Final Independent External Peer Review Report City of Norfolk, Virginia, Coastal Storm Risk Management Feasibility Study, North Atlantic Coast Comprehensive Study Focus Area

Prepared by
Battelle Memorial Institute

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

Contract No. W912HQ-15-D-0001
Task Order: W912HQ18F0001

February 6, 2018

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It can be done

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Executive Summary

PROJECT BACKGROUND AND PURPOSE

Historical storms, including Hurricane Sandy, have impacted the City of Norfolk. In response, the U.S. Army Corps of Engineers (USACE) is investigating solutions that will reduce future coastal storm risk in ways that support the long-term resilience and sustainability of the coastal ecosystem and surrounding communities, and reduce the economic costs and risks associated with large-scale flood and storm events. In support of this goal, USACE completed the North Atlantic Coast Comprehensive Study (NACCS), which identified nine high-risk areas on the Atlantic coast for an in-depth analysis based on preliminary analyses. Norfolk has been identified as one of these nine areas of high risk, or Focus Areas, that warrants an in-depth investigation into potential coastal storm risk management solutions. The Norfolk Focus Area is located on the Chesapeake Bay, a location that has been identified as one of the highest risk areas for relative sea level rise in the country.

The City of Norfolk, Virginia, Coastal Storm Risk Management (CSRM) Feasibility Study is a comprehensive investigation of coastal storm risk management problems and solutions in the City of Norfolk. The study considers past, current, and future coastal storm risk management and resilience planning initiatives and projects under way by the non-Federal sponsor, the City of Norfolk, USACE, and other Federal, state, and local agencies. This study was authorized by Resolution of the Senate Committee on Environment and Public Works dated July 25, 2012:

> "Resolved by the Committee on Environment and Public Works of the United States Senate, that the Secretary of the Army is requested to review the report of the Chief of Engineers on beach erosion and hurricane protection for Norfolk, VA, dated April 17, 1984, and other pertinent reports, to include existing flood risk management studies and engineering reports to determine whether any modifications of the recommendations contained therein are advisable in the interest of flood damage reduction in the vicinity of Norfolk, VA."

The study is not expected to be challenging, with one exception: a large study area will likely result in a large array of different project alternatives that are expected to vary across different areas of the city. The City of Norfolk is bordered by the Chesapeake Bay to the north and the Elizabeth River to the west; in addition, other, smaller creeks and bodies of water occur within the city limits, which leads to varying coastal risk across the city. A holistic/systems approach will be used to mesh various measures into one cohesive and comprehensive plan, but this will likely be accomplished only after technical and political challenges are met.

The City of Norfolk has been identified as one of the Atlantic Coast communities most vulnerable to the effects of relative sea level rise, the combined effect of land subsidence and sea level rise. Per Engineer

Regulation (ER) 1100-2-8162, Incorporating Sea Level Change in Civil Works Programs, USACE evaluates three sea-level-rise scenarios as part of the planning process, and additional relative sea level rise estimates have been completed by various academic institutions and government agencies available for the study area, but there is no single projection of relative sea level rise that can be used to guarantee that a coastal storm risk management project will remain effective throughout the entire 50-year period of analysis. As a result, the recommended project must be adaptable in order to remain effective throughout the period of analysis.

Implementation of a coastal storm risk management project could potentially reduce flood-related risks to human life/safety; however, the recommended project will be selected based on economic analysis in combination with other considerations, such as whether the project is acceptable, feasible from an engineering standpoint, and complete. The overall study will focus on coastal storm risk management measures along with comprehensive solutions across multiple disciplines, including, but not limited to, relocation, fortification, living shorelines, natural and nature-based infrastructure, beach nourishment, bulkheads, storm surge barriers, and hardened structures. Non-performance or design exceedance of these measures may result in risks to life safety.

The project is not expected to involve significant public dispute as to the size, nature, or effects of the project. The City of Norfolk, its residents, and stakeholders recognize the need for the study as a way to address the coastal flooding that has been affecting the city more significantly every year, and thus support the study and are anticipating the recommended project.

The City of Norfolk CSRM Feasibility Study has been developed to reflect USACE's modernized planning initiative, in which project studies use a risk-informed assessment, generally with only enough detail developed for each alternative to allow relative comparison, to determine the appropriate information to identify a Tentatively Selected Plan (TSP). Although this new process has altered the milestones and evaluation procedures in a feasibility study, the manner in which alternatives are developed from problems, opportunities, measures, and constraints remains the same.

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 City of Norfolk, Virginia, CSRM Feasibility Study, North Atlantic Coast Comprehensive Study (NACCS) Focus Area (hereinafter: Norfolk CSRM IEPR). As a 501(c)(3) non-profit science and technology organization, Battelle is independent, 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 this IEPR. 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 decision documents and the overall scope of the project, Battelle identified potential candidates for the Panel in the following key technical areas: Civil Works planning/ economics, biological resources and environmental law compliance, coastal/hydrology and hydraulic engineering, structural engineering, geotechnical engineering, and civil engineering/risk review. Battelle

screened the candidates to identify those most closely meeting the selection criteria and evaluated them for COIs and availability. USACE was given the list of all the final candidates to independently confirm that they had no COIs, and Battelle made the final selection of the six-person Panel from this list.

The Panel received electronic versions of the decision documents (1,621 pages in total), along with a charge that solicited comments on specific sections of the documents to be reviewed. Following guidance provided in USACE (2012a) and OMB (2004), USACE prepared the charge questions, 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 at 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.

IEPR panel members reviewed the decision documents individually and produced individual comments in response to the charge questions. 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.

Battelle received public comments from USACE on the Norfolk CSRM (approximately 210 pages of written comments from the public and Federal and state agencies) and provided them to the IEPR panel members. The panel members were charged with determining if any information or concerns presented in the public comments raised any additional discipline-specific technical concerns regarding the Norfolk CSRM review documents. After completing its review, the Panel identified one new issue (Final Panel Comment 23) and subsequently generated one Final Panel Comment that summarized the concern.

Overall, 29 Final Panel Comments were identified and documented. Of these, two were identified as having high significance, four had medium/high significance, 12 had a medium significance, six had medium/low significance, and five had 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 Norfolk CSRM 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 decision documents clearly represent a great deal of effort and reflect high attention to detail when developing the economic analyses and geotechnical design. It is a well thought out comprehensive study aimed at reducing coastal storm risk and associated problems in the City of Norfolk coastal community. However, the Panel identified several areas of the report where additional analysis, required by the National Environmental Policy Act (NEPA), is warranted and places where clarification of project decisions, findings, and actions need to be documented or revised.

Economics: While most of the economic assumptions are reasonable and acceptable, no consideration is given to the incentive for study area residents and businesses to act in their own self-interest should

there be an absence of Federal action. At least some portion of the population affected by increasing frequency of damaging events will react by either protecting themselves at their own expense or simply abandoning the assets when it becomes cost effective to do so. While estimating this impact is not always easy, it is a reasonable consideration that should be included in the future without project conditions alternative (also known as the No Action alternative).

The Panel also found that key economic measures, including the benefit exceedance probability relationship and project performance by reach, are absent from the document and are needed to assess the justification for choosing the TSP. More information is also needed to explain why damage data collected from the New Orleans, Louisiana area are representative of potential damage in Norfolk, Virginia. Given the geographical differences in locality, it is not directly evident why the impacts would be similar. Providing additional data on these issues will strengthen the economic analysis.

Engineering: The Panel is concerned that the decision to use the NACCS 50 percent confidence interval (CI) data set may have been driven by a desire to avoid a design water surface elevation that is considered higher than reasonable and that would result in higher cost rather than based on the application of risk-based decision points. This may have been bolstered by a belief that the risk associated with the judgment to use the 50 percent CI data would be reduced by an adaptive management approach. However, the Panel also noted that the design alternatives do not appear to consider future adaptive management strategies that may require replacement of I-walls if sea level rise is higher than predicted.

For adequate structural design of floodwalls, all the potential basic load cases and associated load combinations typically encountered during a hurricane storm event are critical and should be included in the structural design calculations. At this time, some of these basic load cases and their load combinations have not been assessed. In addition, important foundation design issues, such as piping (seepage erosion), scouring on the protected side of the floodwall, soil heave, and soil settlement, which are critical in adequate foundation design and overall stability of the floodwalls, are not discussed in the Draft Feasibility Study. The Panel recognizes that the PDT did follow Engineer Manual (EM) 1110-2-2502 (September 1989) as required by USACE policy. However, based on more recent hurricane damage, USACE and other agencies have recognized the need for additional assessments not required by EM 1110-2-2502. The Panel suggests that the USACE New Orleans District's *"Hurricane and Storm Damage Risk Reduction System Design Guidelines"* (USACE, 2012b) is an excellent reference document that outlines the latest design criteria, analysis methods, critical load cases, and load combinations to consider in structural design to ensure the design of floodwalls will be adequate.

The Panel noted that there is insufficient detail on wave overtopping and wave force calculations and assumptions made within the calculations and analyses to determine the reasonableness of the results. There is also insufficient detail to understand how additional modeling in the pre-construction engineering and design (PED) phase will evaluate how the TSP structures will interact with water levels and waves from a NACCS storm suite of 1,050 synthetic tropical storms and 100 extra-tropical storms.

Environmental: The Panel is concerned about the lack of environmental impact analyses and results included in the Draft Feasibility Study and appendices. Based on the limited information provided, it appears that items required by NEPA were not addressed. For example, assessment of environmental short- and long-term impacts on numerous resources identified in the description of the existing environment appear underestimated or possibly were omitted from the documentation. Conclusions reached in the environmental analyses about cumulative effects appear to be based only on issues

related to the TSP and to the No Action alternative and do not consider either past, present, and reasonably foreseeable future actions as required by NEPA or a systemic approach. Mitigation measures compensating for or reducing environmental effects are potentially inadequate or absent. The environmental justice analysis lacks sufficient detail on access to the non-structural measures. All these items are commonly required by NEPA, but do not appear to be sufficiently covered by the document.

In addition, the estimates of impacts on wetlands and other aquatic resources presented in the Draft Feasibility Study were based on 2017 National Wetlands Inventory (NWI) maps produced by the U.S. Fish and Wildlife Service (USFWS). The NWI maps are described in the Draft Feasibility Study and Appendix D as being used to identify both sizes and types of wetlands that may be affected by the TSP. While this resource is adequate for comparative purposes to assist in determining the relative impacts associated with each measure described in the array of alternatives, the maps are known to be highly inaccurate (40 to 50 percent) and are not generally used to determine mitigation requirements or to evaluate the function and value of wetlands and other aquatic resources. The Panel is also concerned about the ambiguity over the potential presence of contaminated soil/sediment, creating uncertainty in the project cost estimate, environmental effects analysis, schedule, and public health and safety risk. Providing additional details on the short- and long-term impacts, cumulative effects, actual wetlands present in the area, and the potential presence of contaminated soil/sediment will strengthen the Draft Feasibility Study's compliancy with NEPA.

Plan Formulation: The Panel recognizes that this is a very large and complex project. Based on that, they are concerned that during plan formulation, the amount of time and staffing required to close all 84 gates in advance of incoming storm surge may not have been taken into consideration when compiling the TSP. The Panel suggests that an analysis be performed to determine the duration needed by the non-Federal sponsor to effect closure of the line-of-protection in advance of storm surge, considering factors such as the number of staff typically available in advance of an emergency to close gates, the time required to actually close each type of gate, the time of transportation between gates accounting for weather delays, any specialized transportation or equipment required (i.e., boats), and any lessons learned on how often gate closure is prolonged by mechanical or other complications.

Table ES-1. Overview of the 29 Final Panel Comments Identified by the Norfolk CSRM IEPR Panel

No.	Final Panel Comment
Significance – High	
1	The planning and economic assumptions do not consider the potential for residents and businesses to act on their own to reduce their risks from future sea level change.
2	The risk associated with using the NACCS 50 percent CI data set adds uncertainty to the potential effectiveness of the project.
Significance – Medium/High	
3	Key measures, including the benefit exceedance probability relationship and project performance by reach, are absent from Appendix C, but are critical to establishing confidence in whether the project will perform as planned.
4	The structural analysis of T-walls does not take into consideration all potential combinations of loads that could occur during tropical and extra-tropical storms.
5	Foundation design issues such as piping (seepage erosion), scouring on the protected side of the floodwall, soil heave, and soil settlement are not addressed in Appendix B.
6	The evaluation of design alternatives does not appear to consider adaptive management strategies if sea level rise is higher than predicted.
Significance – Medium	
7	The review documents do not address the time required to close all 84 gates in advance of incoming storm surge.
8	Conclusions reached in the environmental analyses about cumulative effects appear to be based only on issues related to the TSP and to the No Action alternative and do not consider past, present, and reasonably foreseeable future actions as required by NEPA and do not consider a systemic approach.
9	The estimates of potential impacts on wetlands and other aquatic resources based on NWI mapping may be inaccurate.
10	The environmental justice analysis, which has implications for NEPA compliance, lacks sufficient detail on access to the non-structural measures.

Table ES-1. Overview of the 29 Final Panel Comments Identified by the Norfolk CSRM IEPR Panel (continued)

No.	Final Panel Comment
11	Short- and long-term impacts on numerous environmental resources identified in the description of the existing environment may be underestimated, or they may be omitted from the documentation.
12	The review documents are ambiguous about the potential presence of contaminated soil/sediment, creating uncertainty in the project cost estimate, environmental effects analysis, schedule, and public health and safety risk.
13	The treatment of utilities in the report increases the project uncertainty regarding cost and non-Federal sponsor Lands, Easements, Rights-of-Way, Relocations, and Disposal Areas (LERRDs).
14	It is not clear from the utility data descriptions and residual risk evaluations whether any utilities will penetrate through or beneath a floodwall, potentially resulting in a weak point in a flood control system.
15	There is insufficient detail on wave overtopping and wave force calculations and assumptions made in the calculations and analyses to determine the reasonableness of the results.
16	There is insufficient detail to understand how additional modeling in the PED phase will evaluate how the TSP structures will interact with water levels and waves from a NACCS storm suite of 1,050 synthetic tropical storms and 100 extra-tropical storms.
17	The documentation does not justify the wave parameters (heights and periods) selected for application in the wave overtopping and wave force calculations.
18	The current design of the project includes extensive floodwall lengths between gates without pedestrian access and traffic passage, but does not address their impact on commerce, recreational access, emergency egress, emergency response, community connectivity, and overall environment.
Significance – Medium/Low	
19	Appendix C does not explain how debris management and depth damage data collected in New Orleans, LA are representative of conditions in Norfolk, VA.
20	References to sea level rise and land subsidence data sources and use of sea level rise and relative sea level rise terminology are inconsistent in the study documents.

Table ES-1. Overview of the 29 Final Panel Comments Identified by the Norfolk CSRM IEPR Panel (continued)

No.	Final Panel Comment
21	The NACCS water level values presented in Table 2.1 of Appendix B, Hydraulics, Hydrology, and Coastal Sub-Appendix do not match the values available from the NACCS Coastal Hazards System (CHS) Web Portal.
22	The mitigation plan and proposed design of Nature and Nature-Based Features lack sufficient detail and justification, and mitigation for many other environmental effects is omitted from the Draft Feasibility Study.
23	During its review of the public comments, the Panel noted the Draft Feasibility Study provides no justification for why the “daylight historic creeks” measure is not carried forward in the screening process as a viable measure.
24	The presentation of pump station back-up generators is inconsistent in the review documents.
Significance – Low	
25	The estimated costs of monitoring vibrations from construction operations and pile driving to prevent direct and indirect damage to nearby structures may be underestimated.
26	Inconsistent berm/levee cross-section designs have been described in the Draft Feasibility Study and Appendices, which could affect the reported cost estimates.
27	The document lacks a clear and detailed description of the future without project conditions.
28	The number of iterations executed in the HEC-FDA analysis has not been explained in sufficient detail.
29	The process used to identify and delineate economic reaches has not been discussed in Appendix C.

Table of Contents

Page

Executive Summary i

1. INTRODUCTION 1

2. PURPOSE OF THE IEPR 2

3. METHODS FOR CONDUCTING THE IEPR 3

4. RESULTS OF THE IEPR 3

   4.1 Summary of Final Panel Comments 3

   4.2 Final Panel Comments 5

5. REFERENCES 46

Appendix A. IEPR Process for the Norfolk CSRM Project

Appendix B. Identification and Selection of IEPR Panel Members for the Norfolk CSRM Project

Appendix C. Final Charge for the Norfolk CSRM IEPR

Appendix D. Conflict of Interest Form

List of Tables

Page

Table ES-1. Overview of the 29 Final Panel Comments Identified by the Norfolk CSRM IEPR Panel. vi

LIST OF ACRONYMS

ADM	Agency Decision Milestone
ATR	Agency Technical Review
CI	Confidence Interval
CHS	Coastal Hazard System
COI	Conflict of Interest
CSRM	Coastal Storm Risk Management
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
HEC-FDA	Hydrologic Engineering Center Flood Damage Reduction Analysis
HTRW	Hazardous, Toxic, Radioactive Waste
IEPR	Independent External Peer Review
IWR	Institute for Water Resources
LERRDs	Lands, Easements, Rights-of-Way, Relocations, and Disposal Areas
NACCS	North Atlantic Coast Comprehensive Study
NED	National Economic Development
NEPA	National Environmental Policy Act
NWI	National Wetland Inventory
O&M	Operation and Maintenance
OEO	Outside Eligible Organization
OMB	Office of Management and Budget
OMRR&R	Operation, Maintenance, Repair, Rehabilitation & Replacement
PDT	Project Delivery Team
PED	Pre-Construction Engineering and Design
RCRA	Resource Conservation and Recovery Act
RSLR	Relative Sea Level Rise
SAV	Submerged Aquatic Vegetation
SLR	Sea Level Rise
TSP	Tentatively Selected Plan
USACE	United States Army Corps of Engineers
USFWS	United States Fish and Wildlife Service
WTP	Water Treatment Plant

1. INTRODUCTION

Historical storms, including Hurricane Sandy, have impacted the City of Norfolk. In response, the U.S. Army Corps of Engineers (USACE) is investigating solutions that will reduce future coastal storm risk in ways that support the long-term resilience and sustainability of the coastal ecosystem and surrounding communities, and reduce the economic costs and risks associated with large-scale flood and storm events. In support of this goal, USACE completed the North Atlantic Coast Comprehensive Study (NACCS), which identified nine high-risk areas on the Atlantic coast for an in-depth analysis based on preliminary analyses. Norfolk has been identified as one of these nine areas of high risk, or Focus Areas, that warrants an in-depth investigation into potential coastal storm risk management solutions. The Norfolk Focus Area is located on the Chesapeake Bay, a location that has been identified as one of the highest risk areas for relative sea level rise in the country.

