects in the area.
- Previous and/or current employment or affiliation with the non-Federal sponsors or any of the following Federal, State, County, local and regional agencies, environmental organizations, and interested groups: State of North Carolina, Federal Emergency Management Agency (FEMA), U.S. Housing & Urban Development, U.S. Small Business Administration, U.S. Department of Agriculture, Department of Labor, Town of Princeville, Town of Tarboro, or Edgecombe County (for pay or pro bono).
- Past, current or future interests or involvements (financial or otherwise) by you, your spouse or children related to the Princeville, North Carolina Flood Risk Management Feasibility Study, the Town of Princeville, the Town of Tarboro, or Edgecombe County.
- Current personal involvement with other USACE projects, including whether involvement was to author any manuals or guidance documents for USACE. If yes, provide titles of documents or description of project, dates, and location (USACE district, division, Headquarters, ERDC, etc.), and position/role. Please highlight and discuss in greater detail any projects that are specifically with the Wilmington District.
- Previous or current involvement with the development or testing of models that could be used for or in support of the Princeville, North Carolina Flood Risk Management Feasibility Study project. Models that will be used in the project include but may not be limited to: HEC-FDA and HEC-RAS 4.0.
- Current firm[2] involvement with other USACE projects, specifically those projects/contracts that are with the Wilmington District. If yes, provide title/description, dates, and location (USACE district, division, Headquarters, ERDC, etc.), and position/role. Please also clearly delineate the percentage of work you personally are currently conducting for the Wilmington District. Please explain.
- Any previous employment by USACE as a direct employee, If yes, provide title/description, dates employed, and place of employment (district, division, Headquarters, ERDC, etc.), and position/role.
- Any previous employment by USACE as a contractor (either as an individual or through your firm[2]) within the last 10 years, notably if those projects/contracts are with the Wilmington District. If yes, provide title/description, dates employed, and place of employment (district, division, Headquarters, ERDC, etc.), and position/role.
- Previous experience conducting technical peer reviews. If yes, please highlight and discuss any technical reviews concerning flood risk management, levees, or life safety concerns and include the client/agency and duration of review (approximate dates).
- Pending, current or future financial interests in the Princeville, North Carolina Flood Risk Management Feasibility Study or levee program or related contracts/awards from USACE.

- A significant portion (i.e., greater than 50%) of personal or firm[2] revenues within the last 3 years came from USACE contracts.
- A significant portion (i.e., greater than 50%) of personal or firm[2] revenues within the last 3 years from contracts with the State of North Carolina or Edgecombe County.
- Any publicly documented statement (including, for example, advocating for or discouraging against) related to the Princeville, North Carolina Flood Risk Management Feasibility Study.
- Participation in relevant prior Federal studies relevant to this project and/or the Princeville, North Carolina Flood Risk Management Feasibility Study.
- Previous and/or current participation in prior non-Federal studies relevant to this project and/or the Princeville, North Carolina Flood Risk Management Feasibility Study.
- Is there any past, present, or future activity, relationship or interest (financial or otherwise) that could make it appear that you would be unable to provide unbiased services on this project? If so, please describe:

Other considerations:

- Participation in previous USACE technical review panels
- Other technical review panel experience.

B.2 Panel Selection

In selecting the final members of the Panel, Battelle chose experts who best fit the expertise areas and had no COIs. Two of the five final reviewers are affiliated with a consulting company; the remaining are independent consultants. Battelle established subcontracts with the panel members when they indicated their willingness to participate and confirmed the absence of COIs through a signed COI form. USACE was given the list of candidate panel members, but Battelle selected the final Panel.

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

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

Technical Criterion	Brown	Storesund	Kabiling	Crouch	Ator
Civil/Structural Engineering					
Minimum 10 years of experience in civil or construction engineering	X				
Familiarity with large, complex Civil Works projects with high public and interagency interests	X				
Demonstrated experience in performing cost engineering/construction management for all phases of flood risk management related projects	X				
Experience in:					
levee, floodwall, box culvert and drainage structure design	X				
utility relocations	X				
Experience with design and construction of flood control structures in areas of karst geology	X				
Experience with long-term operation and maintenance requirements	X				
Experience with traffic and transportation design is desired	X				
Ability to address the USACE Safety Assurance Review (SAR) aspects of all projects. i.e. review of "the design and construction activities for hurricane and storm damage reduction and flood damage reduction projects."	X				
Registered Professional Engineer	X				
Geotechnical Engineering					
Minimum 10 years of experience in geotechnical engineering or engineering geology		X			
Familiarity with large, complex Civil Works projects with high public and interagency interests		X			
Demonstrated experience in performing geotechnical evaluation and geo-civil design for flood risk management projects		X			
Demonstrated experience related to structural and geotechnical practices associated with levee and floodwall design and construction including:					
Static and dynamic slope stability		X			
Seepage through earthen embankments		X			
Underseepage through the foundation		X			
Demonstrated experience related to settlement analysis of the flood risk management structures, including:					
Levee embankments		X			
Floodwalls		X			
Closure structures		X			

Table B-1. Princeville IEPR Panel: Technical Criteria and Areas of Expertise (continued)

