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Prepared by:

Pittsburgh District
Great Lakes and Ohio River Division

EAST BRANCH DAM, DAM SAFETY MODIFICATION PROJECT

Review Plan Revision 6

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MSC Approval Date:

Last Revision Date: *May 2019*

REVIEW PLAN
FOR
EAST BRANCH DAM, DAM SAFETY MODIFICATION PROJECT

EAST BRANCH DAM, EAST BRANCH CLARION RIVER, PENNSYLVANIA

Construction Activities

Pittsburgh District

March 2019
Revision 6

Document History:

	DATE	REASON FOR REVISION	DATE APPROVED	APPROVED BY
Draft for RMC Review	Apr 2010			
Revision 1	Jun 2011	Address RMC Review Comments		
Revision 2	Jun 2011	Address RMC Backcheck Comments		
Revision 3	Aug 2011	Change level of Review Required for Phase 1 – Site Development Work		
Revision 4	Feb 2013	Addition of Phase 2, 3 & 4 Cutoff Wall QCP & Misc.		
Revision 5	June 2014	Cutoff Wall Construction Only		
Revision 6	Mar 2019	Post Implementation Evaluation		

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REVIEW PLAN

EAST BRANCH DAM, DAM SAFETY MODIFICATION PROJECT
PITTSBURGH DISTRICT

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1) PURPOSE AND REQUIREMENTS

a) Purpose. This Review Plan, Revision 6, defines the scope and level of peer review for the construction and post construction activities that will be required to successfully close out the East Branch Dam, Dam Safety Modification Project.

b) References

i) ER 1110-2-1156, Chapter 9, Dam Safety Modification Studies and Documentation, 31 March 2014
ii) Engineer Regulation (ER) 1110-1-12, Quality Management, 31 March 2011
iii) Engineer Circular (EC) 1165-2 217, Review Policy for Civil Works, 20 Feb 2018
iv) Engineer Circular (EC) 1165-2-214, Water Resources Policies and Authorities, Civil Works Review , 15 December 2012
v) EC 1105-2-407, Planning Models Improvement Program: Model Certification, 31 May 2005
vi) East Branch Dam, Dam Safety Project, Project Management Plan, Oct 2010
vii) East Branch Dam, Dam Safety Project, Phase 1 Site Development Contract, Quality Control Plan, March 2011
viii) East Branch Dam, Dam Safety Project, Alternative Refinement – Dam Safety Modification, Quality Control Plan, April 2011.
ix) East Branch Dam Safety Modification Report, August 2010.
x) Document for Screening for East Branch Dam, 8 May 2006, DSAC added December 2008
xi) ER1110-2-401, Operation, Maintenance , Repair, Replacement, and Rehabilitation Manual for Projects and Separable Elements Managed by Project Sponsors, September 1994
xii) 0804 LRD-QC/QA Procedures for Civil Works Engineering and Design Products, LRD Regional Business Processes Manual
xiii) East Branch Dam Safety Review Plan Revision 5, June 2014

c) Requirements. This review plan was developed in accordance with EC 1165-2-217, Review Policy for Civil Works 20 February 2018, which establishes an accountable, comprehensive, life-cycle review strategy for Civil Works products by providing a seamless process for review of all Civil Works projects from initial planning through design, construction, and Operation, Maintenance, Repair, Replacement and Rehabilitation (OMRR&R). It provides the procedures for ensuring the quality and credibility of U.S. Army Corps of Engineers (USACE) decision, implementation, and operations and maintenance documents and work products. The EC outlines three levels of review: District Quality Control (DQC), Agency Technical Review (ATR), and Independent External Peer Review (IEPR). This revision of the Review Plan thru the construction phase addresses the Independent External Peer Review (IEPR) and the review process of the Post Implementation Evaluation (PIE).