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The study is not expected to be challenging, with one exception: a large study area will likely result in a large array of different project alternatives that are expected to vary across different areas of the city. The City of Norfolk is bordered by the Chesapeake Bay to the north and the Elizabeth River to the west; in addition, other, smaller creeks and bodies of water occur within the city limits, which leads to varying coastal risk across the city. A holistic/systems approach will be used to mesh various measures into one cohesive and comprehensive plan, but this will likely be accomplished only after technical and political challenges are met.

The City of Norfolk has been identified as one of the Atlantic Coast communities most vulnerable to the effects of relative sea level rise, the combined effect of land subsidence and sea level rise. Per Engineer Regulation (ER) 1100-2-8162, Incorporating Sea Level Change in Civil Works Programs, USACE evaluates three sea-level-rise scenarios as part of the planning process, and additional relative sea level rise estimates have been completed by various academic institutions and government agencies available for the study area, but there is no single projection of relative sea level rise that can be used to guarantee that a coastal storm risk management project will remain effective throughout the entire 50-year period of analysis. As a result, the recommended project must be adaptable in order to remain effective throughout the period of analysis.

Implementation of a coastal storm risk management project could potentially reduce flood-related risks to human life/safety; however, the recommended project will be selected based on economic analysis in combination with other considerations, such as whether the project is acceptable, feasible from an

engineering standpoint, and complete. The overall study will focus on coastal storm risk management measures along with comprehensive solutions across multiple disciplines, including, but not limited to, relocation, fortification, living shorelines, natural and nature-based infrastructure, beach nourishment, bulkheads, storm surge barriers, and hardened structures. Non-performance or design exceedance of these measures may result in risks to life safety.

The project is not expected to involve significant public dispute as to the size, nature, or effects of the project. The City of Norfolk, its residents, and stakeholders recognize the need for the study as a way to address the coastal flooding that has been affecting the city more significantly every year, and thus support the study and are anticipating the recommended project.

The City of Norfolk CSRM Feasibility Study has been developed to reflect USACE's modernized planning initiative, in which project studies use a risk-informed assessment, generally with only enough detail developed for each alternative to allow relative comparison, to determine the appropriate information to identify a Tentatively Selected Plan (TSP). Although this new process has altered the milestones and evaluation procedures in a feasibility study, the manner in which alternatives are developed from problems, opportunities, measures, and constraints remains the same.

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 City of Norfolk, Virginia, CSRM Feasibility Study, North Atlantic Coast Comprehensive Study (NACCS) Focus Area (hereinafter: Norfolk CSRM IEPR) in accordance with procedures described in the Department of the Army, USACE, Engineer Circular (EC) *Civil Works Review* (EC 1165-2-214) (USACE, 2012) and the Office of Management and Budget (OMB), *Final Information Quality Bulletin for Peer Review* (OMB, 2004). Supplemental guidance on evaluation for conflicts of interest (COIs) was obtained from the *Policy on Committee Composition and Balance and Conflicts of Interest for Committees Used in the Development of Reports* (The National Academies, 2003).

This final report presents the Final Panel Comments of the IEPR Panel (the Panel) on the existing engineering, economic, environmental, and plan formulation analyses contained in the Norfolk CSRM decision documents (Section 4). Appendix A describes in detail how the IEPR was planned and conducted, including the schedule followed in executing the IEPR. 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 in the final Work Plan according to the schedule listed in Table A-1. Appendix D presents the organizational conflict of interest form that Battelle completed and submitted to the Institute for Water Resources (IWR) prior to the award of the Norfolk CSRM IEPR.

2. PURPOSE OF THE IEPR

To ensure that USACE documents are supported by the best scientific and technical information, USACE has implemented a peer review process that uses IEPR to complement the Agency Technical Review (ATR), as described in USACE (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 Norfolk CSRM project was conducted and managed using contract support from Battelle, which is an Outside Eligible Organization (OEO) (as defined by EC 1165-2-214). Battelle, a 501(c)(3) organization under the U.S. Internal Revenue Code, has experience conducting IEPRs for USACE.

3. METHODS FOR CONDUCTING THE IEPR

The methods used to conduct the IEPR are briefly described in this section; a detailed description can be found in Appendix A. The IEPR was completed in accordance with established due dates for milestones and deliverables as part of the final Work Plan and are based on the award/effective date and the receipt of review documents.

Battelle identified, screened, and selected six panel members to participate in the IEPR based on their expertise in the following disciplines: Civil Works planning/economics, biological resources and environmental law compliance, coastal/hydrology and hydraulic engineering, structural engineering, geotechnical engineering, and civil engineering/risk review. The Panel reviewed the Norfolk CSRM documents and produced 29 Final Panel Comments in response to 16 charge questions provided by USACE for the review. This charge included two overview questions and one public comment question added by Battelle. 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 Norfolk CSRM IEPR review documents. The following summarizes the Panel's findings. Based on the Panel's review, the decision documents clearly represent a great deal of effort and reflect high attention to

detail when developing the economic analyses and geotechnical design. It is a well thought out comprehensive study aimed at reducing coastal storm risk and associated problems in the City of Norfolk coastal community. However, the Panel identified several areas of the report where additional analysis, required by the National Environmental Policy Act (NEPA), is warranted and places where clarification of project decisions, findings, and actions need to be documented or revised.

Economics: While most of the economic assumptions are reasonable and acceptable, no consideration is given to the incentive for study area residents and businesses to act in their own self-interest should there be an absence of Federal action. At least some portion of the population affected by increasing frequency of damaging events will react by either protecting themselves at their own expense or simply abandoning the assets when it becomes cost effective to do so. While estimating this impact is not always easy, it is a reasonable consideration that should be included in the future without project conditions alternative (also known as the No Action alternative).

The Panel also found that key economic measures, including the benefit exceedance probability relationship and project performance by reach, are absent from the document and are needed to assess the justification for choosing the TSP. More information is also needed to explain why damage data collected from the New Orleans, Louisiana area are representative of potential damage in Norfolk, Virginia. Given the geographical differences in locality, it is not directly evident why the impacts would be similar.

Engineering: The Panel is concerned that the decision to use the NACCS 50 percent confidence interval (CI) data set may have been driven by a desire to avoid a design water surface elevation that is considered higher than reasonable and that would result in higher cost rather than based on the application of risk-based decision points. This may have been bolstered by a belief that the risk associated with the judgment to use the 50 percent CI data would be reduced by an adaptive management approach. However, the Panel also noted that the design alternatives do not appear to consider future adaptive management strategies that may require replacement of I-walls if sea level rise is higher than predicted.

For adequate structural design of floodwalls, all the potential basic load cases and associated load combinations typically encountered during a hurricane storm event are critical and should be included in the structural design calculations. At this time, some of these basic load cases and their load combinations have not been assessed. In addition, important foundation design issues, such as piping (seepage erosion), scouring on the protected side of the floodwall, soil heave, and soil settlement, which are critical in adequate foundation design and overall stability of the floodwalls, are not discussed in the Draft Feasibility Study. The Panel recognizes that the PDT did follow Engineer Manual (EM) 1110-2-2502 (September 1989) as required by USACE policy. However, based on more recent hurricane damage, USACE and other agencies have recognized the need for additional assessments not required by EM 1110-2-2502. The Panel suggests that the USACE New Orleans District's "Hurricane and Storm Damage Risk Reduction System Design Guidelines" (USACE, 2012b) is an excellent reference document that outlines the latest design criteria, analysis methods, critical load cases, and load combinations to consider in structural design to ensure the design of floodwalls will be adequate.

The Panel noted that there is insufficient detail on wave overtopping and wave force calculations and assumptions made within the calculations and analyses to determine the reasonableness of the results. There is also insufficient detail to understand how additional modeling in the pre-construction engineering

and design (PED) phase will evaluate how the TSP structures will interact with water levels and waves from a NACCS storm suite of 1,050 synthetic tropical storms and 100 extra-tropical storms.

Environmental: The Panel is concerned about the lack of environmental impact analyses and results included in the Draft Feasibility Study and appendices. Based on the limited information provided, it appears that items required by NEPA were not addressed. For example, assessment of environmental short- and long-term impacts on numerous resources identified in the description of the existing environment appear underestimated or possibly were omitted from the documentation. Conclusions reached in the environmental analyses about cumulative effects appear to be based only on issues related to the TSP and to the No Action alternative and do not consider either past, present, and reasonably foreseeable future actions as required by NEPA or a systemic approach. Mitigation measures compensating for or reducing environmental effects are potentially inadequate or absent. The environmental justice analysis lacks sufficient detail on access to the non-structural measures. All these items are commonly required by NEPA, but do not appear to be sufficiently covered by the document.

In addition, the estimates of impacts on wetlands and other aquatic resources presented in the Draft Feasibility Study were based on 2017 National Wetlands Inventory (NWI) maps produced by the U.S. Fish and Wildlife Service (USFWS). The NWI maps are described in the Draft Feasibility Study and Appendix D as being used to identify both sizes and types of wetlands that may be affected by the TSP. While this resource is adequate for comparative purposes to assist in determining the relative impacts associated with each measure described in the array of alternatives, the maps are known to be highly inaccurate (40 to 50 percent) and are not generally used to determine mitigation requirements or to evaluate the function and value of wetlands and other aquatic resources. The Panel is also concerned about the ambiguity over the potential presence of contaminated soil/sediment, creating uncertainty in the project cost estimate, environmental effects analysis, schedule, and public health and safety risk.

Plan Formulation: The Panel recognizes that this is a very large and complex project. Based on that, they are concerned that during plan formulation, the amount of time and staffing required to close all 84 gates in advance of incoming storm surge may not have been taken into consideration when compiling the TSP. The Panel suggests that an analysis be performed to determine the duration needed by the non-Federal sponsor to effect closure of the line-of-protection in advance of storm surge, considering factors such as the number of staff typically available in advance of an emergency to close gates, the time required to actually close each type of gate, the time of transportation between gates accounting for weather delays, any specialized transportation or equipment required (i.e., boats), and any lessons learned on how often gate closure is prolonged by mechanical or other complications.

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

The planning and economic assumptions do not consider the potential for residents and businesses to act on their own to reduce their risks from future sea level change.

Basis for Comment

The Norfolk CSRM Study makes reasonable assumptions regarding relative sea level rise and clearly describes the expected response of non-Federal government entities to increased risk. However, at some point in the future planning period, those with property or livelihoods at risk may decide that conditions are no longer tolerable. If they perceive that no external help will be provided, some will seek to act in their own best interests. Their actions may range from structural modifications to their homes and/or businesses to abandoning flood-prone areas in favor of risk-free or less risky areas. There is no consideration given to a scenario where the proportion of study area residents who react by abandonment significantly affects the future without project conditions damages.

Some of these actions will cause regional transfers of wealth and income. However, these actions are likely to have impacts on National Economic Development since they would lack the completeness and efficiencies brought about by economy of scale. Other significant effects and impacts on the natural environment may also occur.

Practical experience in other parts of the United States makes it clear that private actions do take place when there are expectations of growing risk in the foreseeable future due to relative sea level rise. One example is in southeastern Louisiana, where entire census tracts in St. Bernard and Plaquemines Parishes have been almost completely abandoned. Some parts of southern Mississippi show similar patterns of consumer behavior, as do parts of southern Florida and southern Texas. What is missing from the Draft Feasibility Study is a discussion of how residents, businesses, and non-governmental organizations will respond to increased risk of flooding as a result of sea level rise and land subsidence.

It is also reasonable to conclude that those exposed to the most frequent damaging storm events will be the first to act and that those exposed to less frequent events will act last. While it is difficult to quantify the effects of these activities, it is not reasonable to assume that it will not occur.

Significance – High

Actions taken by private, non-public entities in the absence of Federal action may significantly reduce future without project conditions risk. This would result in a reduction of the expected annual damages, thereby reducing benefits to alternative Federal plans.

Recommendation for Resolution

1. Acknowledge that private action may occur in the absence of a Federal project to reduce risk.
2. Discuss likelihood of private risk reduction.
3. Assess the impact of private risk reduction.
4. Modify the expected annual damages in the study area under the No Action alternative to incorporate private risk reduction measures.

Final Panel Comment 2

The risk associated with using the North Atlantic Coast Comprehensive Study (NACCS) 50 percent confidence interval (CI) data set adds uncertainty to the potential effectiveness of the project.

Basis for Comment

The decision to use the NACCS 50 percent confidence interval data set should be based on the application of risk-based decision points. However, given the various statements throughout the Draft Feasibility Study, the Panel is concerned that other decision factors may have shaped the selection of the 50 percent CI data set. For example:

- Appendix B, Hydraulics, Hydrology, and Coastal Sub-Appendix, Section 2.1 states that "The FEMA Stillwater elevations are closer to the NACCS 50% confidence limit; therefore, it was decided to use the NACCS 50% confidence limit (or mean water surface elevations)." A data set confidence limit should not be selected in order to make project data most closely resemble FEMA data.

- Appendix B, Section 5.2 states, "For this study three separate water levels, at the 50% confidence interval, were used and analyzed." No justification for choosing 50 percent CI instead of other available NACCS data is provided in the review documents.

- Decision Log entry 16 states that a decision was made to go with 50 percent CI even though the associated risk of such a design decision at the 50 percent CI "…may underpredict the wsel [water surface elevation] of a probabilistic storm event." The Decision Log further observes that "A more conservative design recommendation (e.g. 90 % CI level) would result in a more expensive design." The Decision Log entry implies that a data set was selected to keep project costs lower. The selection of a project data set should not be prejudiced by project construction cost considerations.

- Risk Register entry 19 identifies using NACCS data vs. data from the Federal Emergency Management Agency (FEMA) as a risk that may skew analyses toward higher damages and project design, and thus greater costs than if FEMA values had been used. Entry 19 also lists a Risk Management Option to use adaptive operation and maintenance (O&M) strategy to reduce initial construction design and cost where possible as a means to reduce the risk of higher cost of using NACCS data instead of FEMA data. This Risk Register entry appears to suggest that the higher risk associated with using 50 percent CI data could be ameliorated by an adaptive management approach. A search for that suggested adaptive management approach in the Draft Feasibility Study, Appendices A and B did not find any indication that an adaptive management approach would be employed in the project. The Draft Feasibility Study, Section 6.6.3 (p. 56) states that "construction costs also include costs associated with constructing a system that will be adaptable so future enhancements for maintaining the risk reduction levels of structural measures into the future associated with relative sea level rise and/or degradation of the coast, i.e. future levee lifts." However, the Draft Feasibility Study further states that the life cycle cost metric *did not* (italics added) include adaptive management or monitoring costs. Appendix B, Sub-Appendix Hydraulics, Hydrology, and Coastal Sub-Appendix, Chapter 4 discusses adaptive

Final Panel Comment 2

management later in the project life, after sea-level rise, when the wave overtopping may require changes to the structures. But that concept of adaptive management is not fully explored or analyzed. Justification of the NACCS confidence limit should not be considered ameliorated by an adaptive management approach when that adaptive management approach does not appear to have been implemented.

The Panel is concerned that the decision to use the NACCS 50 percent CI data set may have been driven by a desire to avoid a design water surface elevation that is considered higher than reasonable and that would result in higher cost. This may have been bolstered by a belief that the risk associated with the judgment to use the 50 percent CI data would be reduced by an adaptive management approach.

Significance – High

The designation of the design water surface elevation is among the most fundamental issues in the study and influences the technical analysis, subsequent cost estimate, and ultimately the selection of the TSP.

Recommendation for Resolution

1. Provide more complete justification of the NACCS 50 percent CI used.
2. Provide risk-based decision points with respect to the implications of choosing the NACCS 50 percent confidence limit values instead of the 84 percent, or 90 percent.
3. Provide risk-based decision points with respect to the implications of choosing the NACCS 50 percent CI limit values and the associated impacts on wave overtopping analyses.

Final Panel Comment 3

Key measures, including the benefit exceedance probability relationship and project performance by reach, are absent from Appendix C, but are critical to establishing confidence in whether the project will perform as planned.

Basis for Comment

Tables illustrating the benefit exceedance probability relationship and project performance by reach are missing from Appendix C, Section 11. The Panel did not receive the Benefit Exceedance analysis and therefore cannot assess the probability that annual benefits will exceed annual costs. Reviewing this analysis would allow the Panel to determine whether the benefit-cost ratio is likely to be greater than one and whether the net benefits are likely to be positive.

The reach-level project performance analysis allows the Panel to assess the project's long-term ability to perform as planned across the study area.

Significance – Medium/High

Without knowing the key measures of the performance probability, the Panel cannot assess the justification of the TSP.

Recommendation for Resolution

1. Provide a table of benefit exceedance probability.
2. Provide a table of project performance by reach.
3. Discuss how these key measures affect confidence in selecting and implementing the TSP.

Final Panel Comment 4

The structural analysis of T-walls does not take into consideration all potential combinations of loads that could occur during tropical and extra-tropical storms.

Basis for Comment

The load cases C1, C2, C3, C4, and C5 used in the 10 percent design of T-walls do not include all the potential basic loads and load combinations that are typically encountered during hurricane storm events, such as 'reverse head,' barge/boat/debris impact loading, and their potential load combinations. For adequate structural design of floodwalls, all the basic load cases and associated load combinations typically encountered during a hurricane storm event are critical and should be included in the structural design calculations.

Significance – Medium/High

Not including all applicable load cases and load combinations in T-wall analysis and design can result into underestimation of actual loadings on the T-walls that may be encountered during hurricane storm events. This could have significant impact on the structural integrity of the flood walls, life safety hazard, and cost.

Recommendation for Resolution

1. Consider all the possible basic load cases and the load combinations in the design calculations of the floodwalls in the feasibility study phase and subsequent structural design phases. USACE New Orleans District's *"Hurricane and Storm Damage Risk Reduction System (HSDRRS) Revised Design Guidelines"* (USACE, 2012b) is an excellent reference for this.

Literature Cited:

USACE (2012b). Hurricane and Storm Damage Risk Reduction System Design Guidelines. U.S. Army Corps of Engineers, New Orleans District Engineering Division. Updated June 04, 2012. Available online at: http://www.mvn.usace.army.mil/Portals/56/docs/engineering/HurrGuide/EntireDocument.pdf

Final Panel Comments 5

Foundation design issues such as piping (seepage erosion), scouring on the protected side of the floodwall, soil heave, and soil settlement are not addressed in Appendix B.