Technical Criterion	Brown	Storesund	Kabiling	Crouch	Ator
Ability to address the USACE Safety Assurance Review (SAR) aspects of all projects. i.e. review of "the design and construction activities for hurricane and storm damage reduction and flood damage reduction projects."		X			
M.S. or higher degree in engineering		X			
Registered Professional Engineer		X			
Hydraulic and Hydrologic Engineering					
Minimum 15 years of experience in hydrologic and hydraulic engineering			X		
Familiarity with large, complex Civil Works projects with high public and interagency interests			X		
Extensive experience in the field of hydrology and hydraulics, with a thorough understanding of the dynamics of:					
Open channel flow systems			X		
Enclosed systems			X		
Application of detention / retention basins			X		
Experience related to modeling levees and floodwalls in an urban environment with space constraints			X		
Experience related to non-structural measures especially as it relates to multipurpose alternatives including:					
Ecosystem restoration			X		
Flood warning systems			X		
Flood proofing			X		
Interior drainage			X		
Flood frequency analysis			X		
Coincident probability			X		
Experience evaluating the effects of best management practices and low impact development on hydrology and approaches that can benefit water quality.			X		
Experience in the application of risk and uncertainty in defining project performance and assurance.			X		
Familiar with standard USACE hydrologic and hydraulic computer models including:					
HEC-2			X		
HEC-HMS			X		
HEC-RAS			X		

Table B-1. Princeville IEPR Panel: Technical Criteria and Areas of Expertise (continued)

Technical Criterion	Brown	Storesund	Kabiling	Crouch	Ator
HEC-FDA			W[1]		
M.S. or higher degree in engineering			X		
Registered Professional Engineer			X		
Certified floodplain manager			X		
Biology/Ecology					
Minimum 10 years of demonstrated experience in evaluation and conducting National Environmental Policy Act (NEPA) impact assessments, including cumulative effects analyses, for complex multi-objective public works projects with competing trade-offs.				X	
Familiarity with large, complex Civil Works projects with high public and interagency interests				X	
Extensive background experience and working knowledge with the implementation of both the:					
NEPA				X	
National Historic Preservation Act as amended, compliance processes.				X	
M.S. degree or higher in ecology or biology				X	
Economics/Planning/Social Effects					
Minimum 10 years of experience in demonstrated experience in public works planning					X
Minimum 10 years of demonstrated experience in evaluation and conducting social science studies with a particular emphasis on historical minority communities.					X
Familiarity with large, complex Civil Works projects with high public and interagency interests					X
High familiarity with USACE plan formulation process, procedures, and standards.					X
Familiarity with USACE structural flood risk management projects					X
Minimum of 5 years' experience directly dealing with the USACE six-step planning process, which is governed by ER 1105-2-100, Planning Guidance Notebook.					X

[1]Waiver submitted to USACE in the Task 2 deliverable and accepted.

Table B-1. Princeville IEPR Panel: Technical Criteria and Areas of Expertise (continued)

Technical Criterion	Brown	Storesund	Kabiling	Crouch	Ator
Familiarity with the USACE flood risk management analysis and benefit calculations, including use of the USACE HEC-FDA computer program					X
Experience with the National Economic Development (NED) analysis procedures, particularly as they relate to:					
Flood risk management					X
Life loss probability analysis					X
Population at risk					X
Residual risk					X
Vulnerability analysis					X
Experience related to social effects impacts evaluation of large civil works projects, including:					
Community cohesion/identity					X
Cultural and historical value					X
Low income population					X
Economic vitality of the community					X
Vulnerability of the population					X

B.3 Panel Member Qualifications

Chris Brown, P.E., Ph.D.

Role: Civil engineering
Affiliation: University of North Florida

Dr. Brown is an assistant professor at the University of North Florida teaching civil engineering, fluid mechanics, hydraulics, foundation engineering, and engineering geology. He earned his Ph.D. in civil engineering in 2005 from the University of Florida and is a registered professional engineer in Florida and Pennsylvania. Dr. Brown has worked on multiple large Civil Works projects all over the country, including projects involving navigation improvements, locks and dams, flood control/water supply dams, shore protection, flood walls, tunnels, and environmental restoration.

His experience in cost estimating is demonstrated in the development of cost estimates for dam safety improvements for the Iluka Mining project and for a liquefied natural gas project in south Florida. His work on the Tamiami Trail Bridge Modification project also involved cost estimating, including maintenance of traffic evaluations. He has experience working on unit cost development, risk assessment, production/productivity, and change orders, and he is familiar with MCACES, @Risk, and Crystal Ball cost estimating software.

Dr. Brown's experience in construction management includes a rotational assignment for the Construction Division of USACE Philadelphia District working on a large floodwall project in New Jersey. He has also testified in court on construction management deficiencies regarding dewatering and differing site conditions. Dr. Brown has worked on multiple flood mitigation projects including both relocation of structures (e.g., buildings, box culverts, and weirs) and basic utilities. For example, he oversaw development of design alternatives for flood mitigation in the Homestead, Florida area, which included the relocation of water lines, electric, roads, and homes. For the Molly Ann Brook flood mitigation project, Dr. Brown worked on U-wall, L-wall, and T-wall designs, which included utility relocations, utility hardening, and underpinning of an existing building close to the main flood channel. Dr. Brown also developed mitigation alternatives for the Iluka Mining water impoundments including relocation and replacement of outflow structures.