An IEPR is the most independent level of review, and is applied in cases that meet certain criteria where the risk and magnitude of the proposed project are such that a critical examination by a qualified team outside of USACE is warranted. For clarity, IEPR is divided into two types, Type I is generally for decision documents and Type II (Safety Assurance Review) is generally for implementation documents. For the construction phase of the East Branch Dam, Dam Safety Modification a Type II IEPR

is being conducted as required by EC 1165-2-217. Type II IEPRs are conducted on construction activities for hurricane and storm risk management and flood risk management projects, as well as other projects where potential hazards pose a significant threat to human life. This applies to new projects and to the major repair, rehabilitation, replacement, or modification of existing facilities. The external panel will review the construction activities periodically until construction activities are completed and the OMMR&R manual is updated. The review shall be on a regular schedule sufficient to inform the Chief of Engineers on the adequacy, appropriateness, and acceptability of the construction activities for the purpose of assuring that good science, sound engineering, and public health, safety, and welfare are the most important factors that determine the project status.

The PIE for East Branch Dam, Dam Safety Modification in accordance with ER 1110-2-1156, will consist of a potential failure mode analysis (PFMA) and, as a minimum, a semi-quantitative risk assessment (SQRA) using existing background documentation, subsurface exploration and construction data to evaluate the risk reduction associated with construction of the cutoff wall and to also identify and evaluate any additional failure modes created by construction of the wall. This effort will primarily involve review of existing project documents; preparation of focused background material to aid with conducting the risk assessment and preparation of a memorandum documenting the outcome of the assessment. Hydrologic and hydraulic and consequence analyses will not be updated as part of this effort; however, consequences will be reviewed and discussed qualitatively by the PIE team. Dependent upon the PIE outcome, limited additional analysis may be required to evaluate any additional potential failure modes associated with construction of the cutoff wall. These potential failure modes will be summarized within the body of the final memorandum.

The PIE itself is a review of the Dam Safety Modification product and the effectiveness of that product. The PIE will undergo District Quality Control (DQC) and Agency Technical Review (ATR) processes which is covered under Section 5 (a) of this plan. The overall PIE process from beginning to end is covered in Section 5(c) of this plan.

2 REVIEW MANAGEMENT ORGANIZATION (RMO)

a) **RMO Coordination.** The RMO for this project is the USACE Risk Management Center (RMC). In accordance with EC 1165-2-217, Water Resources Policies and Authorities Civil Works Review, dated 20 February 2018 the RMC is responsible for managing the review effort. The RMO has provided the District with written concurrence for this review plan.

b) **Vertical Team.** The Vertical Team consists of District Dam Safety Officer, RMC, CELRD and Headquarters team members. Technical vertical team members can come and go depending on the current project requirements. The District Dam Safety Officer, Dam Safety Program Managers at LRD and HQ and the Director of the RMC.

c) **Mega-Project.** Engineering and Construction Bulletin No. 2013-11 dated 11 April 2013 designated East Branch Dam Safety Modifications as a Mega-Project.

Accordingly, a three-tiered governance structure to manage change control has been established consisting of a Senior Executive Board, an Executive Leadership Team, and a Project Leadership Team. This governance structure is detailed in the Program Management Plan (PMP). Also Design Construction Reviews (DCEs) and In-Progress Reviews (IPR) are described in the PMP.

3 PROJECT SCOPE AND PRODUCTS

a) **General Site Location and Description.** East Branch Dam is located in Elk County, Pennsylvania on the East Branch of the Clarion River, about 7.5 miles upstream of the confluence of the East and West Branches of the Clarion River at Johnsonburg. The project was designed by USACE and constructed between 1947 and 1952 from on-site borrow materials predominantly containing clays, silts, sands, and shales. East Branch Dam is a zoned earth filled embankment with a crest length of 1,725 feet and a maximum height above the streambed of 184 feet. The dam crest is at Elevation (El.) 1,707 feet and has a width of 20 feet.

East Branch Dam was authorized for construction by the Flood Control Act of 22 December 1944. The authorized project purposes for the East Branch Dam are reduction of flood stages on the Clarion River, water conservation, water quality, low-flow augmentation, recreation, fish, and wildlife management. Construction of the rolled, earth embankment dam began in June 1947 when the initial construction contract was awarded. The dam was completed and put into full operation in June 1952.

b) **Decision Documents.** In 1957, the East Branch Dam nearly failed due to internal erosion. Because of the 1957 incident and ongoing seepage concerns at the dam, East Branch was assigned a Dam Safety Action Classification (DSAC) rating of 2 (Urgent and Compelling) during Screening for Portfolio Risk Assessment in 2008.