Basis for Comment

Important foundation design parameters, such as piping (seepage erosion), scouring on the protected side of the floodwall, soil heave, and soil settlement are not considered in sufficient detail at 10 percent design phase. These parameters are critical in adequate foundation design and overall stability of the floodwalls, but are not discussed in Appendix B, Engineering.

Significance – Medium/High

Adequately considering piping, scouring, heave, and settlement issues in the foundation design is critical to ensure stability and structural integrity of the floodwalls. Not addressing these issues properly may result in life safety hazard and impact cost.

Recommendation for Resolution

1. Analyze and include the effects of piping (seepage erosion), scour, soil heave, and soil settlement in the foundation design of the floodwalls in Appendix B.

Final Panel Comment 6

The evaluation of design alternatives does not appear to consider adaptive management strategies if sea level rise is higher than predicted.

Basis for Comment

Appendix B, Hydraulics, Hydrology, and Coastal Sub-Appendix, Chapter 4 discusses adaptive management in the context that later in the project life, after further sea-level rise, the wave overtopping may require changes to the structures. But the concept of adaptive management is not fully explored or analyzed. For example:

- The Draft Feasibility Study, Section 6.6.3, sub-section states that the life cycle cost metric does not include adaptive management or monitoring costs.
- The study documents indicate that the planned I-wall heights vary from 0.5 to 6-feet. The lower end of this range is well below the 6-foot limit, in which case an I-wall becomes a relatively straightforward choice. However, for wall heights approaching the 6-foot limit for I-walls, it may be advisable to consider the T-wall alternative. A T-wall is generally amenable to enlargement during the design life of the floodwall, should the combined effect of sea level rise and land subsidence actually exceed that assumed in the design basis. By contrast, an I-wall enlargement may not be possible without exceeding USACE guidance that discourages the use of I-walls higher than 6 feet.
- Because of known soil subsidence risk in the area**,** a periodic lift requirement for earthen berms/levees should be considered in the TSP and design. It is not addressed in the Draft Feasibility Study.

Significance – Medium/High

Selection of structures that can be readily adapted in the future to changed conditions will enhance system resilience, which has been identified as a key theme for this project; omitting adaptive management strategies may result in reduced degree of flood protection and increased cost of the project.

Recommendation for Resolution

1. Include adaptive management and monitoring costs in the life cycle costs.
2. Consider T-walls in cases where the required height of the floodwall is less than, but approaches, the 6-foot limitation for I-walls.
3. Consider including cost estimates for periodic lifts for earthen berms/levees in the TSP and design.

Final Panel Comment 7

The review documents do not address the time required to close all 84 gates in advance of incoming storm surge.

Basis for Comment

The TSP includes 18 waterway miter gates, one waterway sector gate, and 65 rolling road closure gates. To maintain project completeness, each one of these 84 openings in the line of protection must be closed in a timely manner in advance of coastal storm surge.

The miter gates and sector gate appear to be manually controlled (no remote-controlled operations) with electrical/hydraulic actuators. Nine gates do not coincide with a bridge and therefore appear to need boat transport to carry the operating crew to the operating house at each gate.

The 65 road closure gates appear to operate manually followed by deployment of protected side bracing strut(s). Typical road closure gates, lacking an efficient water seal, often require deployment of some compression sealing mechanism or supplemental sand bagging at the gate/roadway interface to maintain an effective line-of-protection barrier.

While the Panel recognizes that detailed operation, maintenance, repair, rehabilitation & replacement (OMRR&R) procedures will be rightfully developed during following phases of the project, the Panel remains concerned that the duration required to close the gates may affect timely response and completion of the line-of-protection.

Further analysis of operational timelines should be included in the report to demonstrate the feasibility of project completeness.

Significance – Medium

The time required to close 84 gate structures in advance of incoming storm surge may affect project completeness.

Recommendation for Resolution

1. Determine the duration needed by the non-Federal sponsor to effect closure of the line-of-protection in advance of storm surge by considering factors that include the number of staff typically available in advance of an emergency to close gates, the time required to actually close each type of gate (roadway, miter at bridge, miter by boat, etc.), the time of transportation between gates accounting for weather delays, any specialized transportation or equipment required (i.e., boats), and the lessons learned on how often gate closure is prolonged by mechanical or other complications.

2. Compare the duration determined in Recommendation #1 with average duration of advance notice that storm surge will surpass target elevations. If the time to close the gates is greater than the advance notice of needing the gates closed, the project operations should be re-analyzed.

3. Compare the total duration of gate closure (equaling the duration to close determined in Recommendation #1, plus a similar duration to open gates, plus the duration of expected storm

Final Panel Comment 7
surge) with the expected duration of closure cited in the Draft Feasibility Report. If the total duration of closure is significantly different than the duration used in the analysis of environmental effects, revise report analyses accordingly

Final Panel Comment 8

Conclusions reached in the environmental analyses about cumulative effects appear to be based only on issues related to the TSP and to the No Action alternative and do not consider past, present, and reasonably foreseeable future actions as required by NEPA and do not consider a systemic approach.

Basis for Comment

The government defines cumulative effects 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" (40 CFR 1508.7). 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 analyses in Appendix D and the Draft Feasibility Study consider a limited range of cumulative effects related directly to the TSP, but do not consider broader past, present, and future actions as required the National Environmental Policy Act (NEPA) (42 U.S.C. §§4321-4370h). The primary cumulative effects analysis is found in the discussion of the No Action alternative of the Draft Feasibility Study (p. 296). This section states that "multiple past, present, and reasonably foreseeable future projects within the overall study area" are anticipated. However, the Panel did not find a NEPA-compliant discussion of the cumulative effects of the TSP combined with those actions in the documentation. The cumulative effects analysis mandated by NEPA requires a more comprehensive "hard look" list of actions that may be undertaken by others, including other USACE-sponsored projects.

The species of concern described in the Draft Feasibility Study as potentially adversely affected by the TSP may also be adversely affected by other planned projects, and the combined effects must be considered and mitigated. Other environmental effects including, but not limited to, water quality, air quality, traffic/transportation, community cohesion, environmental justice, wetlands, and terrestrial habitats must also be evaluated as part of systemic consequences in the region.

Cumulative effects described in the documentation are indirect and secondary effects of the TSP, but are not an analysis of the cumulative effects as required by NEPA.

The Draft Feasibility Study gives examples of regional organizations that may have planned projects or projects already under way such as:

- The North Atlantic Coast Comprehensive Study (NACCS)
- The Hampton Roads Regional Transit Plan
- The Regional Long-Range Transportation Plan
- The USACE/Virginia Port Authority Feasibility Study
- The Elizabeth River Southern Branch Navigation Channel Dredging
- Periodic Beach Renourishment.

This list must be expanded to include regional projects that are not referenced in the documentation.

Final Panel Comment 8

The broader cumulative effects analysis requires an inventory of past, planned, and on-going regional projects. It also requires some envisioning of future actions that may be undertaken in the project area unrelated to, but affected by, the project. Anticipating activities undertaken in the future that could be adverse to the project itself are also part of this analysis.

Finally, perceived protection from flood risk may also result in a misunderstanding on the part of Norfolk 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 significant and adverse socioeconomic cumulative effect.

Significance – Medium

The cumulative effects analysis put forward in the Draft Feasibility Study and Appendix D does not comply with NEPA, and the study does not apply, as per USACE planning initiative, a systemic approach (USACE Institute for Water Resources).

Recommendation 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, describe the combined effects of all known activities, and describe the potential effects that those activities may have on the TSP itself.
3. Give attention to socioeconomic effects associated with residual risk and potential induced flooding.
4. Describe any anticipated measures to mitigate adverse cumulative effects.
5. Discuss how development of the TSP complies with a systemic approach to the affected coastal system.

Literature Cited:

42 U.S.C. §§4321-4370h. Title 32: National Defense. Subpart B: National Environmental Policy Act and the Decision Process. July 1, 2015. Available online at: https://elr.info/legislative/federal-laws/national-environmental-policy-act

40 CFR §1508.7. Cumulative Impact. July 1, 2012. Available online at: https://www.gpo.gov/fdsys/granule/CFR-2012-title40-vol34/CFR-2012-title40-vol34-sec1508-7

USACE Institute for Water Resources, Coastal Systems Portfolio Initiative. http://www.iwr.usace.army.mil/Missions/Coasts/Programs-and-Initiatives/

Final Panel Comment 9

The estimates of potential impacts on wetlands and other aquatic resources based on National Wetlands Inventory (NWI) mapping may be inaccurate.

Basis for Comment

The estimates of impacts on wetlands and other aquatic resources presented in the Draft Feasibility Study were based on 2017 National Wetlands Inventory (NWI) maps produced by the U.S. Fish and Wildlife Service (USFWS). The NWI maps are described in the Draft Feasibility Study (p. 315, Table 11-2) and Appendix D (p. 17) as being used to identify both sizes and types of wetlands that may be affected by the Tentatively Selected Plan (TSP). While this resource is adequate for comparative purposes to assist in determining the relative impacts associated with each measure described in the array of alternatives, the maps are known to be highly inaccurate (40 to 50 percent) and are not generally used to determine mitigation requirements or to evaluate the function and value of wetlands and other aquatic resources (Matthews et al., 2016).

Appendix D (p. 17) indicates that a field verification was performed on wetlands that potentially could be affected by the TSP. It is unclear if the assessment was confined to the areas shown on the NWI maps or if a more comprehensive study was undertaken to identify wetlands sites within the study area that may have been absent from NWI mapping. If only NWI mapped wetlands were evaluated and a wetlands delineation conforming with USACE (1987 and 2010) was not performed, the areal coverage and types of mitigation described in the mitigation plan may be underestimated. Mitigation costs could be greater than those calculated for the TSP.

Significance – Medium

The actual sizes and types of wetlands and other aquatic resources that may be affected by the TSP are unknown, therefore the associated mitigation requirements and costs cannot be fully evaluated.

Recommendation for Resolution

1. Perform a wetlands delineation of the study area in accordance with USACE (1987 and 2010) to determine whether wetlands and other aquatic resources not mapped on the NWI have been left out of the calculations.
2. Correct any miscalculations of wetlands and aquatic resource sizes and types in the Draft Feasibility Study and Appendix D.
3. Refine the discussion of wetlands/aquatic resource mitigation in the mitigation plan in Appendix D.
4. Correct, if warranted, the wetlands and other aquatic resources discussion in the Draft Feasibility Study.

Literature Cited:

Matthews, J.W., D. Skultety, B. Zercher, M.P. Ward and T.J. Benson (2016). Field verification of original and updated National Wetland Inventory maps in three metropolitan areas in Illinois, USA. Wetlands 36:1155-1165. https://doi.org/10.1007/s13157-016-0836-6

USACE (2010). Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Atlantic and Gulf Coastal Plain Region (Version 2.0). Ed. J. S. Wakeley, R. W. Lichvar, and C. V. Noble. ERDC/EL TR-10-20. Vicksburg, MS: U.S. Army Engineer Research and Development Center. Available online at: https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/16/nrcs143_020653.pdf.

USACE (1987). Corps of Engineers Wetlands Delineation Manual. Wetlands Research Program Technical Report Y-87-1. Final Report. Environmental Laboratory, U.S. Army Corps of Engineers Waterways Experiment Station, Vicksburg, MS. Available online at: https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/16/nrcs143_020653.pdf

Final Panel Comment 10

The environmental justice analysis, which has implications for NEPA compliance, lacks sufficient detail on access to the non-structural measures.

Basis for Comment

The environmental justice analysis must describe vulnerable populations, including, but not limited to, minority and low-income populations, and determine whether there are disproportionately greater environmental effects on those populations. The analysis must consider cumulative effects (past, present, and future actions) in concert with the proposed project.

Access to proposed non-structural measures, including flood-proofing, flood insurance, buy-outs, relocation, and other owner-instigated actions, are a challenge for vulnerable populations. Taking the steps required to take advantage of these benefits, and thus contribute to the reduced flood damages calculated for the project, may be impossible for some elderly, disabled, illiterate, low-income, and non-English speaking groups. Some measures (flood insurance, for example) require expenditures on the part of property owners that are unaffordable.

The Draft Feasibility Study describes (p. 97) why an "*only* non-structural measures" alternative was disqualified from the array of alternatives considered because: "The non-structural only plan would have many additional obstacles with environmental justice, socioeconomics, aesthetics, and cultural resource concerns. These impacts may be mitigable and therefore eventually acceptable, but the impact would be very significant." The document also notes (p. 25): "Younger and older people may be more vulnerable during emergencies, a consideration for preparedness as a non-structural measure." Despite this assessment, the TSP includes a non-structural component, contradicting the argument given for eliminating a non-structural only alternative from the array.

The Draft Feasibility Study does not include sufficient detail that identifies the size, location, and make-up of vulnerable populations in the study area. It also does not describe when and how these populations will be assisted in accessing the benefits afforded by the non-structural measures or when and how on-going public education will be initiated and sustained to inform both the general public and disadvantaged residents on the requirements of participation in the non-structural portion of the TSP. A public education effort, targeted and tailored to vulnerable populations, could include information on how they can get help with the purchase of flood insurance, flood-proofing, buy-outs, understanding evacuation routes, obtaining evacuation assistance, and how to monitor flood warnings, among other benefits. Such a public education effort may mitigate environmental justice concerns.

Significance – Medium

The brevity of the discussion of vulnerable populations creates a NEPA compliance issue with the documentation, and the inability of vulnerable populations to access non-structural measures may affect the benefits calculated for the TSP.

Recommendation for Resolution

Final Panel Comment 10

1. Include more detail on the sizes, locations, and characteristics of vulnerable populations within the study area.
2. Describe how these populations will be informed regarding the availability of non-structural measures, and how they will be assisted in performing the steps required to avail themselves of these benefits.
3. Describe on-going public education efforts targeted and tailored to vulnerable populations regarding evacuation routes, evacuation assistance, flood warnings, and other non-structural measures.
4. Evaluate and discuss the cumulative effects of the non-structural measures on vulnerable populations, considering other past, present, and future actions unrelated to the TSP that will affect them.

Final Panel Comment 11

Short- and long-term impacts on numerous environmental resources identified in the description of the existing environment may be underestimated, or they may be omitted from the documentation.

Basis for Comment

The discussion of the existing environment is substantially complete in Chapter 10 of the Draft Feasibility Study; however, the Panel found that analysis of environmental effects is absent in some cases and not thoroughly evaluated in others.

The requirement of NEPA is to take a "hard look" at the effects of any Federal action. Environmental effects on identified resources, including but not limited to submerged aquatic vegetation (SAVs), wetlands and other aquatic resources, benthic organisms, migratory birds, essential fish habitat, listed species, hazardous materials, noise, air quality, visual effects, cultural resources, and vulnerable populations, that could be significant were described in the documentation as "no effect," insignificant, or "minor," without sufficient analysis and discussion to justify such conclusions. The required hard look at impacts, including due to construction and operation over the life of the project, was overly brief, may be overly optimistic without basis, is absent, or lacking sufficient justification or detail.

Two specific examples, among many others, noted by the Panel are:

- The type of construction to be used during construction for cofferdams, temporary stream diversions, and sluices is not discussed, and effects on water quality are not evaluated.
- A "no effect" conclusion is drawn for effects on SAVs, even though there is a SAV bed only 1500 feet away from a construction area.

The Panel found similar discrepancies in the evaluation of potential effects on many other natural and human resources.

Significance – Medium

Environmental effects may be underestimated, and the discussion of impacts may be non-compliant with NEPA, potentially leading to schedule delays and additional cost for implementation of the TSP.

Recommendation for Resolution

1. Develop an accurate and justifiable description of short- and long-term environmental effects (both positive and negative) on all potentially affected resources both during construction and operation of the TSP.
2. Revise the Draft Feasibility Study to include the description of impacts.
3. Consider dividing the impacts discussion into construction effects (typically temporary and short-term) and long-term effects (lasting and potentially, although not always, significant) during the life of the project.
4. Describe the basis for concluding that environmental effects are temporary or long-term, positive or negative, and minor, insignificant, or significant.

Final Panel Comment 11

5. Include steps that will be taken to mitigate environmental effects during construction and plans for mitigation of long-term effects.

Final Panel Comment 12

The review documents are ambiguous about the potential presence of contaminated soil/sediment, creating uncertainty in the project cost estimate, environmental effects analysis, schedule, and public health and safety risk.

Basis for Comment

The Draft Feasibility Study presents an inconsistent assessment of cost, schedule, and environmental risks of project construction associated with contaminated sites throughout the Norfolk area. For example:

- Draft Feasibility Study, Chapter 10, Section 10.4.4 cites fish consumption advisories issued because of levels of contaminants in fish tissues for Lafayette River, Pretty Lake, and the Elizabeth River due to dioxin, Willoughby/Ocean View due to PCBs, and Lake Whithurst due to mercury. These fish consumption advisories appear to indicate that the fish habitats include contamination.

- Draft Feasibility Study, Chapter 10, Section 10.1.4 calls for special consideration for the former Lamberts Point Landfill. The shoreline area has continued to experience erosion and exposed landfill contents. The risk introduced by this potential source of contamination is not accounted for in the cost estimate or discussed thoroughly in the review documents.

- Draft Feasibility Study, Chapter 10, Section 10.2.4 (pp.114-115) cites an extensive data set (346 total samples) of modern-day scientifically collected and processed geotechnical data from bottom sediments dating back to 1986. These data characterized sediment particle size, as well as environmental contaminants that include hazardous, toxic, and radioactive waste (HTRW). While soil types are characterized in the report text, results regarding environmental contaminants are not indicated. These sediment sample test results could potentially indicate sediment contamination, but they are missing from the review documents.

- Appendix E, Section 11 states that the Real Estate Plan is based on an “As-Clean” condition with no significant hazardous material contamination due to previous and/or adjacent land uses. Further, Appendix B, Cost Engineering Sub-Appendix (p. 6) states that the cost estimate includes no costs for HTRW since there is no potential concern for HTRW. These two citations indicate that the project has assumed no contamination for cost estimation purposes.

The Panel believes that the inconsistency between the fish advisories and landfill observations indicating the presence of contamination and the cost estimate and Real Estate Plan indicating no contamination creates uncertainty regarding the project cost estimate, schedule, and environmental effects analysis.

