



DEPARTMENT OF THE ARMY
CHIEF OF ENGINEERS
2600 ARMY PENTAGON
WASHINGTON, DC 20310-2600

OCT 16 2015

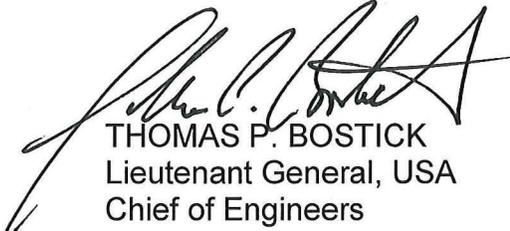
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MEMORANDUM FOR ASSISTANT SECRETARY OF THE ARMY (CIVIL WORKS)
108 ARMY PENTAGON, WASHINGTON, DC 20310-0108

SUBJECT: Mill Creek Flood Risk Management Study Nashville, Tennessee -- Final USACE Response to Independent External Peer Review

1. Independent, objective peer review is regarded a critical element in ensuring the reliability of scientific and engineering analyses. USACE conducted the Independent External Peer Review (IEPR) for the subject project in accordance with Section 2034 of the Water Resources Development Act of 2007, USACE Engineer Circular (EC) 1165-2-214, and the Office of Management and Budget's Final Information Quality Bulletin for Peer Review (2004).
2. A US Treasury Code 501(c)(3) non-profit science and technology organization, independent and free of conflicts of interest, established and administered the peer review panel. The IEPR panel consisted of four members with expertise in hydrology and hydraulic engineering, geotechnical engineering, economics, environmental review, and civil works plan formulation.
3. The final written responses to the IEPR are hereby approved. The enclosed document contains the final written responses of the Chief of Engineers to the issues raised and the recommendations contained in the IEPR report. The IEPR report and the USACE responses have been coordinated with the vertical team and will be posted on the internet, as required in EC 1165-2-214.
4. If you have any questions on this matter, please contact me or have a member of your staff contact Ms. Yvonne Prettyman-Beck at 202-761-4670.

Encl


THOMAS P. BOSTICK
Lieutenant General, USA
Chief of Engineers

**Mill Creek Flood Risk Management
Final Feasibility Report and Environmental Assessment
Davidson County, Tennessee**

**US Army Corps of Engineers Response to
Independent External Review
April 2015**

USACE conducted a Type I Independent External Peer Review (IEPR) for the Mill Creek Flood Risk Management Final Feasibility Report and Environmental Assessment in accordance with Section 2034 of the Water Resources Development Act of 2007, EC 1165-2-214, and the Office of Management and Budget's *Final Information Quality Bulletin for Peer Review* (2004).

USACE engaged Battelle Memorial Institute (Battelle), a non-profit science and technology organization, experienced in establishing and administering peer review Panels, to conduct the IEPR of the Mill Creek Flood Risk Management Final Feasibility Report and Environmental Assessment. Battelle issued the final IEPR Report on 20 March, 2015.

Based on the technical content of the Mill Creek review documents and the overall scope of the project, Battelle selected candidates for the IEPR review Panel in the fields of geotechnical engineering, structural engineering, hydraulics and hydrology, economics, plan formulation, and environmental planning. Overall, the review Panel identified and documented fourteen comments. Of these, one was identified as having high significance, three had medium/high significance, seven had medium significance, and three had medium/low significance. The following discussions present the USACE Final Response to the fourteen comments. Further details on each comment, such as the Basis for Comment, Significance, and Recommendations for Resolution can be found in the IEPR Final Report referenced above.

1. High Significance: The non-Federal sponsor's prohibition against raise-in-place for structures in the floodway removes potentially productive management measures from consideration.

This comment included three recommendations for resolution, all three of which have been adopted.

1. Evaluate key bellwether raise-in-place measures.

USACE Response: Adopted

Action Taken: The report was clarified to better explain re-formulation between March 2014 and August 2014. This can be found in section 4.2 of the Main Report.

2. Determine the viability of these measures, without respect to their conflict with non-Federal codes.

USACE Response: Adopted

Action Taken: USACE has added information on the re-formulation in Section 4 of the report showing these measures are viable based on the Federal standards, but not the non-Federal standards.

3. Describe how raise-in-place measures were coordinated with the non-Federal sponsor.

USACE Response: Adopted

Action Taken: USACE included documentation of the items discussed with the sponsor regarding NED versus locally preferred plan (LPP) and capability of USACE to implement only those items which would be considered part of the NED Plan. The NED Plan would include measures based upon federal regulatory requirements, but not local regulatory requirements. The sponsor supports the NED plan and provided a Letter of Intent (LOI) explaining how it will implement the recommendations.