A primary reason for the DSAC 2 classification was concern over the structural integrity of the 1957 repair near the right abutment. A subsequent potential failure mode analysis (PFMA) conducted by the United States Bureau of Reclamation (USBR), with USACE Pittsburgh District support, in January 2008 identified internal erosion at the location of previously detected internal erosion (repaired in 1957) near the right abutment as the most critical of several significant potential failure modes and a primary threat to public safety. Estimated annualized probability of failure and estimated annualized loss of life were found to be above the threshold that, based on USBR and USACE criteria, justified expedited action to reduce risk.

Potential Failure Modes: In March 2009, a team of USACE experts (Issue Evaluation Study Cadre, or IES Cadre) convened to identify all appropriate potential failure modes as part of the baseline risk assessment for the East Branch Dam Modification Study. In summary, the credible potential failure modes (PFM) are as follows:

(1) PFM 4C – Internal erosion of embankment due to a high permeability layer created by freezing at a seasonal shutdown layer during construction.
(2) PFM 5 – Internal erosion of embankment into fractured bedrock at the right abutment and exit at the toe of the embankment.

(3) PFM 7D – Backward erosion of overburden between STA 11+00 and STA 12+50 with an exit beyond the toe of the dam.
(4) PFM 8 – Internal erosion of overburden into fractured bedrock at the left abutment to an unfiltered exit outcropping in the vicinity of Weirs 4, 5, or 7.
(5) PFM 11 – Internal erosion of embankment at interface of grouted void and drilling and grouting program during the 1957 incident (approximate dam station 8+30) due to softened zones and exiting on the right abutment.

The PFMs indicate the potential for seepage and internal erosion failures to initiate at various stations across the entire dam.

Summary of Interim Risk Reduction Measures (IRRMs): In response to the PFMA conducted by USBR and USACE in 2008, the District implemented various interim risk reduction measures (IRRMs). The primary IRRM was implementation of an interim water control plan which lowered the summer pool to El. 1650 and the target winter pool to El. 1623. Lowering the summer pool by 20 feet and the winter pool by 28 feet has reduced the hydraulic load on and within the dam to allow risk-improved operating conditions for an interim period until the long-range strategy is developed and implemented, while avoiding significant impacts either within the lake or downstream.

The Pittsburgh District also implemented the following secondary measures to closely monitor the areas of concern and to take rapid action upon evidence of initiating events (thereby either preventing or, more likely, reducing consequences of dam failure). The secondary measures are as follows:

- Implement an extensive communication plan to keep stakeholders and public informed of activity at East Branch Dam.
- Enhance and prioritize existing instrumentation, and obtain critical instrumentation readings more frequently to better monitor dam conditions.
- Implement cross-training of regional staff to support staff at the dam.
- Initiate 24-hour staffing to monitor the condition of the dam.
- Update existing Emergency Action Plan to re-evaluate emergency procedures and update calling tree.
- Develop new inundation mapping to better define floodway downstream of East Branch Dam.
- Conduct drills and exercises to better educate and prepare staff and local emergency management personnel.
- Pre-position contracts/materials for emergency response and improve lighting systems.

As of November 2009, all of these secondary IRRM measures have been fully implemented. These measures are reviewed annually or as new information becomes available. The District will change or add to these secondary IRRMs, as warranted, until a permanent risk reduction measure is in-place.

East Branch Dam Safety Modification Report: A Dam Safety Modification Study (DSMS) was conducted in accordance with the ER 1110-2-1156. The purpose of the study was to address potential failure modes and to identify what measures would

need to be undertaken to reduce the associated risk to meet tolerable risk guidelines and so that the dam would meet USACE essential guidelines. Risk reduction measures were identified and incorporated into non-structural and structural risk reduction plans. The plans were compared against the baseline condition, and then against one another. Plan S3, a full depth concrete cutoff wall, was recommended based on the goal of long term risk reduction at East Branch Dam and the economic feasibility of the plan. The Study was approved in Oct 2010 by the District, Division and HQUSACE Dam Safety Officers.