During review of the public comments, the Panel noted that the Virginia Department of Environmental Quality provided several pages listing hazardous waste, Resource Conservation and Recovery Act (RCRA), and other potentially contaminated sites in the project area that should be considered. The U.S. Environmental Protection Agency also noted concerns regarding the exposure of landfill contents that could lead to release of contaminates or add worker and public safety risk. This

Final Panel Comment 12

information further supports the Panel's concerns regarding the potential impacts of contaminated soil/sediment on the project.

Significance – Medium

The inconsistent reporting of potential contamination presents a fundamental problem that affects cost risk, schedule risk, and public health and safety risk. These risks have a low probability of influencing the technical basis for selection of the TSP.

Recommendation for Resolution

1. Revise the Draft Feasibility Study to address the uncertainty introduced by potential contamination of soil and sediment to the report. While it is appropriate within the SMART Planning construct to not detail previous sediment testing data, provide a summary of any environmental contamination found in the 346 sediment samples.
2. Provide report language that correlates the contamination found by the fish advisories, and in the 346 sediment samples, to the risk-based decision regarding inclusion or exclusion of contamination from project decisions.
3. Conduct a simple cost risk sensitivity analysis to compare no contamination (the current estimate) to two scenarios of increasing contamination to validate the project risk decisions. In Appendix B, Cost Engineering Sub-Appendix, provide more detail on the risk-based cost estimate adjustment made to capture cost and schedule risk associated with contamination.
4. Revise Appendix E, Section 11 to indicate the potential range of real estate cost variance depending on various contamination scenarios.
5. Revise the environmental effects analysis to show the effects of potential contamination on worker and public health and safety, and water quality.
6. During pre-construction engineering and design (PED), describe the USACE protocol for dealing with contaminated sites discovered during construction.

Final Panel Comment 13

The treatment of utilities in the report increases the project uncertainty regarding cost and non-Federal sponsor Lands, Easements, Rights-of-Way, Relocations, and Disposal Areas (LERRDs).

Basis for Comment

Appendix A, Plan Formulation, Table 2 recognizes that unknown utilities represent a risk to construction time and cost. The Draft Feasibility Study, especially Sections 10.20 and 11.21, also recognizes the presence of multiple utilities, public and private, beyond those shown elsewhere in the report, but does not quantify or locate them. The study team also recognized the risk presented by unknown utilities in Risk Register entry 21 and lists as the risk management option to "assume worst case based on existing information." Further still, the 10 percent design plan sheets indicate some of the water, wastewater, and storm drain system utility networks in several locations are adjacent and perhaps crossing the project footprint. Additionally, unnumbered plan sheet (following Sheet 26) indicates a floodwall protecting the Water Treatment Plant (WTP). WTPs typically are associated with numerous large critical utilities leading in and out of the site. These potential WTP utilities are not discussed in the report.

However, Appendix E, Real Estate Plan, Table 1 states that utility impacts, once determined, should be added in a later design phase. This would imply that the cost of utility relocations was not included in the LERRDs and therefore the non-Federal partner's LERRD responsibility is understated. Further, Appendix B, Cost Engineering Sub-Appendix does not include any cost allowance for utilities. Given that the review documents expect utility conflicts to occur, the Panel would expect documentation on a commensurate increase in the cost estimate due to this uncertainty. Utilities are not indicated as a cost factor in the Cost Engineering Sub-Appendix, including the Abbreviated Risk Analysis.

Significance – Medium

Utility conflicts with project features can have a fundamental impact on project design and construction schedule and cost and significantly impact the non-Federal sponsor's LERRD responsibility.

Recommendation for Resolution

1. Modify Appendix E to include a placeholder dollar amount for the relocation or replacement of any public or private water, wastewater, storm water, telephone, power, natural gas, fiber optic, petroleum, and compressed gas systems to better inform the non-Federal sponsor of potential LERRD responsibilities.

2. Modify Appendix B, Cost Engineering Sub-Appendix to address how the uncertainty of utilities is included in the cost estimate.

Final Panel Comment 14

It is not clear from the utility data descriptions and residual risk evaluations whether any utilities will penetrate through or beneath a floodwall, potentially resulting in a weak point in a flood control system.

Basis for Comment

The Draft Feasibility Study indicates that an extensive utility network exists in the project area. A particular concern is whether utilities will cross levee and floodwall alignments. If utility penetrations through floodwalls or levees at some locations are unavoidable, they can increase the risk of piping and seepage-related failure, which, in turn, can increase the residual risk for the project.

Significance – Medium

The occurrence of utilities in the project area can require relocation that can potentially increase the residual risk for the project.

Recommendation for Resolution

1. Make a preliminary assessment of the scope of the utility relocations that will be required for the project.
2. Assess the likelihood that the final design will involve utility penetrations through or beneath the floodwalls or levees.
3. If utility penetrations through the levees or floodwalls are deemed to be unavoidable, evaluate the impact of such penetrations on the probability of failure for these flood control structures, along with the effect on the residual risk of flooding.

Final Panel Comment 15

There is insufficient detail on wave overtopping and wave force calculations and assumptions made in the calculations and analyses to determine the reasonableness of the results.

Basis for Comment

For the TSP, the wave overtopping and wave force calculations are critical to the robustness of the structures during elevated water levels, which affects life safety concerns. The specific methods and equations discussed in Appendix B, Hydraulics, Hydrology, and Coastal Sub-Appendix, Chapter 4 (overtopping) and Chapter 5 (wave forces) appear adequate.

However, the chapters do not provide sufficient detail on the parameters applied and assumptions made in the completed analyses. Therefore, the Panel could not adequately review the analyses and determine the accuracy and appropriateness of the results. For example, the results in Tables 4.3a and 4.4a show identical wave overtopping results for the EurOtop method for both the vertical floodwall and sloped levee. The documentation does not explain how the identical values were derived and the Panel does not understand how the two different wall conditions develop identical overtopping rates. The ability to understand and confirm the analyses is important as underestimated or incorrect wave overtopping rates or wave forces affect TSP costs and benefits and could cause structure failure that can become a life safety hazard.

Significance – Medium

The wave overtopping and wave force calculations and results influence the TSP features, costs, and benefits and could affect life safety hazards. The information provided does not allow for a complete understanding of the calculations and results.

Recommendation for Resolution

1. Provide tables and/or text that identify the pertinent parameter values applied within the wave overtopping calculations that developed the results in Tables 4.1a, 4.2a, 4.3a, 4.4a (Appendix B, Hydraulics, Hydrology, and Coastal Sub-Appendix). For parameters that required selection of a value within a range of acceptable values, provide justification or rationale for the value applied.

2. Provide tables and/or text that identify the pertinent parameter values applied in the wave force calculations that developed the results in Tables 5.1a, 5.2a, 5.3a (Appendix B, Hydraulics, Hydrology, and Coastal Sub-Appendix). For parameters that required selection of a value within a range of acceptable values, provide justification or rationale for the value applied.

Final Panel Comment 16

There is insufficient detail to understand how additional modeling in the PED phase will evaluate how the TSP structures will interact with water levels and waves from a NACCS storm suite of 1,050 synthetic tropical storms and 100 extra-tropical storms.

Basis for Comment

The TSP contains structures that will alter the hydrodynamics and wave conditions in many project areas. The Draft Feasibility Study, Appendix B, and Appendix B, Hydraulics, Hydrology, and Coastal Sub-Appendix, briefly describe how the structures were developed and analyzed using current NACCS results. However, the documentation does not sufficiently describe the analyses and simulations needed to accurately evaluate how the structures will interact with water levels and waves.

The interaction of the TSP structures with storm surge and waves is a critical aspect of the TSP performance and effectiveness. However, Chapter 7 of the Appendix B, Hydraulics, Hydrology, and Coastal Sub-Appendix does not contain enough detail to understand how the PED phase will refine these analyses to simulate how the TSP structures will interact with the storm surge and waves.

The documentation states additional modeling will be undertaken to evaluate the interaction of water levels and waves with the proposed structures and measures. However, it appears no plan is presented for how the NACCS results, from a storm suite of 1,050 synthetic tropical storms and 100 extra-tropical storms, could or would be applied in an efficient manner to evaluate the structure-induced changes.

Significance – Medium

Inadequate methods to evaluate the structure interaction with water levels and waves could lead to inaccurate costs and benefits for the structures or unexpected project performance.

Recommendation for Resolution

1. Provide additional detail for the modeling planned to evaluate the interaction of the TSP structures with water levels and waves. The discussion should address how the structure are included in the model, how storms are selected, the number of simulations to execute, how tide conditions are applied, and whether tropical or extra-tropical storms are included.

Final Panel Comment 17

The documentation does not justify the wave parameters (heights and periods) selected for application in the wave overtopping and wave force calculations.

Basis for Comment

The second paragraph of Chapter 4 in Appendix B, Hydraulics, Hydrology, and Coastal Sub-Appendix presents wave heights of 2, 3, and 4.5 feet and wave periods of 4, 6, and 8 seconds as applied in the 20-year, 50-year, and 100-year return period wave overtopping calculations. As deeper water can support larger waves, increasing the wave height as the water level (and return period) increases seems reasonable. However, the discussion does not justify the basis for these wave height and period values as applied in the wave overtopping analysis. The discussion states the NACCS determined an average wave height value of 4.5 feet. Low-frequency storm events that produce low frequency water levels (20-, 50-, and 100-year return period levels) could provide wave conditions higher than “average” conditions. As the 20-, 50-, and 100-year return period levels do not represent “average” conditions, the text does not document the rationale or method to justify the various wave heights and periods to “average” conditions.

The second paragraph of Chapter 5 in the Appendix B, Hydraulics, Hydrology, and Coastal Sub-Appendix presents the wave height applied in the wave force calculations (3 feet). However, the discussion states the NACCS determined an average wave height of 4.5 feet. The discussion does not justify the basis for these wave height and period values as applied in the wave force analysis. Additionally, the discussion contains the statement “For the Goda method, a maximum wave height is calculated from the significant wave height. This calculated maximum wave height is greater than the NACCS value of 4.5 feet; therefore, the NACCS wave height value is covered under the Goda method.” This statement appears to neglect that the NACCS wave height is a significant wave height value, so the maximum wave height from the NACCS data (based on NACCS average wave height) would have a value near 8 feet (~1.8*Hsig).

Figures 5.2 and 5.3 in Appendix B, Hydraulics, Hydrology, and Coastal Sub-Appendix show the monthly average significant wave heights and monthly average significant wave period from the Hampton Roads area for a 12-month period. However, these monthly data do not represent conditions that could occur during a low-frequency storm event.

The wave height and period values are critical to the wave overtopping and wave force analyses that affect the TSP structures, project benefits, and project costs. The documentation of the wave height and period values applied in the wave overtopping and wave force analyses needs to provide additional information to justify the selected values.

Significance – Medium

If the wave overtopping and wave forces analyses to develop the TSP structures applied values that cannot be defended or validated, then structure configuration, project costs, and project benefits may need to be revised.

Recommendation for Resolution

Final Panel Comment 17

1. Provide additional discussion and justification for the wave height and wave period values applied in the wave overtopping analysis.
2. Provide additional discussion and justification for the wave height and wave period values applied in the wave force analysis.
3. Discuss the NACCS statistical wave height and period values near the project area for low-frequency storm events (20-, 50-, and 100-year). Discuss how these values compare to the values applied in the TSP analysis.

Final Panel Comment 18

The current design of the project includes extensive floodwall lengths between gates without pedestrian access and traffic passage, but does not address their impact on commerce, recreational access, emergency egress, emergency response, community connectivity, and overall environment.

Basis for Comment

Several floodwall reaches include long, uninterrupted lengths between gate structures. The relative longer distance between gates in some areas of the project increases the life safety risk due to limited public egress and limited emergency access. It also can impact commercial activities and recreational access to coastal areas. The relative longer distance between gates in some areas of the project is a design limitation not addressed in the review documents, including how the floodwalls may serve as barriers to connectivity of terrestrial wildlife habitat and how the separation of communities/ neighborhoods by long floodwalls, depending on the relative economic standing of the adjacent neighborhoods, may breach standards of environmental justice.

The areas of concern affected by the current design of floodwall lengths are separated commercial, recreation, and residential areas. For example:

- The north and east Pretty Lake floodwall (Sheet-3) is approximately 1500 linear feet (LF) without gates.
- The south and west Pretty Lake floodwall (Sheet-4) has two reaches, one approximately 1000 LF and the other 1900 LF with only one gate.
- The floodwall shown on Sheets 11/12/13/14/15 is approximately 7,500 LF without a gate. (The 7,500 LF distance does not include the floodwall where railroad tracks parallel on the unprotected side.)
- The Waterside Festival Marketplace (Sheet 18) is largely separated from the waterside for which it is named.
- Ingelside Road (Sheet 23) offers no gate at the only road access under the existing freeway in the area.

The separation of large parts of the community by floodwalls is a fundamental issue in the study documents, yet it has not been addressed.

Significance – Medium

The separation of large parts of the community can affect life safety and cost and cause environmental and potentially environmental justice impacts.

Recommendation for Resolution

1. Re-evaluate the spacing of pedestrian and traffic gates in long reaches of floodwalls.

Final Panel Comment 18

2. Re-evaluate the environmental impacts on commerce and recreational access due to long expanses of uninterrupted floodwalls.
3. Re-evaluate the environmental impacts on wildlife and community connectivity due to long expanses of uninterrupted floodwalls.
4. Re-evaluate the life safety and environmental impacts on emergency egress and emergency response due to long expanses of uninterrupted floodwalls.
5. Update the cost estimate to reflect any changes to the project based on these findings.

Final Panel Comment 19

Appendix C does not explain how debris management and depth damage data collected in New Orleans, LA are representative of conditions in Norfolk, VA.

Basis for Comment

In the absence of site-specific data on depth damage values and storm-generated debris in Norfolk, VA, the study applies similar data collected in the New Orleans, LA metro area to describe these values. These data are used in the economic analysis to estimate the National Economic Development (NED) costs caused by damage to both structures and their contents. Specifically, debris management is a significant part of cleanup costs after a storm event, and the uncertainty assigned to the depth damage function affects the variability of flood damages. As a result, these data can affect how benefits are calculated.

While it is likely that the data from New Orleans are suitable for use in Norfolk, there is no justification given as to why this is the case, or why more recent data from areas affected by Superstorm Sandy are not better than older data from Louisiana. As a result, there is reduced confidence in the results of calculations based on the data chosen.

Significance – Medium/Low

A justification is needed to confirm that the best available data were used in estimating damages caused by storm events and that data from other areas were less suitable.

Recommendation for Resolution

1. Explain if data from Superstorm Sandy or data from a geographically similar region were considered or why such data were deemed less than suitable.
2. List the similarities of the two areas (historical, architectural, coastal, etc.)
3. Explain the differences between the two areas (climate, economy, culture, etc.)
4. Explain how the data used are suitable for the study area.

Final Panel Comment 20

References to sea level rise and land subsidence data sources and use of sea level rise and relative sea level rise terminology are inconsistent in the study documents.

Basis for Comment

The Draft Feasibility Study and Appendices do not present a clear picture of sea level rise concerns and data inputs. These inconsistencies do not allow a clear and complete understanding of how the parameters were applied within the study analyses. For example:

- Sea level rise: Appendix B, Section 3.6.1 states "It should be noted that the global average sea level is estimated to be 0.00492 feet per year (Kamphuis 2010)." However, the Draft Feasibility Study, Section 1.5.3 references IPCC (2013) values for global sea level rise, which are different than the Kamphuis values.

- Land subsidence: Appendix B, Section 3.6.2 states "…the general land subsidence in the Chesapeake Bay area is approximately -0.0131 feet per year, which is 1.3 feet over the next 100 years" (Boon et al., 2010). However, the Draft Feasibility Study, Section 1.5.3 states, "…still causing local land subsidence today (Boon et al. 2010) estimated at 2.101 mm yr-1 for Chesapeake Bay." [2.101 mm/yr = 0.0069 ft/yr]." The Boon et al. (2010) land subsidence values do not appear consistent.

In addition, the focus for increasing water levels differs between sea level rise (SLR) and relative sea level rise (RSLR). The Draft Feasibility Study discussion focuses on RSLR and Appendix B focuses on SLR. The inconsistent references and focus (SLR vs. RLSR) hamper the review of the actual sea level rise and land subsidence values applied in the study and their effect on the analyses completed. Appendix B, Hydraulics, Hydrology, and Coastal Sub-Appendix, Section 3.7 includes references to SLR, but no reference to land subsidence or RSLR. Section 2.7.2 of the Draft Feasibility Study references climate change multiple times when discussing RSLR. The presentation of the sea level rise and land subsidence information needs to be consistent to ensure clarity and appropriate analyses. For example, does "increase of SLR" (Draft Feasibility Study, Section 3.2) indicate sea level is increasing, sea level rise is increasing, or the rate of sea level rise is changing?

Significance – Medium/Low

Sea level rise and land subsidence (together forming relative sea level rise) are key parameters that influence that TSP project features, costs, and benefits. Application of consistent sources of sea level rise and land subsidence data and projections in project documentation is critical to ensuring the analyses develop technically sound results.

Recommendation for Resolution

1. Provide additional discussion focused on the source of the sea level rise and land subsidence data and projections applied in the Draft Feasibility Study and Appendix B.

Final Panel Comment 20

2. Update the documentation to reflect a consistent source of sea level rise data or justify the use of different sources and rates in the documentation.

3. Update the documentation to ensure the processes of SLR and RSLR are discussed using consistent terminology.

Final Panel Comment 21

The NACCS water level values presented in Table 2.1 of Appendix B, Hydraulics, Hydrology, and Coastal Sub-Appendix do not match the values available from the NACCS Coastal Hazards System (CHS) Web Portal.

Basis for Comment

The NACCS water level values presented in Table 2.1 (Station 16827) of Appendix B, Hydraulics, Hydrology, and Coastal Sub-Appendix do not match values downloaded (January 2018) from the NACCS CHS Web Portal. Based on notifications on the CHS Web Portal, USACE updated some of their NACCS water level data in November 2016.

If the analysis in Appendix B applied incorrect or outdated NACCS storm surge water levels, then structure configuration, project costs, and project benefits could change. More information needs to be provided to verify the origin of the data in Table 2.1 (Appendix B, Hydraulics, Hydrology, and Coastal Sub-Appendix).

Significance – Medium/Low

Applying incorrect, or outdated, NACCS storm surge water levels when developing the TSP could change the structure configuration, project costs, and project benefits.

Recommendation for Resolution

1. Provide the source of the NACCS data in Table 2.1 (Station 16827) and the date the data were obtained.

2. Confirm that the data applied in the study match the data available on the CHS Web Portal. If the data differ, rectify the water level values and include the most recent data, or confirm why the data applied in the documentation are appropriate.