2. Comment – *Medium/High Significance*: The Draft Integrated Feasibility Report (DIFR) does not discuss or display how the Recommended Plan is expected to perform under benchmark flood events per USACE guidance (ER 1105-2-101).

This comment included two recommendations for resolution. Both recommendations were adopted.

1. Include tables consistent with ER 1105-2-101, Appendix A.

USACE Response: Adopted

Action Taken: The requested data regarding the reduction of flood elevations that would be realized with implementation of the Recommended Plan was added to Section 4.3.3 of the report.

2. Include a discussion of how the risk analysis of the Recommended Plan was conducted.

USACE Response: Adopted

Action Taken: USACE provided further details to Section 4.3.3 of the report to enhance the risk analysis discussion, including information about project performance and residual risk consistent with ER 1105-2-101, Appendix A.

3. Comment – *Medium/High Significance*: The analysis may have used less than conservative assumptions regarding breach location and depth for the Ellington Detention Structure, which may not have accurately identified all downstream hazards under very high flow conditions.

This comment included four recommendations for resolution. All four were adopted.

1. Obtain sufficient subsurface information to estimate the depth of non-erodible bedrock in both the valley and abutment areas.

USACE Response: Adopted

Action Taken: USACE added information to the Engineering Appendix on some additional borings in the project area which were utilized to make reasonable estimates about the depth and quality of rock. USACE agrees that further borings would be necessary during the Preconstruction, Engineering, and Design (PED) phase.

2. During the design phase of the project, USACE conduct a dam breach evaluation for breach sections located in both the valley and abutment areas and use available subsurface information to locate the bottom of the breach at the elevation of the bedrock or other non-erodible material.

USACE Response: Adopted

Action to be Taken: USACE will conduct this analysis during the design phase of the project.

3. Using the breach evaluations, determine the appropriate Inflow Design Flood for the structure as described in ER 1110-8-2 (FR) (USACE, 1991). This flood is the largest flood under which a dam failure will not increase downstream hazard significantly.

USACE Response: Adopted

Action to be Taken: USACE will conduct the prescribed analysis during the more comprehensive dam break study which will occur during the PED phase of the project.

4. Use the revised dam break analysis to refine the design of erosion protection on the embankment and on the abutments. This design update should address the extent of erosion protection and the type of protection that will be used.

USACE Response: Adopted

Action to be Taken: USACE agrees that if during the comprehensive analysis, changes to the design may be warranted. For instance, if greater velocities would occur and/or design revisions, the PDT will adjust the erosion protections, on both the embankment and the abutments.

4. Comment – *Medium/High Significance*: The final cost for the Recommended Plan is uncertain due to omissions, apparent inconsistencies, the design assumptions, and lack of subsurface information.

This comment included three recommendations for resolution. All three recommendations were adopted.

1. Obtain several borings at the Ellington Detention site to define the nature of the overburden material and the elevation of the bedrock, both in the valley and abutment areas.

USACE Response: Adopted

Action to be Taken: USACE plans to obtain the recommended borings during the PED phase. The contingency in the current cost estimate for the Ellington Detention site accurately reflects the risk and uncertainty due to possible changes in the design.

2. Based upon the results of the subsurface exploration, revise the design cross-section and the estimated quantities for the Ellington Structure. Prepare a cost estimate based on the revised design. This will reduce the uncertainties associated with both the design and the resulting cost estimate.

USACE Response: Adopted

Action to be Taken: USACE agrees that the additional analysis will be performed during PED phase, and any changes will require a revised cost estimate prior to Construction.

3. Obtain one boring in the valley section at the Briley bridge, and verify that the proposed foundation system for the bridge piers will adequately support the bridge structure or revise the support system.

USACE Response: Adopted

Action to be Taken: USACE and Tennessee Department of Transportation (TDOT) engineers have both inspected the site. USACE will conduct an additional boring at the location of the new pier for Briley Bridge during PED phase and make any needed adjustments to the current design. The current cost estimate for Briley Bridge includes contingencies that cover the possible changes that could be encountered during PED.

5. Comment – *Medium Significance*: The future year is inconsistently identified, so it is unclear when future damages cease to increase.

This comment included two recommendations for resolution, both of which have been adopted.

1. Identify what the future year is expected to be.

USACE Response: Adopted

Action Taken: USACE indicated the future year is expected to be 2058. This is documented as part of revisions to the Economic Appendix located in section 3.1.