He has worked on multiple projects on karst geology in south Florida, Pennsylvania, and Puerto Rico and he was an IEPR member for projects in Missouri that included some karstic areas. He also testified in court regarding groundwater seepage into a sinkhole beneath a large industrial building in Lake Mary, Florida. He has worked on engineering projects that have included long-term operation and maintenance of dams, levees, spillways, and tunnels. Dr. Brown has worked on a handful of relevant transportation projects including the new Tamiami Trail Bridge that is currently under construction in south Florida. This project also included development of cost estimates. He also developed pavement designs for a Coast Guard helicopter landing area and associated taxiway. He is fully capable of addressing relevant SAR issues and has fulfilled this requirement for at least three other IEPR projects including work on the largest lock and dam project in the United States.

Rune Storesund, P.E., D.Eng, G.E.

Role: Geotechnical engineering
Affiliation: Independent consultant

Dr. Storesund is the lead engineer at Storesund Consulting, the Executive Director of the University of California (UC) Berkeley's Center for Catastrophic Risk Management, and serves as an expert Geotechnical Engineer to the State of California's Department of Consumer Affairs for their annual examination. He earned his D.Eng in civil engineering from UC Berkeley, is a registered civil engineer in California, Louisiana, and Hawaii, and is a registered geotechnical engineer in California. He has 14 years of experience in planning, design, operations/maintenance, construction, and decommissioning of Civil Works structures and has worked on a variety of projects throughout the United States and internationally.

He is familiar with large, complex Civil Works projects with high public and interagency interests. Following Hurricane Katrina in 2005, Dr. Storesund participated in a review of the performance of the Hurricane Defense System for the greater New Orleans area, the largest and most complex flood protection project in the United States. He was personally responsible for inspecting the damaged system as part of the American Society of Civil Engineers (ASCE) and UC Berkeley National Science Foundation (NSF)-sponsored reconnaissance teams and he reviewed thousands of pages of planning documents, design criteria, geologic and geotechnical site characterizations, engineering analyses, cost/benefit ratios, and decision chronology. He also completed a study evaluating the improved Hurricane Protection System from a holistic systems-based perspective, using SysML as a modeling tool to synthesize and integrate disparate system elements. Other large, complex projects he has worked on that had high public and interagency interests include the Louisiana Coastal Restoration initiative (on behalf of the Environmental Defense Fund) and the NSF-sponsored Resilient and Sustainable Infrastructures (RESIN) project, evaluating Interconnected, Interrelated, Interactive Critical Infrastructures (I3CIS) in the California Delta.

He has demonstrated experience performing geotechnical evaluations and geo-civil design for USACE flood risk management projects, most recently 10 years of involvement in the Hamilton Wetland Restoration project in Novato, California. The project included perimeter Federal and local levees to provide flood protection for communities in Novato that surround the wetland project. Other USACE flood protection projects he has worked on are the West Sacramento Flood Control Project, Las Gallinas Coastal Inundation Study, Upper Penitencia Creek Flood Improvement Project, San Lorenzo Flood Control Project, and Upper Napa River Flood Protection Project.

Dr. Storesund has experience related to structural and geotechnical practices associated with levee and floodwall design and construction, including static and dynamic slope stability, seepage through earthen embankments, and underseepage through the foundation. He also has experience related to settlement analysis of the flood risk management structures, including levee embankments, floodwalls, and closure structures. The Hamilton Wetland project involved static and dynamic slope stability, seepage through earthen embankments, underseepage through the levee foundations, and levee/floodwall/structure settlement. He performed analyses for these aspects of the project as well as reviewed analyses completed by others. He has also performed slope stability, seepage, underseepage, and settlement analyses for embankments, floodwalls, and closure structures as part of his work on the New Orleans Hurricane Defense system, the Jones Tract Levee Failure investigation (California Delta), as well as the NSF-sponsored RESIN project (California Delta).

Dr. Storesund has extensive experience addressing the USACE Safety Assurance Review (SAR) aspects of all projects, starting with his participation on the ASCE Assessment team following Hurricane Katrina in the greater New Orleans area. He has been active in advancing Risk-Informed Decision Making for critical infrastructures identification and management of uncertainties and has routinely evaluated redundancy, resiliency, and robustness (e.g., RESIN project is an example application).

Michael Kabiling, P.E., Ph.D., C.F.M.

Role: Hydraulic and hydrologic engineering
Affiliation: Taylor Engineering, Inc.