Literature Cited:

NACCS CHS Web Portal: https://chs.erdc.dren.mil/default.aspx

Final Panel Comment 22

The mitigation plan and proposed design of Nature and Nature-Based Features lack sufficient detail and justification, and mitigation for many other environmental effects is omitted from the Draft Feasibility Study.

Basis for Comment

The mitigation plan in Appendix D addresses only adverse effects on wetlands and aquatic features. The plan describes what is referred to as permittee responsible mitigation, including only the use of Nature and Nature-Based Features (living shorelines and greenways). These features are laudable; however, it is questionable as to whether they are structural features of the TSP or if they truly compensate for habitat loss.

The Panel is concerned that the 3:1 slope (mitigation plan, Appendix D, p. 37) proposed for shoreline features is insufficient to create a sustainable shoreline that mimics nature, as described in the Draft Feasibility Study (p. 9). Natural shorelines supporting substantial marshes have very gradual slopes (USFWS, 1999).

The discussion of mitigation ratios required by the Commonwealth of Virginia calls into question the use of the shoreline and greenway features as satisfactory compensation (Appendix D, p.150).

The Draft Feasibility Study and Appendix D omit mitigation measures for other environmental impacts, including, but not limited to, water quality, air quality, noise, essential fish habitat, benthic organisms, migratory birds, upland vegetation and terrestrial species, marine mammals, sea turtles, vulnerable human populations, visual and aesthetic effects. In several parts of Appendix D, a reference is made to the use of “standard mitigation measures” for a variety of environmental effects. The Panel could not evaluate mitigation measures based on this general statement and thus whether short- and long-term effects are significant.

Significance – Medium/Low

The Panel is unable to discern whether the proposed Nature and Nature-Based Features compensate for calculated losses of wetlands and waters of the U.S. and whether other potentially significant negative short- and long-term environmental effects have been addressed.

Recommendation for Resolution

1. Offer more information on why 3:1 slopes are preferred for the proposed living shoreline features instead of a natural, more gradual sloping shoreline.
2. Clarify whether the living shorelines are structural measures that are part of the TSP or if they compensate for habitat loss and how.
3. Include a discussion of how other short- and long-term environmental effects (air quality, water quality, noise, marine mammals, sea turtles, migratory birds, essential fish habitat, benthos, and other resources) will be mitigated.
4. Include this information in Appendix D and reference it in the Draft Feasibility Study.

Literature Cited:

USFWS (1999). South Florida Multi-Species Recovery Plan. U.S. Fish and Wildlife Service Southeast Region, Atlanta, GA. Available online at https://www.fws.gov/verobeach/ListedSpeciesMSRP.html

Final Panel Comment 23

During its review of the public comments, the Panel noted the Draft Feasibility Study provides no justification for why the "daylight historic creeks" measure is not carried forward in the screening process as a viable measure.

Basis for Comment

In the Draft Feasibility Study, Table 5.1 lists the management measures screened, whether the measure has been carried forward, and a discussion of the action.

In all cases but one, where a measure has not been carried forward, Table 5.1 provides a justification for that action. The one exception is the "daylight historic creeks" measure, which was not carried forward and the decision was not explained. The "daylight historic creeks measure" has been removed from consideration during the screening process without any justification for the action. If there is no justification to remove the measure, then the measure could be moved forward and potentially influence the TSP.

This issue was also identified in the public comments submitted by the Chesapeake Bay Foundation.

Significance – Medium/Low

The Panel is concerned that the screening process may not be thorough for all measures, and every action in the process should be supported with sound analysis. If there is no justification to remove the "daylight historic creeks" measure, then the measure could be moved forward and potentially influence the TSP.

Recommendation for Resolution

1. Provide justification in Table 5.1 for why the "daylight historic creeks" measure is not carried forward.

2. If the "daylight historic creeks measure" lacks justification for being removed from consideration, provide analyses and compare the measure with alternatives that have moved past the initial screening.

Final Panel Comment 24

The presentation of pump station back-up generators is inconsistent in the review documents.

Basis for Comment

Appendix A, Plan Formulation identifies three new pump stations that will include back-up generators to provide electrical power if the primary electrical service is interrupted. Appendix B, Engineering, Section 7.1 also cites pump stations/generators to be included in the General Study measures to be considered and documented in the Draft Feasibility Study. Both citations indicate that back-up generators will be provided at the pump stations. However, other sections of the Draft Feasibility Report indicate that back-up generators are not included. These sections include Appendix B, Section 9.7 that states that "backup generators alone are proposed for existing pump stations," and Appendix B, Cost Engineering Sub-Appendix that provides no construction cost allowance for pump station back-up generators.

Further, Draft Feasibility Study, Section 6.6.3 does not include an OMRR&R cost allowance for generator operation, periodic maintenance, or life cycle replacement or rehabilitation, but Chapter 11 does mention generator/pump buildings (i.e., Section 11.23.2), but only from a perspective of land use and Section 11.27 that makes brief mention of increased greenhouse gas due to pump station generators.

The review documents are inconsistent in the treatment of back-up generators, so the Panel is uncertain whether these generators are included in the project. In addition, information is not provided on the type of proposed generators and their reliability under flooded conditions.

Significance – Medium/Low

The inconsistent technical information on the inclusion of back-up generators in the project affects the clarity, understanding, or completeness of the study documents. While the Panel does not believe that this uncertainty affects alternative selection, it likely affects construction cost and OMRR&R costs.

Recommendation for Resolution

1. Verify whether pump station back-up generators are included in the proposed project.
2. Provide a short paragraph in the Draft Feasibility Report that details that pump stations are proposed to include back-up generators.
3. Revise Draft Feasibility Study, Section 6.6.3 to include an OMRR&R cost allowance for generator operation, periodic maintenance, and life cycle replacement or rehabilitation. Update OMRR&R costs elsewhere in the Draft Feasibility Report accordingly.
4. Modify Appendix B, Cost Engineering Sub-Appendix to include a construction cost allowance for pump station back-up generators.
5. During PED, consider a cost/reliability comparison analysis between the proposed electrically powered pumps with back-up generators vs. direct diesel-powered axial pumps.

Final Panel Comment 25

The estimated costs of monitoring vibrations from construction operations and pile driving to prevent direct and indirect damage to nearby structures may be underestimated.

Basis for Comment

The proposed plan for monitoring potential damage to nearby structures due to construction operations, such as pile driving, centers around vibration monitoring. High levels of vibrations can in fact induce damage to structures. However, vibration can also induce foundation settlement, especially in the widespread loose, cohesionless soils occurring in this study area, which may not be detected by vibration monitoring. Historic structures located in some of the proposed floodwall construction areas may be particularly prone to damage.

In addition to vibration measurement, construction monitoring in urban areas will often also include ground surface settlement, piezometric levels, and tilt measurement on selected structures close to the construction area.

Significance – Low

Expanding the construction monitoring program is unlikely to increase costs to the extent that it would affect the selection of the TSP. However, planning for use of a full range of construction monitoring measures to protect nearby structures will contribute to the completeness of the study cost estimate.

Recommendation for Resolution

1. Consider additional measures for preventing damage to nearby structures due to construction operations, such as measurement of ground surface settlement, piezometric levels, and structural tilt.

Final Panel Comment 26

Inconsistent berm/levee cross-section designs have been described in the Draft Feasibility Study and Appendices, which could affect the reported cost estimates.

Basis for Comment

Crest width for the standard berm/levee geometry reported in the Draft Feasibility Study is 10 feet, but crest widths reported in Appendix A vary from 7 to 12 feet, and from 10 to 12 feet in Appendix B. Therefore, it is not clear what geometry was used as a basis for cost estimates.

Significance – Low

Cost differences associated with variations in the levee geometry are unlikely to be large enough to affect selection of the TSP. However, consistency in the reported levee geometry, or some explanation of why different levee geometries are used along different reaches of levee, would make a more defensible document.

Recommendation for Resolution

1. Resolve or explain the different levee crest widths occurring in various passages of the study documents.

Final Panel Comment 27

The document lacks a clear and detailed description of the future without project conditions.

Basis for Comment

The future without project conditions (also known as the No Action plan) forms the baseline against which all alternative plans are compared. Therefore, it is important to provide a clear and detailed explanation of how the future is expected to look if no Federal action is taken to address the water resource problem under evaluation.

The Draft Feasibility Study and its various appendices all describe the future without a project, but there is no comprehensive description of that condition that brings together the future view of all the disciplines and stakeholders assembled to address this problem. Incorporating the views of all participants in the future without-action conditions can help resolve any existing or potential differences in expectations.

It is common for two or more participating parties to see the future differently. This only becomes an obstacle to plan formulation when the consequences of those differences vary widely in the significance assigned to them. Having a common vision of the baseline condition helps avoid such fractures so that the TSP has a broad enough scope to address each concern.

Significance – Low

The lack of a clear and comprehensive description of the future without project conditions affects the clarity and completeness of the study documents. While unlikely to affect the justification or ranking of alternative plans, such a discussion would demonstrate a comprehensive vision for the study.

Recommendation for Resolution

1. Add a brief section to Chapter 2 of the Draft Feasibility Study summarizing the comprehensive view of the future without project conditions.

Final Panel Comment 28

The number of iterations executed in the HEC-FDA analysis has not been explained in sufficient detail.

Basis for Comment

Appendix C, Section 4.1.1 states that 1,000 iterations were executed by the Hydrologic Engineering Center Flood Damage Reduction Analysis (HEC-FDA) model, but no explanation is given for why that number of iterations produced results that correctly modeled actual conditions. Normally, HEC-FDA modeling requires between 5 and 15 times this number of runs to correctly model actual conditions.

In Part II of Appendix C, information on model stabilization is provided to demonstrate that the number of iterations used in the Beach-fx model produce mean damages that adequately represent the underlying distribution of expected annual damages being simulated by the model. A similar method of demonstrating the completeness of the HEC-FDA simulation exists in the Monte Carlo Analysis summary report. However, the Panel could not find the Monte-Carlo Analysis summary report in Appendix C or the other review documents. The Panel suggests that, at a minimum, USACE should include examples from this report in Appendix C to demonstrate that the number of iterations HEC-FDA performs is adequate and that HEC-FDA is correctly modeling actual conditions.

Significance – Low

The lack of justification for the number of iterations is a technical shortcoming that will not affect justification or selection of the TSP.

Recommendation for Resolution

1. Randomly select a handful of study area economic reaches. Then for one or more analysis years, provide the Monte Carlo Analysis summary report for each economic reach.
2. Explain how the summary reports demonstrate that the model is representing actual conditions and how other reach/analysis year combinations show similar findings.
3. Clarify how in as few as 1,000 iterations the HEC-FDA analysis produced reliable results.

Final Panel Comment 29

The process used to identify and delineate economic reaches has not been discussed in Appendix C.

Basis for Comment

Economic reaches are typically delineated to capture patterns of economic behavior or economic characteristics that are fundamentally different from one another. Each economic reach typically has distinguishing features not found in neighboring areas, such as a hospital, a historic neighborhood, or a hard boundary such as a major road. As a result, reach characteristics may call for different management measures to address the flood risk problems faced by the reach or a set of similar (but not the same) reaches.

Some care must therefore be taken to analyze the study area and characterize the geographic areas so that their characteristics can be differentiated between the reaches more easily.

Significance – Low

This is a minor issue that affects the Panel's ability to assess the completeness of the report documents. Robust discussion of reaches demonstrates attention to important details that describe the economic conditions across the geographic study area.

Recommendation for Resolution

1. Explain the process used to identify and delineate reaches in Appendix C.
2. Use a select few reaches to illustrate differences between neighboring reaches and provide rationale for delineation judgment.

5. REFERENCES

42 U.S.C. §§4321-4370h. Title 32: National Defense. Subpart B: National Environmental Policy Act and the Decision Process. July 1, 2015. Available online at: https://elr.info/legislative/federal-laws/national-environmental-policy-act

40 CFR §1508.7. Cumulative Impact. July 1, 2012. Available online at: https://www.gpo.gov/fdsys/granule/CFR-2012-title40-vol34/CFR-2012-title40-vol34-sec1508-7

Matthews, J.W., D. Skultety, B. Zercher, M.P. Ward and T.J. Benson (2016). Field verification of original and updated National Wetland Inventory maps in three metropolitan areas in Illinois, USA. Wetlands 36:1155-1165. https://doi.org/10.1007/s13157-016-0836-6

NACCS CHS Web Portal: https://chs.erdc.dren.mil/default.aspx

OMB (2004). Final Information Quality Bulletin for Peer Review. Executive Office of the President, Office of Management and Budget, Washington, D.C. Memorandum M-05-03. December 16.

The National Academies (2003). Policy on Committee Composition and Balance and Conflicts of Interest for Committees Used in the Development of Reports. The National Academies (National Academy of Science, National Academy of Engineering, Institute of Medicine, National Research Council). May 12.

USACE (2012a). Water Resources Policies and Authorities: Civil Works Review. Engineer Circular (EC) 1165-2-214. Department of the Army, U.S. Army Corps of Engineers, Washington, D.C. December 15.

USACE (2010). Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Atlantic and Gulf Coastal Plain Region (Version 2.0). Ed. J. S. Wakeley, R. W. Lichvar, and C. V. Noble. ERDC/EL TR-10-20. Vicksburg, MS: U.S. Army Engineer Research and Development Center. Available online at: https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/16/nrcs143_020653.pdf.

USACE (1987). Corps of Engineers Wetlands Delineation Manual. Wetlands Research Program Technical Report Y-87-1. Final Report. Environmental Laboratory, U.S. Army Corps of Engineers Waterways Experiment Station, Vicksburg, MS. Available online at: https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/16/nrcs143_020653.pdf

USACE (2012b). Hurricane and Storm Damage Risk Reduction System Design Guidelines. U.S. Army Corps of Engineers, New Orleans District Engineering Division. Updated June 04, 2012. Available online at: http://www.mvn.usace.army.mil/Portals/56/docs/engineering/HurrGuide/EntireDocument.pdf

USACE Institute for Water Resources, Coastal Systems Portfolio Initiative. http://www.iwr.usace.army.mil/Missions/Coasts/Programs-and-Initiatives/

USFWS (1999). South Florida Multi-Species Recovery Plan. U.S. Fish and Wildlife Service Southeast Region, Atlanta, GA. Available online at https://www.fws.gov/verobeach/ListedSpeciesMSRP.html

APPENDIX A

IEPR Process for the Norfolk CSRM Project

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

Table A-1 presents the major milestones and deliverables of the Norfolk CSRM IEPR. Due dates for milestones and deliverables are based on the award/effective date listed in Table A-1. The review documents were provided by U.S. Army Corps of Engineers (USACE) on October 31, 2017. Note that the actions 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 April 6, 2018. The actual date for contract end will depend on the date that all activities for this IEPR are conducted and subsequently completed.

Table A-1. Major Milestones and Deliverables of the Norfolk CSRM IEPR

Task		Due Date
1	Award/Effective Date	10/31/2017
	Review documents available	10/31/2017
	Public comments available	1/12/2018
	Battelle submits draft Work Plan[a]	11/9/207
	USACE provides comments on draft Work Plan	11/16/2017
	Battelle submits final Work Plan[a]	11/21/2017
2	Battelle submits list of selected panel members[a]	11/16/2017
	USACE confirms the panel members have no COI	11/21/2017
3	Battelle convenes kick-off meeting with USACE	11/8/2017
	Battelle convenes kick-off meeting with panel members	12/6/2017
	Battelle convenes kick-off meeting with USACE and panel members	12/11/2017
4	Panel members complete their individual reviews	1/8/2018
	Panel members provide draft Final Panel Comments to Battelle	1/19/2018
	Battelle sends public comments to panel members for review	1/15/2018
	Panel drafts Final Panel Comment(s) regarding public comments, if necessary	1/22/2018
	Panel finalizes Final Panel Comments	1/29/2018
5	Battelle submits Final IEPR Report to USACE[a]	2/6/2018
6[b]	Battelle convenes Comment Response Teleconference with panel members and USACE	3/22/2018
	Battelle submits pdf printout of DrChecks project file[a]	4/6/2018
	Senior Leader Meeting 1 - Agency Decision Milestone (ADM) meeting[c]	3/6/2018
	Senior Leader Meeting 2 - Post-ADM Senior Leader Meeting (SLM) (estimated date)[c]	10/18/2018
	Contract End/Delivery Date	12/31/2018

[a] *Deliverable.*
[b] *Task 6 occurs after the submission of this report.*
[c] *The ADM and SLM meetings were listed in the Performance Work Statement under Task 3 but were relocated in this schedule to reflect the chronological order of activities.*

At the beginning of the Period of Performance for the Norfolk CSRM 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., terminology to use, access to DrChecks, etc.). Any revisions to the schedule were submitted as part of the final Work Plan. The final charge consisted of 16 charge questions provided by USACE, two overview questions and one public comment question added by Battelle (all questions were included in the draft and final Work Plans), and 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 after their subcontracts were finalized, all the 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 review documents and reference/supplemental materials listed in Table A-2.

Table A-2. Documents to Be Reviewed and Provided as Reference/Supplemental Information

Review Documents	No. of Review Pages
Draft Feasibility Report & Environmental Impact Statement	474
Appendix A Plan Formulation Appendix	102
Appendix B Engineering Appendix	594
Appendix C Economic Appendix	117
Appendix D Environmental Appendix	226
Appendix E Real Estate Appendix	21
Appendix F Correspondence and Coordination Appendix	79
Appendix G Review Certifications	8
Total Number of Review Pages	**1,621**
Supplemental Information[a]	
Public Comments (approximate)[b]	100
North Atlantic Coast Comprehensive Study (NACCS) Main Report and Appendices A through D	2,085
Engineer Research and Development Center (ERDC) Use of Natural and Nature-Based Features for Coastal Resilience	479
ERDC Coastal Storm Hazards from Virginia to Maine	221
ERDC NACCS Coastal Storm Model Simulations: Waves and Water Levels	252
ERDC NACCS Phase 1: Statistical Analysis of Historical Extreme Water Levels with Sea Level Change	125

Table A-2. Documents to Be Reviewed and Provided as Reference/Supplemental Information (continued)

Review Documents	No. of Review Pages
NACCS Physical Depth Damage Function Summary Report	306
FUGRO Reports: Mason Creek, The Hague, Lafayette River, Pretty Lake, Downtown Floodwall (5 separate files)	947
ER 1105-2-100, Planning Guidance Notebook	712
EM 1110-2-1619 Risk Based Analysis for FDR Studies	63
ER 1110-2-1150 Engineering and Design for Civil Works Projects	65
Risk Register	10
Decision Log	10
Total Number of Reference Pages	**5,375**

[a] *Supporting documentation only. These documents are not for Panel review and should be used as information sources only. They are not included in the total page count.*

[b] *USACE will submit public comments to Battelle upon their availability according to the schedule in Table A-1, who will in turn submit the comments to the IEPR Panel for review.*

In addition to the materials provided in Table A-2, the panel members were provided the following USACE guidance documents.