2. Include in the affected appendices a brief narrative explaining why the future year is the most reasonable.

USACE Response: Adopted

Action Taken: USACE added a narrative to the Economic Appendix in section 3.1 to explain the choice of the year 2058 as the most reasonable.

6. Comment – *Medium Significance*: Public safety and loss of life due to flooding associated with the Recommended Plan are not addressed.

This comment included five recommendations for resolution. Four of the recommendations were adopted and one was not adopted.

1. Include the reduction of risk to public safety in the statement of objectives.

USACE Response: Adopted

Action Taken: USACE included this objective in the Main Report Section 2.4 on page 15.

2. Describe the threat to public safety in the discussion of the future without-project condition.

USACE Response: Adopted

Action Taken: USACE provided further details in the Main Report, Sections 3.2 describing the future without-project threat to public safety.

3. Discuss qualitatively how the various alternatives and the Recommended Plan address the objective of reducing the threat to public safety and the risk of loss of life.

USACE Response: Adopted

Action Taken: USACE provided further detail to Section 4.33 to qualitatively address how the alternatives reduce the threat to public safety and the risk of loss of life.

4. If an alternative other than the Recommended Plan has a greater potential to reduce public safety risk, discuss why other factors resulted in the selection of the Recommended Plan.

USACE Response: Adopted

Action Taken: USACE revised section 4.33 to better discuss the reduction and 4.25 to provide a better overview of the acceptability of each plan.

5. Specifically define “life safety hazard” and how that is differentiated among different types of structures within the 5-year return frequency flood inundation area. Provide inundation mapping to show (1) where structures associated with life safety hazards exist, and (2) structures that are within the same inundation area but are not considered a life safety hazard.

USACE Response: Not Adopted

USACE did not adopt this recommendation due to policy concerns with respect to defining “life safety hazard”. Instead of providing a definition, the referenced metric was removed from the main report. All subsequent references to the life safety hazard or metric were also removed in relation to justifying specific structures for flood risk action where no economic justification existed. The economically justified plan also includes a reduction in life safety hazards, but is not solely justified on that basis.

7. Comment – *Medium Significance*: Uncertainty and residual risk as a result of climate variability have not been quantified and may have impacts over the life of the project.

This comment included two recommendations for resolution. Both recommendations were adopted.

1. Include a brief section in the text that acknowledges that climate variability may affect the level of protection that is estimated from this project. Acknowledge that extreme flood events have occurred recently and others may occur during the life of this project.

USACE Response: Adopted

Action Taken: USACE provided further details to Section 7.12 to explain that the Mill Creek Feasibility Study is in compliance with ECB 2014-10; Guidance for Incorporating Climate Change Impacts to Inland Hydrology in Civil Works Studies, Designs, and Projects. The subject ECB requires USACE to incorporate climate change and variability in hydrologic analyses. The subject ECB requires that various sensitivity analysis be performed relating to floodplain storage and range of affected flows on a level consummate with HUC-4 sub-regions. Modeling for the watershed reflects the risk and uncertainty required by the ECB and was done to much greater detail than required, down to one square mile drainage areas.

2. Include an analysis in the design phase of this project to evaluate the stability and integrity of all project elements to withstand extreme flood events during the life of the project.

USACE Response: Adopted

Action to be Taken: USACE will conduct further analysis in PED phase to ensure that all features are able to withstand extreme flood events. This includes acquiring further geotechnical borings and performing design analysis given any new data that is acquired. In addition to this further analysis, USACE will conduct a Safety Assurance Review in the form

of a Type II Independent External Peer Review in accordance with Section 2035 of WRDA 2007.

8. Comment – *Medium Significance*: It is not possible to determine if the occupancy type population was sampled appropriately or how the first floor elevations (FFE) were obtained because the statistical analysis lacks detail.

This comment included four recommendations for resolution. All four recommendations were adopted.

The IEPR panel recommended that USACE : (1) Provide inferential statistical analysis of the representativeness of the FFE sample; (2) Provide inferential statistical analysis of the representativeness of the structure value sample; (3) Describe the shapes of the various distributions used in HEC-FDA; and (4) Explain why these distribution shapes were used.

USACE Response: Adopted

Action Taken: USACE added the requested information by revising the Economic Appendix to provide greater detail on occupancy type and First Floor Elevations(FFE). Sections 3.2, 3.3.2, and 3.3.3 were revised in the Appendix on pages 7, 8, and 11. Distribution shapes used in the Mill Creek Basin study are as follows: Uncertainty distributions of structure values, first floor elevations and content-to-structure value ratios for all structures used a normal distribution, which is bell-shaped in nature. Occupancy type uncertainty distributions of single family residential structures and automobiles are also normal distributions. Occupancy type uncertainty distributions for all non-residential and multi-family residences are triangular distributions. These had an upper limit and lower limit and the best estimate that creates the “triangle”, which is usually not symmetrical in nature.