Dr. Kabiling is a senior engineer with Taylor Engineering Inc. in Jacksonville, Florida. He has over 20 years of experience in water resources, hydrologic, hydraulic, and coastal engineering, and numerical modeling. He earned his Ph.D. in hydraulic and coastal engineering from Yokohama National University in Japan, is a registered professional engineer in Florida, Georgia, and South Carolina, and is a certified floodplain manager. Dr. Kabiling's project experience includes the application of one-, two-, and three-dimensional models such as UNET, HEC-2, HEC-RAS, MIKE11, HEC-HMS, RMA2, RMA4, CGWAVE, EFDC, and ADCIRC, the MIKE21/MIKE3 model suites, and the ACES, STWAVE, REFDIF1, CGWAVE, and MIKE21 wave models. He has applied these models on more than 25 hydraulics and scour studies in Florida, South Carolina, and Louisiana and more than 65 numerical modeling projects focused on hydrology, hydrodynamics (dam break, surge, tide, flow, and circulation), waves, water quality, contaminant transport, sediment transport, and surge and flood.

Dr. Kabiling has had extensive experience with large, complex Civil Works projects with high public and interagency interest, including USACE's Herbert Hoover Dam Breach Dam-Break Analysis, for which he led the review, analysis, and selection of dam breach and flood routing models and applied one-dimensional (1-D) HEC-RAS and MIKE11, two-dimensional (2-D) MIKE21, and combined 1-D and 2-D MIKE-FLOOD hydrodynamic and dam break models to simulate several dam failure inundation scenarios. For the Jacksonville Harbor Deepening Project, he supervised the Environmental Fluid Dynamics Code (EFDC) model validation, model application for various harbor dredging scenarios, and provided quality assurance/quality control reviews of the EFDC modeling. His work on projects such as the Rio de la Plata Two-Dimensional Flood Analysis demonstrates his thorough understanding of the dynamics of open channel flow, closed conduit flow, detention/retention basin. As team leader for that project, he led the collection, review, and application of existing data to develop a 2-D hydrodynamic model for the northern Rio de la Plata drainage basin. He conducted MIKE21 2-D hydrodynamic flood routing and estimated without-project and with-project flood elevations, depth of inundations, and flow velocities. Dr. Kabiling also served as the hydrodynamic modeler for the evaluation of Jasmine Street Tide Barrier Alternatives in Nassau County, Florida, for which he converted an existing UNET model of Egan's Creek to HEC-RAS, calibrated the HEC-RAS model to existing conditions, and set up in HEC-RAS and evaluated the performance of several detention/retention basins, gate/valve, and culvert alternatives.

Dr. Kabiling has project experience related to modeling levees and floodwalls in an urban environment with space constraints, including the Pasig River Rehabilitation Project in the highly urbanized metropolitan area of Manila, Philippines. He conducted regular periodic numerical modeling of the water levels, river flow, and water quality of leveed rivers and channels along select locations in Manila. The Rio de la Plata and Herbert Hoover Dam Breach Dam Break projects also involved modeling urbanized levees. He has experience with non-structural measures, including ecosystem restoration and flood warning systems (e.g., Pasig River project); flood proofing (e.g., San Juan Flood Control Project in

Manila); interior drainage (e.g., Hermosa Industrial Park Regional Hydrology, Drainage, and Flooding in Bataan, Philippines); and flood frequency analysis and coincident probability (e.g., Bridge Improvement over Lofton Creek, Nassau County, Florida and Bridge Replacement over Combahee and Ashepoo Rivers, Colleton County, South Carolina).

Dr. Kabiling also has experience evaluating the effects of best management practices and low impact development on hydrology and approaches that can benefit water quality. His work on the Pasig River Rehabilitation Project included supervising field monitoring program implementation, preparing regular technical reports on water quality assessment and evaluating the effects of low impact management and best management practices such as embankment vegetation and use of screens at drainage systems to the river. His work on bridge replacements over Folly River and Sol Legare Creek in South Carolina included analyzing and recommending low impact development such as bank revetment and vegetation as erosion countermeasures and as a means to preserve water quality. His experience in applying risk and uncertainty in defining project performance and assurance includes the Herbert Hoover Dam project which involved illustrative flood inundation maps and associated sensitivity and uncertainty analyses.

Kay Crouch

Role: Biology/ecology
Affiliation: Crouch Environmental Services, Inc.

Ms. Crouch is president of Crouch Environmental Services, Inc., a company specializing in NEPA analysis, environmental site assessment, permitting, and mitigation for projects with high public and interagency interests. She earned her M.S. in biology/aquatic ecology in 1978 from Steven F. Austin State University, and has received additional academic training in the NEPA process from the Duke University Nicholas School of Environmental and Earth Sciences (2004-2005), including a course called “Accounting for Cumulative Effects in the NEPA Process.” As an expert in coastal ecology, freshwater and coastal wetlands and waters of the U.S., habitat modeling, riparian ecology, listed species, and general biology and ecology, Ms. Crouch has 35 years of nationwide experience in conducting environmental site assessments and NEPA impact assessments for complex multi-objective public works projects with competing trade-offs. She has performed numerous environmental evaluations throughout the coastal ecosystems of Louisiana and Texas in support of Federal Energy Regulatory Commission (FERC) filings and NEPA documentation. She has prepared over 100 NEPA documents since 1978 for large power plants, pipelines transmission lines, and flood damage reduction projects, all of which have involved cumulative effects analysis. Environmental inventories and preparation of documents complying with the NEPA are an area of specialization for Ms. Crouch. On an on-going basis, she prepares all or parts of NEPA documents for transportation projects (Texas Department of Transportation and Harris County) and has prepared NEPA documents for activities regulated by FERC for liquid natural gas facilities (Freeport LNG for FERC the Vista Del Sol project for ExxonMobil), and port facilities (the Bayport Container Terminal and Cargo Road for the USACE and the Port of Houston Authority).