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

About halfway through the review, a teleconference was held with USACE, Battelle, and the Panel so that USACE could answer any questions the Panel had concerning either the review documents or the project. Prior to this teleconference, Battelle submitted 11 panel member questions to USACE. USACE was able to provide written responses to all the questions prior to the teleconference and provided clarifying responses to follow up questions on the teleconference.

A.2 Review of Individual Comments

The Panel was instructed to address the charge questions/discussion points within a charge question response form 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 into a preliminary list of overall comments and discussion points. Each panel member's individual comments were shared with the full Panel.

A.3 IEPR Panel Teleconference

Battelle facilitated a 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 should 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.

A.4 Preparation of Final Panel Comments

Following the teleconference, Battelle distributed 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 Norfolk CSRM 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 a summary email 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:** There is a fundamental issue within study documents or data that will influence the technical or scientific basis for selection of, justification of, or ability to implement the recommended plan.

2. **Medium/High:** There is a fundamental issue within study documents or data that has a strong probability of influencing the technical or scientific basis for selection of, justification of, or ability to implement the recommended plan.

3. **Medium:** There is a fundamental issue within study documents or data that has a low probability of influencing the technical or scientific basis for selection of, justification of, or ability to implement the recommended plan.

4. **Medium/Low:** There is missing, incomplete, or inconsistent technical or scientific information that affects the clarity, understanding, or completeness of the study documents, and there is uncertainty whether the missing information will affect the selection of, justification of, or ability to implement the recommended plan.

5. **Low:** There is a minor technical or scientific discrepancy or inconsistency that affects the clarity, understanding, or completeness of the study documents but does not influence the selection of, justification of, or ability to implement the recommended plan.

- 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. At the end of this process, the 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 full text of the Final Panel Comments is presented in Section 4.2 of the main report.

A.5 Conduct of the Public Comment Review

Following the schedule in Table A-1, Battelle received two pdf files containing 210 pages of public comments on the Norfolk CSRM project from USACE. Battelle then sent the public comments to the panel members in addition to the following charge question:

1. **Do the public comments raise any additional discipline-specific technical concerns with regard to the overall report?**

The Panel produced individual comments in response to the charge question. Each panel member's individual comments for the public comment review were shared with the full Panel. Battelle reviewed the comments to identify any new technical concerns that had not been previously identified during the initial IEPR. After completing its review, the Panel noted that some of the issues raised in the public comments augmented at least one of their IEPR Final Panel Comments. Final Panel Comment 12 was updated to include this detail. The Panel confirmed that one new issue (Final Panel Comment 23) was identified in addition to those already covered in the Final Panel Comments. One panel member was identified by Battelle as the lead author responsible for coordinating the development of the Final Panel Comment and submitting it to the other panel members and Battelle. The Final Panel Comment was developed as part of a four-part structure following guidance previously described in Section A.4.

Battelle reviewed and edited the Final Panel Comment for clarity, consistency with the comment statement, and adherence to guidance on the Panel's overall charge, which included ensuring that the comment did not make any observations regarding either the appropriateness of the selected alternative or USACE policy. At the end of the public comment review, a new total of 29 Final Panel Comments were prepared and assembled. There was no direct communication between the Panel and USACE during the preparation of the Final Panel Comment.

A.6 Final IEPR Report

After concluding the review and preparation of the Final Panel Comments, Battelle prepared a final IEPR report (this document) on the overall IEPR process and the IEPR panel members' findings (this document). Each panel member and Battelle technical and editorial reviewers reviewed the IEPR report prior to submission to USACE for acceptance.

A.7 Comment Response Process

As part of Task 6, Battelle will enter the 29 Final Panel Comments (28 Final Panel Comments from the review of the decision documents plus one new Final Panel Comment from the public comment review) 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.

APPENDIX B

Identification and Selection of IEPR Panel Members for the Norfolk CSRM Project

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B.1 Panel Identification

The candidates for the City of Norfolk, Virginia, Coastal Storm Risk Management (CSRM) Feasibility Study, North Atlantic Coast Comprehensive Study (NACCS) Focus Area Independent External Peer Review (hereinafter: Norfolk CSRM IEPR) Panel were evaluated based on their technical expertise in the following key areas: Civil Works planning/economics, biological resources and environmental law compliance, coastal/hydrology and hydraulic engineering, structural engineering, geotechnical engineering, and civil engineering/risk review. These areas correspond to the technical content of the review documents and overall scope of the Norfolk CSRM 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 six experts for the final Panel. The remaining candidates were not proposed for a variety of reasons, including lack of availability, disclosed COIs, or lack of the precise technical expertise required.

Candidates were screened for the following potential exclusion criteria or COIs. These COI questions were intended to serve as a means of disclosure in order to better characterize a candidate's employment history and background. Battelle evaluated whether scientists in universities and consulting firms that are receiving USACE-funding have sufficient independence from USACE to be appropriate peer reviewers. Guidance in OMB (2004, p. 18) states,

> "…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."

Panel Conflict of Interest (COI) Screening Statements for the IEPR of the Norfolk CSRM
1. Previous and/or current involvement by you or your firm with the City of Norfolk, Virginia, Coastal Storm Risk Management (CSRM) Feasibility Study, North Atlantic Coast Comprehensive Study (NACCS) Focus Area and related projects.
2. Previous and/or current involvement by you or your firm in coastal storm risk management studies or work related to the City of Norfolk, Virginia, CSRM Feasibility Study, or NACCS Focus Area.
3. Previous and/or current involvement by you or your firm in the conceptual or actual design, construction, or operation and maintenance (O&M) of any projects with the City of Norfolk, Virginia CSRM Feasibility Study, or NACCS Focus Area or related projects.

Panel Conflict of Interest (COI) Screening Statements for the IEPR of the Norfolk CSRM
4. Current employment by the U.S. Army Corps of Engineers (USACE).
5. Previous and/or current involvement with paid or unpaid expert testimony related to the City of Norfolk, Virginia, CSRM Feasibility Study, or the NACCS Focus Area.
6. Previous and/or current employment or affiliation with the non-Federal sponsors or any of the following cooperating Federal, State, County, local and regional agencies, environmental organizations, and interested groups *(for pay or pro bono):* • City of Norfolk • U.S. Environmental Protection Agency, Region 3
7. Past, current, or future interests or involvements (financial or otherwise) by you, your spouse, or your children related to the City of Norfolk, Virginia, the CSRM project, or the NACCS Focus Area.
8. Current personal involvement with other USACE projects, including whether involvement was to author any manuals or guidance documents for USACE. If yes, provide titles of documents or description of project, dates, and location (USACE district, division, Headquarters, Engineer Research and Development Center [ERDC], etc.), and position/role. Please highlight and discuss in greater detail any projects that are specifically with the Norfolk District.
9. Previous or current involvement with the development or testing of models that will be used for, or in support of the City of Norfolk, Virginia, CSRM Feasibility Study, NACCS Focus Area project (e.g., hydrodynamic and water quality modeling, ADCIRC, HEC-FDA, Beach-fx, Coastal Storm Modeling System, STWAVE, HYSED-3D. HEM-3D, New England Salt Marsh Model).
10. Current firm involvement with other USACE projects, specifically those projects/contracts that are with the Norfolk 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 Norfolk District. Please explain.
11. Any previous employment by USACE as a direct employee, notably if employment was with the Norfolk District. If yes, provide title/description, dates employed, and place of employment (district, division, Headquarters, ERDC, etc.), and position/role.
12. Any previous employment by USACE as a contractor (either as an individual or through your firm) within the last 10 years, notably if those projects/contracts are with the Norfolk District. If yes, provide title/description, dates employed, and place of employment (district, division, Headquarters, ERDC, etc.), and position/role.
13. Previous experience conducting technical peer reviews. If yes, please highlight and discuss any technical reviews concerning coastal storm risk management and include the client/agency and duration of review (approximate dates).
14. Pending, current, or future financial interests in the City of Norfolk, Virginia, CSRM or NACCS Focus Area related contracts/awards from USACE.

Panel Conflict of Interest (COI) Screening Statements for the IEPR of the Norfolk CSRM
15. Significant portion of your personal or office's revenues within the last three years came from USACE contracts.
16. Significant portion of your personal or office's revenues within the last three years came from City of Norfolk contracts.
17. Any publicly documented statement (including, for example, advocating for or discouraging against) related to the City of Norfolk, Virginia, CSRM Feasibility Study, or NACCS Focus Area.
18. Participation in relevant prior and/or current Federal studies relevant to this project and/or City of Norfolk, Virginia, CSRM Feasibility Study, or NACCS Focus Area.
19. Previous and/or current participation in prior non-Federal studies relevant to this project and/or City of Norfolk, Virginia, CSRM Feasibility Study, or NACCS Focus Area.
20. Has your research or analysis been evaluated as part of the City of Norfolk, Virginia, CSRM Feasibility Study, or NACCS Focus Area?
21. 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.

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. The term "firm" in a screening question referred to any joint venture in which a firm was involved. It applied to whether that firm serves as a prime or as a subcontractor to a prime. Candidates were asked to clarify the relationship in the screening questions.

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. Table B-1 provides information on each panel member's affiliation, location, education, and overall years of experience. Two panel members were independent consultants and the other four were affiliated with consulting companies. 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.

Table B-1. Norfolk CSRM IEPR Panel: Summary of Panel Members

Name	Affiliation	Location	Education	P.E.	Exp. (yrs)
Civil Works Planner / Economist					
David Luckie	Independent Consultant	Mobile, AL	B.A., Economics & Finance	N/A	28
Biological Resources and Environmental Law Compliance Specialist					
Kay Crouch	Crouch Environmental Services, Inc.	Houston, TX	M.S., Biology and Aquatic Ecology	N/A	39
Coastal / Hydrology and Hydraulic Engineer					
Christopher Bender	Taylor Engineering	Jacksonville, FL	Ph.D., Coastal Engineering	Yes	15
Structural Engineer					
Jay Jani	Engineering Consulting Services, Inc.	Metairie, LA	Ph.D., Ocean Engineering	Yes	32
Geotechnical Engineer					
Charles Aubeny	Independent Consultant	Bryan, TX	Ph.D., Civil Engineering	Yes	34
Civil Engineer / Risk Reviewer					
Phillip Brozek	Brozek & Associates	Eugene, OR	B.S., Civil Engineering	Yes	35

Table B-2 presents an overview of the credentials of the final six members of the Panel and their qualifications in relation to the technical evaluation criteria. More detailed biographical information on the panel members and their areas of technical expertise is given in Section B.3.

Table B-2. Norfolk CSRM IEPR Panel: Technical Criteria and Areas of Expertise

Technical Criterion	Luckie	Crouch	Bender	Jani	Aubeny	Brozek
Civil Works Planner / Economist						
Minimum of 15 years of demonstrated experience in economics	X					
Minimum MS degree or higher in economics	X					
At least 10 years of experience directly related to water resource economic evaluation with comprehensive understanding of regional economic development as well as traditional USACE national economic development benefits	X					
Familiar with USACE plan formulation processes, procedures, and standards as they relate to hurricane and coastal storm risk management Civil Works projects	X					
Minimum of 5 years of experience directly dealing with the USACE six-step planning process and policies governed by Engineer Regulation (ER) 1105-2-100, Planning Guidance Notebook	X					
Familiar with USACE application of risk and uncertainty analyses in storm risk management studies	X					
Familiar with the standard USACE Engineering Center (HEC) economic modeling computer software including HEC Flood Damage Reduction Analysis (FDA)	X					
Biological Resources and Environmental Law Compliance Specialist						
Minimum of 15 years of experience directly related to water resources environmental evaluation or review		X				
Minimum MS degree or higher in related field		X				
At least 10 years of experience in evaluating and conducting National Environmental Policy Act (NEPA) impact assessments, including cumulative effects analyses for complex, multi-objective public works projects with competing trade-offs and environmental mitigation needs		X				
Knowledge of construction impacts on marine and terrestrial ecology of coastal regions of the mid-Atlantic coast of North America		X				
Familiar and have experience with United States Fish and Wildlife Service Habitat Evaluation Procedure (HEP), the Habitat Equivalency Analysis (HEA), Endangered Species Act (ESA), Clean Water Act (CWA), Marine Mammals Protection Act (MMPA) and essential fish habitat (EFH)		X				
Active participation in related professional societies is encouraged		X				

Table B-2. Norfolk CSRM IEPR Panel: Technical Criteria and Areas of Expertise (continued)

Technical Criterion	Luckie	Crouch	Bender	Jani	Aubeny	Brozek
Coastal / Hydrology and Hydraulic Engineer						
Registered Professional Engineer			X			
Minimum of 15 years of experience in coastal hydrologic and hydraulic engineering with an emphasis on coastal storm risk management projects, particularly projects in urbanized coastal areas, or a professor from academia with extensive background in coastal practices & processes and hydraulic theory and practice			X			
Thorough understanding and knowledge of the development of stage frequency statistics, coastal hydrodynamics, application of detention/retention basins, application of levees and flood walls, interior drainage, and nonstructural solutions involving flood warning systems and flood proofing			X			
Familiar with the following coastal models: Beach-fx, SBEACH, and ACES. Familiarity with the HEC-RAS, HEC- HMS, GENESIS, STWAVE, ADCIRC, CMS-Wave, and CMS-Flow computer applications/model is desired but not required			X			
Capable of addressing the USACE Safety Assurance Review (SAR) aspects of all projects per Engineer Circular (EC) 1165-2-214, Appendix D, Para. 2.c(3)			X			
Structural Engineer						
Registered Professional Engineer				X		
Minimum of 15 years of experience in the structural engineering of coastal structures, hydraulic steel structures, and storm water drainage structures				X		
Minimum MS degree or higher in engineering				X		
Experience in performing structural evaluation and structural design for all phases of coastal storm risk management projects, specifically those with structural and nonstructural coastal storm risk management measures				X		
Familiar with and have demonstrated experience related to USACE hydraulic steel structures, sheet pile “I” walls, and T-wall practices associated with flood management channels, construction and engineering				X		
Active participation in related professional engineering and scientific societies is encouraged				X		
Geotechnical Engineer						
Registered Professional Engineer					X	
Minimum of 15 years of experience in geotechnical/structural engineering					X	
Minimum MS degree or higher in engineering					X	
Experience in performing geotechnical evaluation and geo-civil design for all phases of coastal storm risk management projects, specifically those with structural and nonstructural coastal storm risk management measures					X	

Table B-2. Norfolk CSRM IEPR Panel: Technical Criteria and Areas of Expertise (continued)

Technical Criterion	Luckie	Crouch	Bender	Janji	Aubeny	Brozek
Familiar with and have demonstrated experience related to USACE geotechnical practices associated with flood walls, levees, flood management channels, construction, and soil engineering					X	
Active participation in related professional engineering and scientific societies is encouraged					X	
Capable of addressing the USACE SAR aspects of all projects per EC 1165-2-214, Appendix D, Para. 2.c(3)					X	
Civil Engineer / Risk Reviewer						
Registered Professional Engineer						X
Minimum of 15 years of experience in engineering or architecture.						X
Experience in large public works projects						X
Familiar with structural and nonstructural coastal storm risk management measures						X
Familiar with the USACE application of risk and uncertainty analyses in coastal storm risk management projects, particularly projects in urbanized coastal areas						X

B.3 Panel Member Qualifications

Detailed biographical information on each panel members' credentials and qualifications and areas of technical expertise are summarized in the following paragraphs.

Name	**David Luckie**
Role	**Civil Works Planner/Economist**
Affiliation	**Independent Consultant**

Mr. Luckie is an independent consultant with nearly 30 years of professional experience in water resource economics, planning, plan formulation, benefit-cost analysis, and risk-based analysis. His public works experience encompasses decades of work with Federal and non-Federal agencies, as well as local and state organizations. He earned his B.S. in economics and finance from the University of South Alabama in 1986. His professional experience includes working with multidisciplinary teams to provide or review complex planning studies for coastal storm risk management, dam safety, flood risk management, ecosystem restoration, and water supply and water quality studies. He is intimately familiar with Engineer Regulation (ER) 1105-2-100 and the 6-Step Planning Process and has prepared, supervised, or reviewed numerous planning studies in his career.

Mr. Luckie is familiar with the evaluation of alternative plans for both CSRM and flood risk management (FRM) studies, and has conducted, supervised, or reviewed several water resource studies featuring

numerous alternative plans constructed from an array of different management measures. Over the last three decades, Mr. Luckie has been involved in numerous CSRM studies. Two examples are the Panama City Beach, Florida, study, a multipurpose project that included structural, non-structural, and recreation outputs, and the Mississippi Coastal Improvements Program following Hurricanes Katrina and Rita. He has also served as a panel member on the IEPRs of the Hereford Inlet CSRM Study in New Jersey and the Encinitas-Solana Beach CSRM Study in California. He applied his knowledge of ER-1105-2-100 and the 6-Step Planning Process in each of these high-profile efforts.

Least cost analysis, also known as cost-effectiveness analysis, has been a very important aspect of Mr. Luckie's decades of work. He is familiar with the evaluation of alternative plans. As a Regional Economist with the USACE Mobile District (1988-2006), Mr. Luckie conducted, supervised, or reviewed benefit-cost analyses for a variety of water resource projects, both single-purpose and multi-purpose projects covering the full range of USACE missions. Relevant studies include the Apalachicola-Chattahoochee-Flint River and the Alabama-Coosa-Tallapoosa Comprehensive Studies and the draft Programmatic Environmental Impact Statements covering the states of Alabama, Florida, and Georgia; and the Hunting Bayou General Reevaluation Report (GRR) in Houston, Texas.

Mr. Luckie is very familiar with USACE standards and procedures. He has extensive experience in performing National Economic Development (NED) analyses, specifically as they relate to flood and coastal risk management. For more than 25 years, he has performed, supervised, or reviewed NED procedures for technical accuracy and compliance with policy and guidance and accepted planning principles. Such studies as Panama City Beaches and Mississippi Coastal Improvements reflect this expertise.