9. Comment – *Medium Significance*: Flood attenuation through new upland floodwater controls has not been evaluated during the formulation of the alternatives.

This comment included three recommendations for resolution. All three recommendations were adopted.

The IEPR panel recommended that USACE: (1) Document and discuss upland stormwater reduction and retrofit opportunities throughout Williamson and Davidson Counties that have been or are under consideration for implementation with respect to their potential to attenuate peak discharges;(2) Provide an expanded discussion on the changes that have been implemented by Davidson County in the land development regulations that will require this type of flood mitigation infrastructure for future development; and (3) Evaluate Federal, state, and local programs currently in place or likely to be adopted within the 50-year Federal planning horizon for this project to facilitate improved stormwater controls in Williamson and Davidson counties.

USACE Response: Adopted

Action Taken: Per the Panel recommendations, USACE expanded Section 3 of the main report. Section 3 now includes an extensive evaluation of current watershed and floodplain management practices and their impact to stormwater runoff and flood stages over the life of the project. The section also discusses local stormwater, floodplain and water quality policies currently in place which are more conservative and comprehensive than federal guidelines. The above information provides details showing the long-term impacts of the surrounding counties non-participation and/or modification to their current flood control ordinances on the USACE ability to maintain the project flood control objectives.

10. Comment – *Medium Significance*: The impacts of sediment transport and deposition on the efficacy of the project have not been addressed.

This comment included five recommendations for resolution. Three of the recommendations were adopted, and two were not adopted.

1. Characterize sediment supply in the Mill Creek project area

USACE Response: Adopted

Action Taken: In response to this comment, USACE modified the report to include these points in the discussion of the Nashville Crayfish, and can be found in Sections 7.7 and 7.8. Sevenmile Creek channel is very stable with limestone rock bottom and established vegetated banks. There are a few isolated stream bank stability issues along Sevenmile Creek and mostly occur due to burial of sewer lines and utilities near creek stream banks.

2. Evaluate aggradation above the proposed Ellington Ag Bridge in-stream detention facility

USACE Response: Adopted

Action Taken/to be Taken: The recommended analysis was previously conducted and the details of that analysis appear in section 6.2 of the report. The analysis shows that there are no significant sediment aggradation or degradation problems along Sevenmile Creek. Channel incision is also unlikely since the stream bottom is composed of limestone bedrock. Further investigation will be performed during design phase to characterize the sediment supply along Sevenmile Creek and to evaluate bedload transport in the vicinity of the Ellington project for the purpose of habitat enhancement for the Nashville Crayfish.

3. Evaluate degradation below the proposed Ellington Ag Bridge in-stream detention facility

USACE Response: Adopted

Action Taken: The recommended analysis was conducted and there are no significant sediment aggradation or degradation problems along Sevenmile Creek. Channel incision is also unlikely since the stream bottom is composed of limestone bedrock. Further investigation will be performed during design phase to characterize the sediment supply

along Sevenmile Creek and to evaluate bedload transport in the vicinity of the Ellington project for the purpose of habitat enhancement for the Nashville Crayfish.

4. Analyze the potential for aggradation to adversely affect flood storage attenuation and channel stability in the vicinity of the upstream pool limit.

USACE Response: Not Adopted

In response to this comment, USACE demonstrated that the stream has a stable bank and that there are no channel instability issues. No changes were made based on this comment and specific details about the channel are discussed in section 6.2 of the report.

5. Discuss the loss of bedload transport and loss of nursery habitat for the Nashville crayfish for the section of Mill Creek downstream of the proposed Ellington Ag Bridge.

USACE Response: Not Adopted

In response to this comment, USACE had previously coordinated with U.S. Fish and Wildlife Service to obtain a Biological Opinion (Bi-Op) on the crayfish and habitat specific to the detention basin. In accordance with the Bi-Op, no modifications to the recommendations or findings of the report were made. The USFWS provided "Reasonable and Prudent Measures" as well as "Terms and Conditions" for the proposed action. These are summarized in Section 6 of this Main Report and Appendix D. A copy of the BA and BO can be found in the Environmental Appendix D. See Section 6.3.3 for future details regarding Threatened and Endangered Species. During construction the Corps would ensure that suitable habitat for the Nashville Crayfish and other aquatic species was restored. Great consideration would be given to opportunities that might arise during construction to further enhance the habitat for aquatic species.