Nearly every NEPA project that Ms. Crouch has worked on requires coordination with the State Historic Preservation Office (SHPO) and addressing the National Historic Preservation Act (NHPA). The highways (e.g., Interstate 45, State Highway [SH] 288, SH 36, Interstate 610) and flood damage reduction projects (e.g., Clear Creek, Halls Bayou, Greens Bayou, White Oak Bayou) that Ms. Crouch has been involved with require cultural and historical site evaluation and SHPO coordination. Every Section 404 permit that Ms. Crouch works on includes a cultural resources evaluation to comply with NHPA. An example of a project that required extensive SHPO and NHPA coordination includes pipeline projects in Louisiana,

Mississippi, and Alabama that had potential effects on Indian mounds, requiring on-site experts to monitor construction. Ms. Crouch also recently worked on an Environmental Assessment, including stakeholder involvement, for the Battleship Texas Dry Berth project, which included extensive coordination with the SHPO and compliance with the NHPA.

Donald Ator

Role: Economics, planning, and social effects
Affiliation: Independent Consultant

Mr. Ator is an independent consultant and economist with 34 years of demonstrated experience in public works planning, working with project teams to identify and evaluate measures and alternatives using appropriate planning methodologies to reduce life safety risk. He earned his M.S. in economics and agricultural economics and also has an MBA in finance and accounting from Louisiana State University. He has worked with 22 different USACE districts nationwide, as well as with the Bureau of Land Management, Bureau of Reclamation, and the Department of Commerce. He was the associate director and senior economist for the Gulf South Research Institute and project/program manager and senior economist at three private engineering firms. He has conducted more than 500 Civil Works projects that required the development of relevant and credible socioeconomic information and analysis, and performed the quality assurance review for all economic aspects of these projects. He is experienced in determining the scope and appropriate methodologies for impact assessment and analyses for a variety of projects and programs with high public and interagency interests, including Economic Evaluation of Benefits from Beneficial Use Disposal Alternatives of Dredged Material for Consistency with State of Texas Coastal Management Plan, Texas (USACE, Galveston District); Missouri River Authorized Purposes Study (MRAPS) Project Management Plan (USACE, Omaha and Kansas City Districts); and the Municipal and Industrial Water Use Forecast, Southwest Florida Feasibility Study, Florida (USACE, Jacksonville District).

Mr. Ator's experience has made him intimately familiar with the USACE plan formulation process, procedures, and standards as they relate to flood risk management. He has demonstrated proficiency in the USACE six-step planning process as evidenced by development of a template for preparing Project Management Plans for feasibility studies for USACE Regional Planning and Environment Division South, Mississippi Valley Division in 2011 and field testing the template in 2012. Most recently he worked with the USACE New Orleans District Project Delivery Team to develop the Project Management Plan for the West Shore Lake Pontchartrain Flood and Storm Damage Risk Reduction Project. In 2010 Mr. Ator served as a team leader while embedded in the Plan Formulation Branch USACE New Orleans District directing plan formulation activities of three plan formulators and providing project oversight and review to ensure compliance with USACE guidelines.

Mr. Ator is familiar with the USACE structural flood risk management analysis and economic benefit calculations and standard USACE computer programs, including HEC-FDA. He has conducted structure inventory surveys for flood damage reduction studies, developed content-to-structure value relationships for urban flood control economic analyses, and has prepared Section 905(b) flood damage reduction and ecosystem restoration reconnaissance reports. A majority of the projects he has conducted have required use of the HEC-FDA computer program. He attended a USACE-sponsored workshop on the model certified version of HEC-FDA in March of 2010 hosted by the Mississippi Valley Division. His related project experience includes the Structure and Content Depth Damage Relationship Surveys, Ouachita Parish, Louisiana (USACE, Vicksburg District); the Development of Content to Structure Value

Relationships for Urban Flood Control Economic Analysis, Cypress Creek, Texas (USACE, Galveston District.); and the Orleans Parish, Louisiana, Urban Flood Control Feasibility Study, Structure Inventory (USACE, New Orleans District).

Mr. Ator's experience with National Economic Development analysis procedures, particularly as they relate to flood risk management, includes serving as a team leader in 2010 while embedded in the Plan Formulation Branch (USACE, New Orleans District). His responsibilities included directing plan formulation activities, and providing project oversight and review to ensure compliance with USACE guidelines. In this capacity he worked closely with Project Delivery Teams to identify and evaluate measures and alternatives using appropriate planning methodologies on 13 projects to reduce life safety risk, all of which included a combination of flood risk management, life loss probability analysis, population at risk, residual risk, and vulnerability analysis. For example, Mr. Ator's work on the Greens Bayou Residual Flood Plain Properties Buyout Analysis, Texas (USACE, Galveston District) included flood risk management, population at risk, residual risk, and vulnerability analysis. In addition, the Donaldsonville to the Gulf - Flood Damage Risk Reduction Feasibility Study, Louisiana (USACE, New Orleans District) included flood risk management, life loss probability analysis, population at risk, residual risk, and vulnerability analysis.