Mr. Luckie has been using the Hydrologic Engineering Center's Flood Damage Reduction Analysis (HEC-FDA) software since its inception in the 1990s. He has also performed, reviewed, or trouble-shot scores of HEC-FDA analyses for Federal, non-Federal, and private sector clients. In addition, he has mentored interns and junior economists in USACE methodologies for coastal flood risk management, requiring them to calculate without- and with-project condition damages, either by hand or with a Microsoft Excel spreadsheet, before allowing them to use HEC-FDA. He is also very familiar with the USACE Regional Economic System (RECONS) model and the estimation of Regional Economic Development benefits, and has used the model for both Federal and non-Federal project proponents since its inception.

Name	**Kay Crouch**
Role	**Biological Resources & Environmental Law Compliance Specialist**
Affiliation	**Crouch Environmental Services, Inc.**

Ms. Crouch is board chair of Crouch Environmental Services, Inc., a company specializing in National Environmental Policy Act (NEPA) analysis, environmental site assessment, permitting, and mitigation for projects with high public and interagency interests. She earned her M.S. in biology/ecology in 1978 from Stephen 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). Ms. Crouch has more than 39 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 nation in support of Federal Energy Regulatory Commission (FERC) filings and NEPA

documentation. For the first 10 years of her consulting career, Ms. Crouch worked predominantly in Louisiana performing NEPA analyses for oil and gas pipelines crossing the Louisiana Coastal Zone and has prepared over 100 NEPA documents since 1978.

Ms. Crouch has experience working with NEPA impact assessment in marsh and urban areas and related ecosystem species and habitats. She has done extensive work in the coastal marsh habitats that span the Gulf Coast, and has performed site selection studies and FERC NEPA analyses in the mid-Atlantic region as well. She has experience in high and low tidal marsh restoration and evaluation, as well as inland wetlands. Additionally, she has worked on projects in Louisiana involving evaluation of chenieres and inland swamps. In the mid-1990s, Crouch Environmental Services (CESI) designed and constructed the Baytown Nature Center, Texas, a large coastal marsh creation project for which the company received the 1998 Award of Excellence from the National Association of Landscape Architects. Since that time, Ms. Crouch and CESI have designed and constructed numerous tidal marshes, restored coastal prairie habitat, and revegetated forested habitats.

Ms. Crouch is familiar with USACE calculations of environmental benefits and routinely performs cumulative effects analyses on high-visibility public works projects as part of her extensive NEPA practice. This type of modeling has been required on every flood damage reduction and ecosystem restoration project she has worked on relating to USACE, including the Clear Creek Flood Damage Reduction Project and the Addicks and Barker Dams and Reservoirs system in Harris County, Texas. Other NEPA projects have consisted of flood damage reduction projects, dams, ports, parks, offshore activities, linear transportation corridors, and power plants and other types of projects involving Federal funding.

Ms. Crouch has 39 years of experience with endangered species. She has completed several projects that involve compliance with the Endangered Species Act (ESA), specifically with the listed species found in Southern Louisiana (including state-listed species), through her work in the Louisiana coastal zone.). The evaluation of the presence or absence of listed species is required for almost every project she has been involved in. These include USACE 404 permit applications requiring field investigations for listed species in numerous states; she also has completed the Section 7 consultation process for several species.

Ms. Crouch also has demonstrated experience with cultural resource surveys. Almost every project she works on requires an investigation and evaluation of cultural resource issues. She is intimately familiar with the record search step as well as field survey techniques for cultural resources. Her experience is supervisory and relates to USACE 404 permits and NEPA documentation. She also has experience with Section 106 for the analysis of historical issues. She has demonstrated knowledge of conducting biological assessments, including wetlands delineation, compilation of Biological Assessments for Section 404 permitting, and NEPA documentation. She has dealt with numerous types of habitats in many locations nationwide.

Ms. Crouch is familiar with USACE's calculation and application of environmental impacts and benefits. She routinely performs cumulative effects analyses on high-visibility public works projects as part of her extensive NEPA practice. She is well versed in various modeling types and in the performance of incremental cost analysis for mitigation evaluation for dam repair and restoration. She has experience reviewing the application of Wetland Value Assessment (WVA) methodology and has calculated the environmental losses and benefits of USACE projects using the hydrogeomorphic (HGM) approach, habitat evaluation procedures (HEP), and WVA, as well as other models. Most recently, she performed

WVA analysis for the Addicks and Barker Dams environmental assessment in Harris County, Texas, for the Galveston District. Additionally, she has experience serving as an environmental expert in previous IEPRs of USACE Louisiana Water Resources Council (LWRC) projects. Ms. Crouch is a member of the Society of Wetland Scientists.

Name	**Christopher Bender, Ph.D., D. CE, P.E.**
Role	**Coastal/Hydrology and Hydraulic Engineer**
Affiliation	**Taylor Engineering**

Dr. Bender is a senior engineer in the coastal engineering group at Taylor Engineering, Inc. He earned a Ph.D. in coastal engineering from the University of Florida in 2003 and is a registered professional engineer in Florida and Mississippi. He leads much of Taylor Engineering's simulations and evaluations of hurricane surges, wave mechanics and loading, littoral processes, shoreline stability and protection, beach renourishment, and sediment transport. He has also served as an adjunct professor at the University of North Florida since 2009, teaching coastal engineering and processes classes.

His experience includes large urban coastal risk reduction engineering projects and shore protection projects and designs in Florida and coastal storm surge studies in the southeastern United States, New York, New Jersey, and the Gulf of Mexico. Studies include the Federal Emergency Management Agency (FEMA) Region IV Coastal Storm Surge Update Studies in South Carolina, Georgia, Northeast Florida, and East Coast Central Florida and the Nuclear Regulatory Commission (NRC) Evaluation of Coastal Storm Surge for Nuclear Power Plants. Dr. Bender has also served on USACE IEPR panels as the coastal engineering discipline expert for coastal storm damage reduction studies for the Hereford Inlet to Cape May Inlet, New Jersey, Hurricane and Coastal Storm Damage Risk Reduction Project Draft Feasibility Report and Environmental Assessment; the Surf City and North Topsail Beach, North Carolina, Integrated Feasibility Report and Environmental Impact Statement; the South Shore of Staten Island Coastal Storm Damage Reduction Feasibility Study; and the Fire Island to Montauk Point Coastal Storm Risk Management Hurricane Sandy General Reformulation Report.

Dr. Bender is familiar with USACE coastal, hydrologic and hydraulic computer models and has extensive experience setting up, executing, and post-processing results in USACE coastal models, including Coastal Modeling System (CMS), Steady State Spectral WAVE (STWAVE), Advanced Circulation (ADCIRC), Storm-induced Beach Change Model (SBEACH), Beach-fx, Simulating Waves Nearshore model (SWAN), Generalized Model for Simulating Shoreline Change (GENESIS), and Coastal Engineering Design and Analysis System (CEDAS) for several projects. He has worked with the CMS system and models and the Surface-water Modeling System (SMS) software. During recent studies, he has applied STWAVE for nearshore and offshore spectral wave modeling and ADCIRC to simulate storm surge levels, with efforts during the entire modeling process: grid development, model validation, storm simulation, and processing of model results. Dr. Bender has applied spreadsheet models for wave growth, wave runup, and wave overtopping along Louisiana coastal levees and during evaluation of storm surge hazard at NRC nuclear sites. He is also familiar with the Generalized Risk and Uncertainty Coastal Plan (GRANDUC model) and has successfully applied these models to many locations from Florida to Texas.

Dr. Bender is familiar with risk and uncertainty analyses for coastal storm risk management projects, participating in such studies as the development of GRR and limited reevaluation report (LRR) documents for the Ft. Pierce, Florida, Shore Protection Project; GRR document for the Panama City Beaches,

Florida, Shore Protection Project; and Feasibility Study for the Walton County, Florida, Project. The projects applied USACE models to define damages and benefits and NED aspects of project alternatives. Efforts on the various projects included storm damage modeling, alternative development, alternative analysis, and NED plan selection. He also worked with a team of experts to develop a risk-based methodology to calculate revised coastal storm surge and wave estimates for the Joint USACE/FEMA Coastal Storm Surge Studies along the Louisiana and Texas coasts. He also participated in projects to develop revised coastal storm surge and wave estimates for FEMA coastal storm surge studies along the South Carolina, Georgia, and east Florida coasts.

Dr. Bender is capable of addressing the USACE Safety Assurance Review (SAR) requirements and has conducted SARs in support of such studies as the Shore Protection Projects (SPP) in Martin County and St. Lucie County, Florida. He has also authored or co-authored numerous publications on nearshore wave transformation, coastal processes, and simulation of nearshore waves. His involvement in the Fort Pierce, Florida, LRR and GRR projects, the Nassau County, Florida, GRR, and the Panama City Beaches, Florida, GRR project included working with the USACE application of risk and uncertainty analyses in coastal storm damage reduction studies.

Name	**Jay Jani, Ph.D., P.E.**
Role	**Structural Engineer**
Affiliation	**Engineering Consulting Services, Inc.**

Dr. Jay Jani, P.E., has more than 32 years of experience as a structural engineer working on a variety of projects including offshore and coastal structures, flood protection, subsea pipelines, and industrial structures. He earned his Ph.D. in ocean engineering with a major in structural engineering and an emphasis on offshore and coastal structures from Florida Atlantic University in 1990. Dr. Jani founded his firm, Engineering Consulting Services, Inc.(ECS) in 2000 and has been ECS's president/CEO and senior structural engineer since the firm's founding. He also served as an adjunct faculty member in the Department of Civil Engineering at the University of New Orleans.

Dr. Jani has served on previous post-Katrina IEPR panels for the USACE New Orleans District's Hurricane and Storm Damage Risk Reduction System (HSDRRS) projects. These projects' structures (specifically, the Lake Pontchartrain and Vicinity 144 project) included T-walls, I-walls, L-walls, T-wall sheetpiles, levees, steel gates, levee tie-ins, temporary retaining structures, transition and scour protection, barge/boat impact loads, and flood protection structures. He also has participated in other IEPR panels, reviewing documents such as the New Orleans District's "HSDRRS Design Guidelines" (USACE, 2012b), "Aberrant Barge Impact Loads on HSDRRS Floodwalls," and "Spiral Welded Pipe (SWP) Piles." Dr. Jani also performed structural inspections of USACE New Orleans District's Bayou Dupre and Bayou Bienvenue control structures to assess their post-Katrina structural integrity and condition. Dr. Jani has extensive experience in the structural design of steel-reinforced concrete structures, pile foundations, construction, and rehabilitation projects in soft Louisiana soils.

He also has extensive experience designing and assessing the structural integrity of all phases of offshore platform design for various projects, including a floating tension-leg platform in the Gulf of Mexico, in-place analysis of fixed offshore platforms, installation engineering (load-out, transportation analysis, lift analysis, lift rigging design, etc.), pile foundation design, subsea pipelines, and steel catenary risers (SCR) and SCR hook design and earthquake analysis In addition, he participated in the structural integrity assessment of many residential buildings in metro New Orleans and vicinity following Hurricane

Katrina. In 2008-2009, Dr. Jani served as Chairman of the American Society of Civil Engineers/Structural Engineering Institute Structures Committee (New Orleans chapter).

Name	**Charles Aubeny, Ph.D., P.E., C.E.**
Role	**Geotechnical Engineer**
Affiliation	**Independent Consultant**

Dr. Aubeny is currently employed at Texas A&M University teaching soil mechanics, geotechnical design, geotechnical testing, and numerical methods. He earned his PhD in Civil Engineering from Massachusetts Institute of Technology in 1992. His academic experience includes 18 years of teaching, conducting research, and consulting on topics involving slope stability, earth-retaining structures, geotechnical site characterization, numerical analysis, offshore foundations and pipelines, and unsaturated soils. Prior experience includes eight years with the Embankment Dams Branch of the U.S. Bureau of Reclamation and seven years in private consulting in geotechnical engineering, offshore engineering, dam engineering, levees and flood control, and geo-environmental engineering. He has had direct personal involvement in a wide range of geotechnical practice, including field investigations, laboratory testing, analysis, design, construction quality control and assurance, and performance monitoring of structures during operation.

Dr. Aubeny has 34 years of experience in the planning, analysis, design and construction of earthen embankments and floodwalls. His background includes design and analysis for slope stability, settlement, seepage control, wave run-up protection, and overtopping. He has teamed with structural engineers in the design of traditional floodwalls and has extensive knowledge of earth-retaining structures, including sheetpile walls, drilled shafts, and mechanically stabilized earthfill. His design experience also includes the planning and implementation of instrumentation programs that monitor the performance of embankments and retaining walls. He has been involved in the construction aspects of geotechnical practice throughout his career, including serving as resident engineer for Pacific Gas & Electric during construction of the seismic retrofit of Butt Valley Dam (1997) and as chief of geotechnical monitoring for the East Bay Municipal Utility District for the upgrade of the Mokelumne Aqueduct (1998).

Dr. Aubeny's prior service as an external peer reviewer on coastal engineering projects includes the USACE Mississippi Coastal Improvement Study (2009), which considered a wide range of both structural and nonstructural risk management measures, and the USACE Freeport Harbor Navigation Improvement Project (2008). He also was an external peer reviewer on other USACE projects involving flood risk management in the Lower San Joaquin River in California (2015), the Dallas Floodway (2013), the Santa Maria levees in California (2012), and the Kansas City levees (2012). He served as Project Manager on several flood control projects governed by USACE geotechnical standards, including the Sacramento Area Flood Control Levee Upgrades (1996) and multiple levee systems throughout the Sacramento-San Joaquin River Delta (1992-1998). His annual graduate course on slope stability and retaining walls presents USACE practice for the analysis, design, and construction of levees, earth dams, sheetpile walls, flood walls, and retaining walls. He has served on prior IEPR panels for USACE projects involving SARs for flood management, including the Santa Maria and Bradley Canyon levee system, the Kansas City Flood Risk Management Project, and the Dallas Floodway Feasibility Report and Environmental Impact Statement.

Dr. Aubeny actively participates in professional engineering and scientific societies, including service as an Editorial Board Member for the Journal of Geotechnical and Geoenvironmental Engineering and the Geotechnical Testing Journal. He is frequently called as an expert witness on forensic cases involving distressed slopes, retaining walls, and underwater lifelines. He authored a textbook titled *Geomechanics of Marine Anchors* outlining the state of practice on offshore site soil characterization and on anchor and pile design for coastal and ocean engineering projects. He regularly performs service activities to the profession and currently supervises three Texas A&M doctoral students performing site inspections and data collection for the Geotechnical Extreme Events Reconnaissance study of coastal Texas following Hurricane Harvey in 2017. He received the American Society of Civil Engineers (ASCE) Middlebrooks Award and is an ASCE Fellow.

Name	**Phillip Brozek, P.E.**
Role	**Civil Engineer/Risk Reviewer**
Affiliation	**Brozek & Associates**

Mr. Brozek, a principal with Brozek & Associates, has 35 years of experience as a practicing engineer. He earned his B.S. in civil engineering in 1979 from California State University, Sacramento, and is a registered professional engineer in California and Oregon. In addition to additional academic coursework in water resources engineering, Mr. Brozek holds a Certificate in Hazardous Material Management from the University of California Extension, Davis, and an Associates Certificate in Project Management from George Washington University. He also was a founding member of the Practitioner Advisory Committee at the Department of Civil Engineering, California State University, Sacramento.

Mr. Brozek's familiarity with large, complex Civil Works projects with high public and interagency interest includes work on projects both as an employee of USACE and as a private consultant. Project objectives for this work included flood risk management, levee and dam safety risk management, and watershed restoration. Mr. Brozek's review capability is enhanced by significant experience in construction management and the practical operation and maintenance, repair, replacement, and rehabilitation (OMRR&R) implementation for projects focusing on project resiliency.

Mr. Brozek served as a Civil Works Senior Project Manager for 11 years with the USACE Sacramento District, overseeing large multi-objective projects. He was also project and program manager for the interagency restoration of the Lake Tahoe watershed, which included multi-objective planning and implementation as part of a long-term $3.5 billion watershed restoration plan. His USACE experience featured structural and nonstructural elements, including levee embankments, stability berms, dam removal, reinforced concrete channels and floodwalls on top of embankments, box culverts, bridge appurtenances, pump stations, sheetpiles, off-stream detention basins and on-stream overbank storage, and control features to maximize storage while attenuating and reducing peak discharge. Environmental restoration project features included vegetated basins to provide incremental water quality improvements, aquatic ecosystem improvements, and recreation access and opportunities when areas are not inundated. Typical projects included the San Lorenzo River (with coastal outlet), South Sacramento Streams group, Yuba River, Magpie Creek, Sacramento River Gradient Structure, multiple stream restoration projects (e.g., Mill Creek, Blackwood Creek, Upper Truckee River) in the Lake Tahoe watershed, and oversight as senior project manager of an entire portfolio of other projects.

For nearly eight years, Mr. Brozek has worked as a consultant on large Civil Works projects that include levee vegetation management risk waivers; training of USACE project managers in risk management and

practical application of risk and uncertainty principles in actual projects; risk register updates for feasibility study; dam design and construction; reservoir land use planning; dam modification design-dam safety; risk assessment integration; safety review of the new construction and demolition of concrete flood walls, flood gates, and other appurtenances; review of slope stabilization during demolition of existing structures; work around historic, archeological and environmentally sensitive areas; and the planning, design, and review of material management plans for projects that involve the removal, separation, storage, and disposal of large amounts of excess material, including concrete and soil.

Typical projects included the San Lorenzo River Levee Vegetation Management; Phases 4 and 5 of the Folsom Dam Joint Federal Project; Folsom Dam Raise; Folsom Water Control Manual; and El Paso Feasibility Study. All these projects attracted significant scrutiny from political leadership, Federal, state, and local agencies, tribes, non-governmental organizations (NGOs), and engaged and vocal stakeholders. Mr. Brozek also presented original material on elements of USACE Planning Modernization, including the application of risk-based decision process to a meeting of the Society of American Military Engineers.

Mr. Brozek has served on several IEPR Type I review panels and provided technical facilitation and review planning for several USACE project Agency Technical Reviews and IEPR Type II SAR efforts (before the Risk Management Center was staffed to complete that same type of work). That effort included design in accordance with ER 1110-2-1150, Engineering and Design for Civil Works Projects, with due consideration for the sufficiency of surveys, investigations, and engineering; appropriateness of assumptions and models; and analysis of risk. He also prepared a modification of the Folsom Dam Water Control Manual Review Plan to better integrate elements of both Type I and Type II IEPRs into a hybrid IEPR process for a unique project.