11. Comment – *Medium Significance*: The variables that contribute to uncertainty have not been discussed.

This comment included three recommendations for resolution. All three recommendations have been adopted.

The IEPR panel recommended: (1) Identify the variables contributing most to uncertainty; (2) Explain what steps were taken to reduce uncertainty; and (3) Discuss how those efforts reduced uncertainty and improved confidence in the performance of the Recommended Plan.

USACE Response: Adopted

Action Taken: USACE updated the report with the following details. In accordance with U.S. Army Corps of Engineers Guidance documents EM 1110-2-1619 and ER 1105-2-101, a risk and uncertainty analysis is required to be performed for the hydrologic (discharge-probability function), hydraulic (stage-discharge function), and economic (stage-damage

function) portions of a feasibility study. The future without project conditions were used for the baseline of all uncertainty analysis contained in this document. Information gathered from this analysis provided the hydrologic and hydraulic uncertainty functions for HEC-FDA, a flood risk analysis model. Additional text on risk and uncertainty from Section 8 of the H+H Appendix has been added to Section 4.3.3 and 4.5.8. Section 8 of the H+H Appendix contains much further detail on this topic.

12. Comment – *Medium/Low Significance*: It is unclear if the concept design for the selected articulated concrete mat has a demonstrated performance record and if the entire embankment including the crest section is protected against overtopping flows.

This comment included four recommendations for resolution. Three of the recommendations were adopted, and one was not adopted.

1. Determine Inflow Design Flood (IDF), which should form the basis for the design of the overtopping protection.

USACE Response: Adopted

Action to be Taken: USACE will conduct the analysis during the prescribed comprehensive dam break analysis in PED phase.

2. Interview manufacturers to determine whether their products have actually performed under the proposed hydraulic conditions. If it is determined that an articulated concrete mat will not provide the required degree of protection, other forms of overtopping protection such as roller-compacted concrete (RCC) should be considered.

USACE Response: Not Adopted

USACE revised Section 2.2 of Appendix C to reflect the articulated concrete block ability to withstand designed velocities. The Cross-Section displaying the articulated mat, was also revised showing that the mat extends under the pavement through the crest. On the selection sheet are velocities that the ACB is capable of withstanding and those velocities fall within the expected range where they will be used. This information documented the rationale used and no changes were made based on this comment.

3. Revise the design and cost estimate for the overtopping protection based upon the manufacturer's recommendations to provide complete protection for the embankment under the IDF.

USACE Response: Adopted

Action to be Taken: USACE will refine the cost estimate during the Preconstruction-Engineering and Design phase should additional analysis require design changes. The current cost estimate includes sufficient contingencies to account for any needed changes that could occur during PED.

4. Provide documentation in Appendix C describing the design process and the basis for the overtopping protection.

USACE Response: Adopted

Action Taken: USACE revised Section 2.2 of Appendix C to reflect the articulated concrete block ability to withstand designed velocities. The Cross-Section displaying the articulated mat, was also revised showing that the mat extends under the pavement through the crest.

13. Comment – *Medium/Low Significance*: The Recommended Plan does not clearly state how the proposed project will address the non-Federal sponsor’s objectives.

This comment included one recommendation for resolution which was adopted.

1. Add a text section that specifically addresses how the non-Federal Sponsor’s goals for flood damage reduction in the four Damage Centers have been addressed.

USACE Response: Adopted

Action Taken: USACE added text sections to Sections 4.1.4 and 4.5.1 to address the comment and support the recommendation. The goals of the non-Federal sponsor alligned with the goals of the project to reduce threats to life and property, restore contiguous segments of historic floodway for flood storage, increase attenuation through detention, and improve conditions for endangered species.

14. Comment – *Low Significance*: The HEC-recommended National Weather Service DAMBRK model was not used to acquire higher accuracy data in the analysis of the Ellington Detention structure and may result in an underestimate of potential downstream hazards and loss of life.

This comment included one recommendation for resolution which was adopted.

1. During the design phase of this project, analyze the potential impacts caused by an overtopping breach of the Ellington Detention structure using the NWSDAMBRK model.

USACE Response: Adopted

Action to be Taken: USACE will include additional dam break analysis in PED phase. However, USACE has moved away from using the NWSDAMBRK model since the development of the unsteady flow simulation in HEC-RAS (River Analysis System) software. USACE will use the HEC-RAS model in PED to conduct the recommended analysis.