In Mr. Ator's 34 years of experience, he has worked on social effects evaluation of large Civil Works projects for hundreds of NEPA compliance documents, including experience with community cohesion/identity, cultural and historical value, low income population, economic vitality of the community, and vulnerability of the population. For example, he contributed to a social impact assessment for the Little Colorado River in Holbrook, Arizona (USACE, Los Angeles District) and an environmental impact statement for U.S. Navy Home Porting Projects (USACE, Galveston District), both of which dealt with community cohesion and identity. His work on the Historic American Building Survey Documentation for the Perry Creek Flood Control Project in Sioux City, Iowa (USACE, Omaha District) and on screening the cultural and historic features at the Di-Lane Plantation, Georgia (USACE, Savannah District) illustrates his experience with evaluating cultural and historical value. He gained experience working with low-income populations through assessing the socioeconomic impacts from flooding and flood control measures in the Yazoo Delta, Mississippi (USACE, Vicksburg District) and through the development of an initial job training program for the Community Impact Mitigation Plan for the Inner Harbor Navigation Canal Lock in New Orleans, Louisiana (USACE, New Orleans District). Mr. Ator has experience with the economic vitality of the community through working on the Memphis Riverfront Development Project (USACE, Memphis District) and on an analysis of economic development benefits from the construction of a floodwall and levee system along the Greenbrier River and Knapp Creek in Marlinton, West Virginia (USACE, Huntington District). Finally, he is familiar with the vulnerability of the population through his work on a social impact assessment for the Kissimmee River Upper Basin Restoration Project (USACE, Jacksonville District) and from the Environmental Impact Statement for the proposed widening of the Pascagoula Lower Sound/Bayou Casotte Channel (USACE, Mobile District).

APPENDIX C

Final Charge to the IEPR Submitted to USACE on June 16, 2014 for the Princeville Project

Charge Questions and Guidance to the Panel Members for the IEPR of the Princeville, North Carolina Flood Risk Management Feasibility Study Integrated Feasibility Report and Environmental Assessment

BACKGROUND

The Town of Princeville, North Carolina is the first municipality in the United States incorporated by and for former slaves. Freed slaves were given low-lying land in the Tar River floodplain at the end of the Civil War and eventually incorporated the town in 1885. While the Town of Princeville was built on low ground, the Town of Tarboro is sited on the opposite side of the river on much higher ground. Because of its low-lying location, the Town of Princeville experienced flood damages on numerous occasions since its founding.

Today, the Town of Princeville remains over 97 percent African-American. Approximately 40 percent of the population is over 55 years old. Per capita income for Princeville is approximately $12,600, which is 32.6 percent of the national average of $38,611. The average structure value is $56,600, which is 47 percent of the national average of $119,600. Approximately 2,000 residents are currently exposed to public/life safety issues associated with flood risk.

In 1967, the U.S. Army Corps of Engineers (USACE) constructed a levee along the Tar River to address the frequent and severe flooding. After construction of the levee the Town of Princeville did not suffer from severe flooding again until 1999 when there was catastrophic flooding as a result of Hurricane Floyd (greater than 0.2 percent-annual-chance flood event), and a loss of nearly all 1,000 residential structures. Floodwaters initially entered the damage area through a number of ungated culverts under a section of U.S. Highway 64. As the flood event worsened, the existing project was then circumvented at its north end and the remaining portions of Town were inundated. Up to 20 feet of water stood in the Town of Princeville for nearly 10 days until river levels subsided enough that the floodwaters could be pumped back into the river.

As a result of the catastrophic flooding and historical significance of the Town of Princeville, President Clinton issued Executive Order 13146, which established a President's Council on the Future of Princeville, North Carolina. The executive order directed the President's Interagency Council as follows:

> In consideration of Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-income Populations," Federal agencies are also required to consider potential disproportional adverse effects or denial of potential benefits of Federal policies and programs to communities such as Princeville.

Numerous heavily damaged structures of historical value were demolished under cleanup requirements and only four structures remain eligible for the National Register of Historic Places and one baptismal site is considered eligible as a Traditional Cultural Property. The Town of Princeville turned down a buyout offer from the Federal Emergency Management Agency (FEMA) because of the adverse social,

economic, and cultural impacts that would likely occur as a result. Many homeowners obtained second mortgages to rebuild.

Numerous Federal agencies including FEMA, the U.S. Department of Housing and Urban Development, the U.S. Small Business Administration, the U.S. Department of Agriculture, and the U.S. Department of Labor provided millions of dollars for recovery and reconstruction of the town.

USACE was authorized to prepare a feasibility study to address flood risk management issues and funds were provided in 2001. USACE and the State of North Carolina signed a feasibility cost sharing agreement in July 2002, and the State of North Carolina has provided matching funding.