APPENDIX C

Final Charge for the Norfolk CSRM IEPR

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Charge Questions and Guidance to the Panel Members for the Independent External Peer Review (IEPR) of the City of Norfolk, Virginia, Coastal Storm Risk Management (CSRM) Feasibility Study, North Atlantic Coast Comprehensive Study (NACCS) Focus Area

This is the final Charge to the Panel for the Norfolk CSRM IEPR. This final Charge was submitted to USACE as part of the final Work Plan, originally submitted on November 21, 2017.

BACKGROUND

Historical storms including Hurricane Sandy, have impacted the City of Norfolk. In response, the U.S. Army Corps of Engineers (USACE) is investigating solutions that will reduce future coastal storm risk in ways that support the long-term resilience and sustainability of the coastal ecosystem and surrounding communities, and reduce the economic costs and risks associated with large-scale flood and storm events. In support of this goal, USACE completed the North Atlantic Coast Comprehensive Study (NACCS), which identified nine high-risk areas on the Atlantic coast for an in-depth analysis based on preliminary analyses. Norfolk has been identified as one of these nine areas of high risk, or Focus Areas, that warrants an in-depth investigation into potential coastal storm risk management solutions. The Norfolk Focus Area is located on the Chesapeake Bay, a location that has been identified as one of the highest risk areas for relative sea level rise in the country (Figure 1).

The City of Norfolk, Virginia, Coastal Storm Risk Management (CSRM) Feasibility Study is a comprehensive investigation of coastal storm risk management problems and solutions in the City of Norfolk. The study considers past, current, and future coastal storm risk management and resilience planning initiatives and projects under way by the non-Federal sponsor, the City of Norfolk, USACE, and other Federal, state, and local agencies. This study was authorized by Resolution of the Senate Committee on Environment and Public Works dated July 25, 2012.

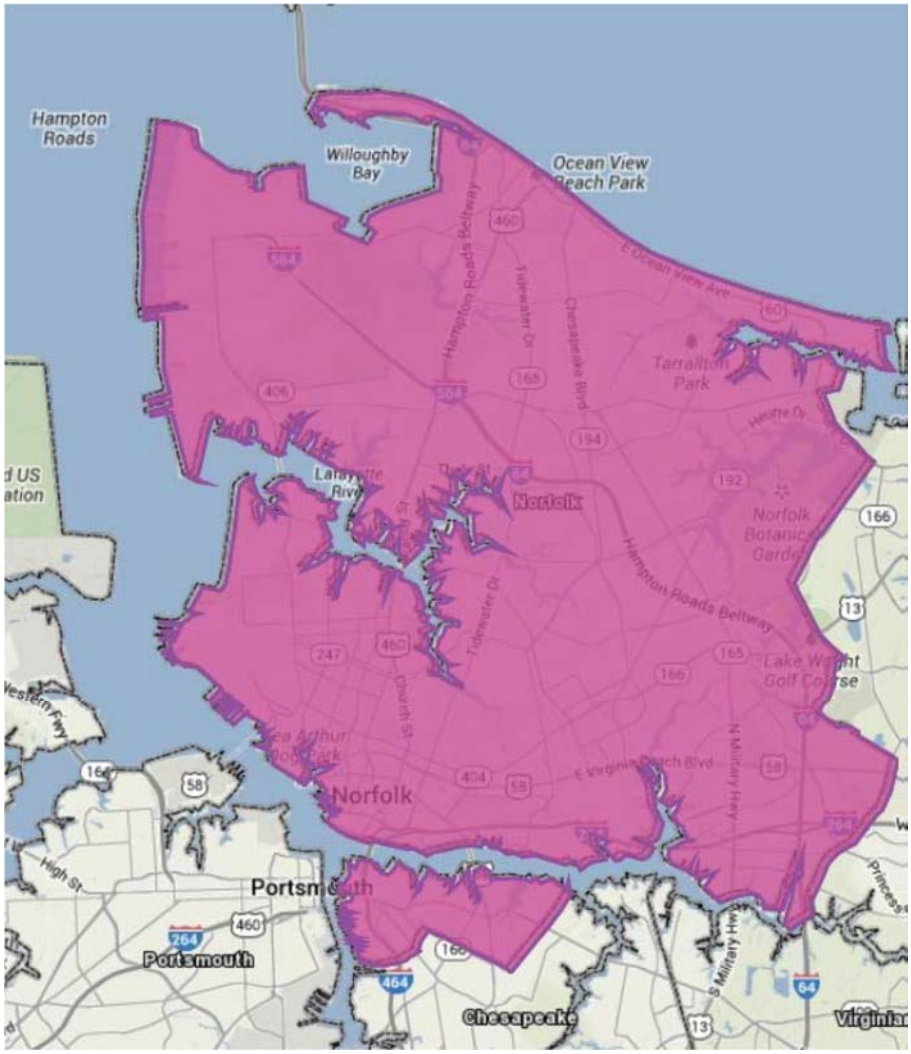
> "Resolved by the Committee on Environment and Public Works of the United States Senate, that the Secretary of the Army is requested to review the report of the Chief of Engineers on beach erosion and hurricane protection for Norfolk, VA, dated April 17, 1984, and other pertinent reports, to include existing flood risk management studies and engineering reports to determine whether any modifications of the recommendations contained therein are advisable in the interest of flood damage reduction in the vicinity of Norfolk, VA."

The study is not expected to be challenging, with one exception: a large study area will likely result in a large array of different project alternatives that are expected to vary across different areas of the city. The City of Norfolk is bordered by the Chesapeake Bay to the north and the Elizabeth River to the west; in addition, other, smaller creeks and bodies of water occur within the city limits, which leads to varying coastal risk across the city. A holistic/systems approach will be used to mesh various measures into one cohesive and comprehensive plan, but this will likely be accomplished only after technical and political challenges are met.

The City of Norfolk has been identified as one of the Atlantic Coast communities most vulnerable to the effects of relative sea level rise, the combined effect of land subsidence and sea level rise. Per Engineer Regulation (ER) 1100-2-8162, Incorporating Sea Level Change in Civil Works Programs, USACE evaluates three sea-level-rise scenarios as part of the planning process, and additional relative sea level rise estimates have been completed by various academic institutions and government agencies available for the study area, but there is no single projection of relative sea level rise that can be used to guarantee

that a coastal storm risk management project will remain effective throughout the entire 50-year period of analysis. As a result, the recommended project must be adaptable in order to remain effective throughout the period of analysis.

Figure 1: City of Norfolk Study Area



Implementation of a coastal storm risk management project could potentially reduce flood-related risks to human life/safety; however, the recommended project will be selected based on economic analysis in combination with other considerations, such as whether the project is acceptable, feasible from an engineering standpoint, and complete. The overall study will focus on coastal storm risk management measures along with comprehensive solutions across multiple disciplines, including, but not limited to, relocation, fortification, living shorelines, natural and nature-based infrastructure, beach nourishment, bulkheads, storm surge barriers, and hardened structures. Non-performance or design exceedance of these measures may result in risks to life safety;

The project is not expected to involve significant public dispute as to the size, nature, or effects of the project. The City of Norfolk, its residents, and stakeholders recognize the need for the study as a way to

address the coastal flooding that has been affecting the city more significantly every year, and thus support the study and are anticipating the recommended project.

The City of Norfolk CSRM Feasibility Study has been developed to reflect USACE's modernized planning initiative, in which project studies use a risk-informed assessment, generally with only enough detail developed for each alternative to allow relative comparison, to determine the appropriate information to identify a Tentatively Selected Plan (TSP). Although this new process has altered the milestones and evaluation procedures in a feasibility study, the manner in which alternatives are developed from problems, opportunities, measures, and constraints remains the same.

OBJECTIVES

The objective of this work is to conduct an independent external peer review (IEPR) of the City of Norfolk, Virginia, CSRM Feasibility Study, North Atlantic Coast Comprehensive Study (NACCS) Focus Area (hereinafter: Norfolk CSRM IEPR) in accordance with the Department of the Army, USACE, Water Resources Policies and Authorities' *Civil Works Review* (Engineer Circular [EC] 1165-2-214, dated December 15, 2012), and the Office of Management and Budget's (OMB'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 decision 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) who meet the technical criteria and areas of expertise required for and relevant to the project.

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

Review Documents	No. of Review Pages
Draft Feasibility Report & Environmental Impact Statement	474
Appendix A Plan Formulation Appendix	102
Appendix B Engineering Appendix	594
Appendix C Economic Appendix	117
Appendix D Environmental Appendix	226
Appendix E Real Estate Appendix	21
Appendix F Correspondence and Coordination Appendix	79
Appendix G Review Certifications	8
Total Number of Review Pages	**1,621**
Supplemental Information*	
Public Comments**	100
North Atlantic Coast Comprehensive Study (NACCS) Main Report and Appendices A through D	2085
ERDC Use of Natural and Nature-Based Features for Coastal Resilience	479
ERDC Coastal Storm Hazards from Virginia to Maine	221
ERDC NACCS Coastal Storm Model Simulations: Waves and Water Levels	252
ERDC NACCS Phase 1: Statistical Analysis of Historical Extreme Water Levels with Sea Level Change	125
NACCS Physical Depth Damage Function Summary Report	306
FUGRO Reports: Mason Creek, The Hague, Lafayette River, Pretty Lake, Downtown Floodwall (5 separate files)	947
ER 1105-2-100, Planning Guidance Notebook	712
EM 1110-2-1619 Risk Based Analysis for FDR Studies	63
ER 1110-2-1150 Engineering and Design for Civil Works Projects	65
Risk Register	10
Decision Log	10
Total Number of Reference Pages	**4,663**

* Supporting documentation only. These documents are not for Panel review and should be used as information sources only. They are not included in the total page count.

** Page count for public comments is approximate. USACE will submit public comments to Battelle, who will in turn submit the comments to the IEPR Panel.

Documents for Reference

- USACE guidance *Civil Works Review,* (EC 1165-2-214, December 15, 2012)
- Office of Management and Budget's *Final Information Quality Bulletin for Peer Review* (December 16, 2004)
- Foundations of SMART Planning
- SMART Planning Bulletin (PB 2013-03)
- SMART – Planning Overview
- Planning Modernization Fact Sheet.

SCHEDULE

Note that dates presented in the schedule below could change due to panel member and USACE availability.

Task	Action	Due Date
Attend Meetings and Begin Peer Review	Subcontractors complete mandatory Operations Security (OPSEC) training	1/3/2018
	Battelle convenes kick-off meeting with USACE	11/8/2017
	Battelle sends review documents to panel members	12/5/2017
	Battelle convenes kick-off meeting with panel members	12/6/2017
	Battelle convenes kick-off meeting with USACE and panel members	12/7/2017
	Battelle convenes mid-review teleconference for panel members to ask clarifying questions of USACE	12/19/2017
Prepare Final Panel Comments and Review Public Comments	Panel members complete their individual reviews	1/8/2018
	Battelle provides talking points for Panel Review Teleconference to panel members	1/10/2018
	Battelle convenes Panel Review Teleconference	1/11/2018
	Battelle provides Final Panel Comment templates and instructions to panel members	1/12/2018
	Panel members provide draft Final Panel Comments to Battelle	1/19/2018
	Battelle provides feedback to panel members on draft Final Panel Comments; panel members revise Final Panel Comments	1/20/2018 - 1/28/2018
	Panel finalizes Final Panel Comments	1/29/2018
Prepare Final Panel Comments and Review Public Comments [1]	Battelle receives public comments from USACE	1/4/2018
	Battelle sends public comments to Panel	1/10/2018
	Panel completes its review of public comments	1/17/2018
	Battelle and Panel review Panel's responses to public comments	1/18/2018

Task	Action	Due Date
	Panel drafts Final Panel Comment for public comments, if necessary	1/24/2018
	Panel finalizes Final Panel Comment regarding public comments, if necessary	1/26/2018
Review Final IEPR Report	Battelle provides Final IEPR Report to panel members for review	1/31/2018
	Panel members provide comments on Final IEPR Report	2/2/2018
	*Battelle submits Final IEPR Report to USACE	2/6/2018
	USACE Planning Center of Expertise (PCX) provides decision on Final IEPR Report acceptance	2/13/2018
Comment/ Response Process	Battelle inputs Final Panel Comments to Design Review and Checking System (DrChecks) and provides Final Panel Comment response template to USACE	2/15/2018
	Battelle convenes teleconference with USACE to review the Comment Response process	2/15/2018
	Battelle convenes teleconference with Panel to review the Comment Response process	2/15/2018
	USACE Project Delivery Team (PDT) provides draft Evaluator Responses to USACE PCX for review	3/6/2018
	USACE PCX reviews draft Evaluator Responses and works with USACE PDT regarding clarifications to responses, if needed	3/12/2018
	USACE PCX provides draft PDT Evaluator Responses to Battelle	3/13/2018
	Battelle provides draft PDT Evaluator Responses to panel members	3/15/2018
	Panel members provide draft BackCheck Responses to Battelle	3/20/2018
	Battelle convenes teleconference with panel members to discuss draft BackCheck Responses	3/21/2018
	Battelle convenes Comment Response Teleconference with panel members and USACE	3/22/2018
	USACE inputs final PDT Evaluator Responses to DrChecks	3/29/2018
	Battelle provides final PDT Evaluator Responses to panel members	3/30/2018
	Panel members provide final BackCheck Responses to Battelle	4/4/2018
	Battelle inputs panel members' final BackCheck Responses to DrChecks	4/5/2018
	*Battelle submits pdf printout of DrChecks project file	4/6/2018
SLM 1	Senior Leader Meeting (SLM) 1 - Agency Decision Milestone (ADM) Meeting	3/6/2018
SLM 2	Senior Leader Meeting 2 – Post-ADM	10/18/2018

* Deliverables

CHARGE FOR PEER REVIEW

Members of this IEPR Panel are asked to determine whether the technical approach and scientific rationale presented in the decision 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 decision 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 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 (Lynn McLeod; mcleod@battelle.org) or Program Manager (Rachel Sell; sellr@battelle.org) for requests or additional information.

3. In case of media contact, notify the Battelle Program Manager, Rachel Sell (sellr@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 Lynn McLeod, mcleod@battelle.org no later than 10 pm ET by the date listed in the schedule above.

Independent External Peer Review of the City of Norfolk, Virginia, Coastal Storm Risk Management (CSRM) Feasibility Study, North Atlantic Coast Comprehensive Study (NACCS) Focus Area

Charge Questions and Relevant Sections as Supplied by USACE

The following Review Charge to Reviewers outlines the objectives of the Independent External Peer Review (IEPR) for the subject study and identifies specific items for consideration for the IEPR Panel.

The objective of the IEPR is to obtain an independent evaluation of whether the interpretations of analysis and conclusions based on analysis are reasonable for the subject study. The IEPR Panel is requested to offer a broad evaluation of the overall study decision document in addition to addressing the specific technical and scientific questions included in the Review Charge. The Panel has the flexibility to bring important issues to the attention of decision makers, including positive feedback or issues outside those specific areas outlined in the Review Charge. The Panel can use all available information to determine what scientific and technical issues related to the decision document may be important to raise to decision makers. This includes comments received from agencies and the public as part of the public review process.

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

Panel review comments are to be structured to fully communicate the Panel’s intent by including the comment, why it is important, any potential consequences of failure to address, and suggestions on how to address the comment.

The Panel is asked to consider the following items as part of its review of the decision document and supporting materials.

Broad Evaluation Review Charge Questions

1. Is the need for and intent of the decision document clearly stated?
2. Does the decision document adequately address the stated need and intent relative to scientific and technical information?
3. Given the need for and intent of the decision document, assess the adequacy and acceptability of the project evaluation data used in the study analyses.
4. Given the need for and intent of the decision document, assess the adequacy and acceptability of the economic, environmental, and engineering assumptions that underlie the study analyses.

5. Given the need for and intent of the decision document, assess the adequacy and acceptability of the economic, environmental, and engineering methodologies, analyses, and projections.
6. Given the need for and intent of the decision document, assess the adequacy and acceptability of the models used in the evaluation of existing and future without-project conditions and of economic or environmental impacts of alternatives.
7. Given the need for and intent of the decision document, assess the adequacy and acceptability of the methods for integrating risk and uncertainty.
8. Given the need for and intent of the decision document, assess the adequacy and acceptability of the formulation of alternative plans and the range of alternative plans considered.
9. Given the need for and intent of the decision document, assess the adequacy and acceptability of the quality and quantity of the surveys, investigations, and engineering sufficient for conceptual design of alternative plans.
10. Given the need for and intent of the decision document, assess the adequacy and acceptability of the overall assessment of significant environmental impacts and any biological analyses.
11. Evaluate whether the interpretations of analysis and the conclusions based on analysis are reasonable.
12. Assess the considered and tentatively selected alternatives from the perspective of systems, including systemic aspects being considered from a temporal perspective, including the potential effects of climate change.
13. For the tentatively selected plan, assess whether the models used to assess life safety hazards are appropriate.
14. For the tentatively selected plan, assess whether the assumptions made for the life safety hazards are appropriate.
15. For the tentatively selected plan, assess whether the quality and quantity of the surveys, investigations, and engineering are sufficient for a concept design considering the life safety hazards and to support the models and assumptions made for determining the hazards.
16. For the tentatively selected plan, assess whether 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.

Battelle Summary Charge Questions to the Panel Members[1]

Summary Questions

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

[1] Questions 17 through 19 are Battelle supplied questions and should not be construed or considered part of the list of USACE-supplied questions. These questions were delineated in a separate appendix in the final Work Plan submitted to USACE.

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

Public Comment Questions

19. Do the public comments raise any additional discipline-specific technical concerns with regard to the overall report?

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APPENDIX D

Conflict of Interest Form

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Eric Thor
USACE, Institute for Water Resources
October 4, 2017
C-2

Conflicts of Interest Questionnaire

Independent External Peer Review

CITY OF NORFOLK, VA

COASTAL STORM RISK MANAGEMENT FEASIBILITY STUDY

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

NAME OF FIRM: **Battelle Memorial Institute Corporate Operations**
REPRESENTATIVE'S NAME: **Jason M. Jenkins**
TELEPHONE: **614-424-4873**
ADDRESS: **505 King Avenue, Columbus, Ohio 43201**
EMAIL ADDRESS: jenkinsj@battelle.org

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

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

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

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

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

No additional information to report.

Jason M. Jenkins — October 4, 2017
Date

Use or disclosure of data contained on this sheet is subject to the restriction on the title page of this proposal

BATTELLE

It can be done