The tentatively selected plan (TSP) includes measures to extend the existing levee and raise U.S. Highway 258 and Shiloh Farm Road north of the Town of Princeville to create a barrier to circumvention of the existing levee, as well as ramping residential, farm, and commercial driveways and subdivision streets to meet the new elevation. An earthen "shoulder levee" would be added along the east side of U.S. Highway 64 on the southwest side of the Town of Princeville to prevent overtopping at that location. In addition, the TSP includes modification and raising of the U.S. Highway 64/N.C. Highway 33 interchange, installation of backflow devices (flap gates) to culverts through existing embankments, raising nine structures outside the proposed levee footprint, and implementing interior drainage improvements to ensure proper routing of flow on the back side of the levee system. The TSP also includes non-structural measures consisting of an updated flood warning and evacuation plan, continued floodplain management and updating of local building and zoning codes, a flood risk management education and communication plan for both the community and local schools, and flood warning measures, all of which were ultimately deemed essential to an adequate flood risk management strategy for the Town of Princeville. The estimated cost of the TSP is $21.1M.

OBJECTIVES

The objective of this work is to conduct an independent external peer review (IEPR) for the Princeville, North Carolina Flood Risk Management Feasibility Study Integrated Feasibility Report and Environmental Assessment (hereinafter: Princeville IEPR) in accordance with the Department of the Army, USACE, Water Resources Policies and Authorities' *Civil Works Review* (Engineer Circular [EC] 1165-2-214, December 15, 2012), and the Office of Management and Budget's *Final Information Quality Bulletin for Peer Review* (December 16, 2004).

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

The purpose of the IEPR is to assess the "adequacy and acceptability of the economic, engineering, and environmental methods, models, and analyses used" (EC 1165-2-214; p. D-4) for the Princeville IEPR documents. The IEPR will be limited to technical review and will not involve policy review. The IEPR will be conducted by subject matter experts (i.e., IEPR panel members) with extensive experience in civil/structural engineering, geotechnical engineering, hydrologic and hydraulic engineering, biology/ecology/social effects, and economic/planning issues relevant to the project. They will also have experience applying their subject matter expertise to flood risk management.

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

DOCUMENTS PROVIDED

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

Documents for Review

The following documents are to be reviewed by designated discipline:

Title	Approx. No. of Pages	Required Disciplines
Integrated Feasibility Study Report and Environmental Assessment	300	All Disciplines
Hydrology and Hydraulics	120	H&H Engineering; Geotechnical Engineering
Design	25	All Disciplines
Geotechnical	35 (plus 223 pages of figures, boring logs, models, etc.)	Geotechnical Engineering; H&H Engineering
Cost Engineering	30	All Disciplines
Real Estate	30	Economics/Planning; Biology/Ecology/Social Effects
Economics	40	Economics/Planning; Biology/Ecology/Social Effects
Other Social Effects	100	Economics/Planning; Biology/Ecology/Social Effects
Public Comments	50	All Disciplines
Total Page Count	**730**	

Documents for Reference

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

SCHEDULE

This final schedule is based on the May 19, 2014, receipt of the final review documents.

Task	Action	Due Date
Conduct Peer Review	Battelle sends review documents to panel members	6/16/2014
	Battelle convenes kick-off meeting with panel members	6/18/2014
	Battelle convenes kick-off meeting with USACE and panel members	6/18/2014
	Battelle convenes mid-review teleconference for panel members to ask clarifying questions of USACE	7/26/2014
	Panel members complete their individual reviews	7/8/2014
Prepare Final Panel Comments and Final IEPR Report	Battelle provides panel members with talking points for Panel Review Teleconference	7/14/2014
	Battelle convenes Panel Review Teleconference	7/14/2014
	Battelle provides Final Panel Comment templates and instructions to panel members	7/15/2014
	Panel members provide draft Final Panel Comments to Battelle	7/22/2014
	Battelle provides feedback to panel members on draft Final Panel Comments; panel members revise Final Panel Comments	7/23-7/30/2015
	Battelle finalizes Final Panel Comments	7/31/2014
	Battelle provides Final IEPR Report to panel members for review	8/4/2014
	Panel members provide comments on Final IEPR Report	8/5/2014
	*Battelle submits Final IEPR Report to USACE	8/7/2014
Comment/ Response Process	Battelle inputs Final Panel Comments to DrChecks and provides Final Panel Comment response template to USACE	8/11/2014
	Battelle convenes teleconference with Panel to review the Post-Final Panel Comment Response Process	8/11/2014
	USACE provides draft Project Delivery Team (PDT) Evaluator Responses to Battelle	8/14/2014
	Battelle provides the panel members the draft PDT Evaluator Responses	8/15/2014
	Panel members provide Battelle with draft BackCheck Responses	8/20/2014
	Battelle convenes teleconference with panel members to discuss draft BackCheck Responses	8/21/2014
	Battelle convenes Comment-Response Teleconference with panel members and USACE	8/22/2014
	USACE inputs final PDT Evaluator Responses to DrChecks	8/26/2014
	Battelle provides final PDT Evaluator Responses to panel members	8/28/2014

Task	Action	Due Date
	Panel members provide Battelle with final BackCheck Responses	9/2/2014
	Battelle inputs the panel members' final BackCheck Responses to DrChecks	9/3/2014
	Battelle submits pdf printout of DrChecks project file	9/4/2014
Civil Works Review Board (CWRB)	Panel prepares and/or reviews slides for CWRB	3/2015
	Civil Works Review Board	4/2015

* Deliverables

CHARGE FOR PEER REVIEW

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

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

General Charge Guidance

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

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

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

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

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

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

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

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

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

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

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

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

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

Please submit your comments in electronic form to Dick Uhler, uhlerr@battelle.org, no later than July 8, 2014, 10 pm ET.

IEPR of the Princeville, North Carolina Flood Risk Management Feasibility Study Integrated Feasibility Report and Environmental Assessment

CHARGE QUESTIONS AND RELEVANT SECTIONS AS SUPPLIED BY USACE

1. Were all models used in the analyses, including the models assessing the hazards, used in an appropriate manner?

2. Are the assumptions that underlie the various analyses sound?

3. Have risks and uncertainties been sufficiently considered?

4. Are potential life safety issues accurately and adequately described under existing, future without-project, and future with-project conditions?

5. Is the quality and quantity of the surveys, investigations, and engineering sufficient for a concept design?

6. Are the assumptions made for the hazards appropriate, as well as the models used to assess them?

7. Does the analysis adequately address the uncertainty and residual risk, given the consequences associated with the potential for loss of life for this type of project?

8. In your opinion, does the report clearly present the study background and context in a manner that explains to the reader the reasons for determination of Federal interest based upon Other Social Effects and not positive benefit-to-cost calculations?

Problem, Opportunities, Objectives, and Constraints

9. Are the problems, opportunities, objectives, and constraints adequately and correctly defined? Are there any gaps or overstatements?

10. Do the identified problems, opportunities, objectives, and constraints reflect a systems, watershed, and/or ecosystem approach, addressing a geographic area large enough to ensure that plans address the cause-and-effect relationships among affected resources and activities that are pertinent to achieving the study objectives; i.e., evaluate the resources and related demands as a system?

11. In describing the criteria, goals, and objectives of the study, were the resources and issues important to the decision-making process clearly identified? Did the study address those resources and issues?

Existing and Future Without Project Resources

12. Has the character and scope of the study area been adequately described and is the identified study area appropriate in terms of undertaking a watershed based investigation?

13. Do you agree with the general analyses of the existing social, financial, and natural resources within the study area?

14. For your particular area of expertise, provide an in-depth review of whether the analyses of the existing social, financial, and natural resources within the project area are sufficient to support the estimation of impacts of the array of alternatives.

15. Given your area of expertise, does the documentation appropriately address the existing conditions of all resources pertinent to the study?

16. Was the hydrology discussion sufficient to characterize current baseline conditions and to allow for evaluation of how forecasted conditions (with and without proposed actions) are likely to affect hydrologic conditions? Is the discussion of the relationship between subsurface hydrology and the hydrodynamics of the project area complete?

17. Was the discussion of natural resources sufficient to characterize current baseline conditions and to allow for evaluation of forecasted conditions (with and without proposed actions)?

18. Were the assumptions used as the basis for developing the most probable future without-project conditions reasonable? Were the potential effects of climate change addressed?

19. Are the future conditions expected to exist in the absence of a Federal project logical and adequately described and documented?

20. Please comment on the conclusion of the most probable future without-project condition. Do you envision other potential probable outcomes?

Plan Formulation/Alternative Development

21. Does the report adequately describe the methodology behind development of the existing array of possible measures and alternatives?

22. Did the formulation process follow the requirement to avoid, minimize, and then mitigate adverse impacts on resources?

23. Were the assumptions made for use in developing the future with-project conditions for each alternative reasonable?

24. Does each alternative meet the formulation criteria of being effective, efficient, complete, and acceptable?

25. Are the changes between the without- and with-project conditions adequately described for each alternative?

26. Is there sufficient information presented to identify, explain, and comment on the assumptions that underlie the engineering analyses?

27. Are future Operation, Maintenance, Repair, Replacement, and Rehabilitation efforts adequately described and are the estimated costs of those efforts reasonable for each alternative?

28. Were the engineering, economic, and environmental analyses used for this study consistent with generally accepted methodologies? Are cumulative impacts adequately described and discussed? If not, please explain.

29. Does any alternative include identified separable elements (a portion of a project that is physically separable, and produces hydrologic effects or physical or economic benefits that are separately identifiable from those produced by other portions of the project)? If so, is each identified separable element independently justified and are the benefits, costs, and effects of the separable elements correctly divided?

Recommended Plan

30. Was the explanation for selecting a plan with a benefit-to-cost ratio of less than unity adequately explained?

31. Comment on whether the recommended plan meets the study objectives and avoids violating the study constraints? Are there any unmitigated environmental impacts not identified?

32. Please comment on the likelihood that the recommended plan achieves the expected outputs.

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

34. Are residual risks adequately described and is there a sufficient plan for communicating the residual risk to affected populations?

Summary Questions

35. Please identify the most critical concerns (up to five) you have with the project and/or review documents.

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

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