Computation Model Certification was addressed in the Review Plan for the Dam Safety Modification Study and no longer applies. All legal and policy reviews and necessary checklists and approvals were included with the Dam Safety Modification Study.

Environmental Assessment: An environmental assessment (EA) was developed for the East Branch Dam Safety Modification project as a "stand-alone" document and distributed to the public during May 2010 for review and comment. Comments received from the public were answered, made a part of the public record, and incorporated into the Final EA/Finding of No Significant Impact (FONSI). The FONSI was signed by the District Engineer on 01 July 2010.

c) **Recommended Plan.** The objective of the current work is to construct the recommended risk reduction plan (Plan S3) from the Dam Safety Modification Study (DSMS). Plan S3 includes a full depth cut-off wall over the entire length of the embankment, and permanent rock grouting along the downstream right abutment contact to address seepage. The design and construction of the full depth cut-off wall (S3) is divided into six work features, as follows:

i) Site Development: Project work involved widening and reconstructing the existing dam access road to the dam to accommodate large traffic loads, utility preparation, and site preparation for a future contractor laydown area and field office construction.

ii) Alternative Refinement. This work was generated from comments by the Senior Oversight Group and their request for additional, detailed analysis of three possible alternatives stated in the Dam Safety Modification Study. Based on alternative refinement and screening level costs the approved recommended plan S3 was optimized and will be retained. The alternative refinement work was compiled in a Memorandum for Record (MFR) and includes basic sketch drawings, quantity/cost tables, a comparison matrix and technical narratives. No additional Quality Consistency and Control or Senior Oversight Group review was be required.

iii) Geotechnical investigations and potential foundation grouting. A geotechnical and environmental drilling program was initiated in the fall of 2010 to conduct the following work:

(a) Geotechnical - Boreholes were drilled along the alignment of the proposed cutoff wall and at the toe if the dam. Geotechnical data was collected to characterize the soil for future cutoff wall properties and installation. The

drilling program also increased understanding of the condition of the bedrock. The only test results to this point were 2008 – 2009 bedrock results, which showed that the bedrock layer was highly permeable.

(b) Environmental – A Phase I Site Assessment showed that the dam and surrounding area had the potential to be contaminated due to the presence of legacy oil wells. The Phase II Site Investigation was conducted.

The drilling program was expanded in the spring of 2011 by increasing the number of borings along the alignment of the proposed, full depth cut-off wall. Additional geotechnical tests were conducted to further test the bedrock over the entire length of the grouted wall, with the advantage of not having to interpolate the data as much due to the increased number of borings.

iv) Full length, full depth cutoff wall. During this phase, project work focused on constructing a hydromilled, full depth and full length cutoff wall over the entire length of the dam.

v) New instrumentation. Project work involved the installation of new instrumentation, such as piezometers that are used to monitor the dam response and quantify the effectiveness of the constructed cutoff wall.

vi) Post construction site remediation. Project work includes demolition of the work platform, regrading the dam crest, installation of dam crest guiderails, paving site lots and roads, site cleanup, and seeding former construction areas.

vii) Project closeout.

d) **In-Kind Contributions.** A Non Federal Cost Share Sponsor is not required for this project.

4) PROJECT DELIVERY TEAM (PDT). The project delivery team members are listed in Attachment 1.

5) REVIEW EXECUTION.

a) **District Quality Control.** This consists of three aspects: 1) Construction Quality Assurance (QA),2) Quality Control (QC) for Engineering During Construction (EDC), and 3) QC for the PIE.

District Quality Control during construction is detailed in the Construction Quality Assurance Plan (CQAP) Supplement for the East Branch Dam Safety Modification Project. The CQAP describes how Contractor Quality Control (CQC) will be monitored and assures cutoff wall construction compliance with Plans and Specifications of the construction contract and all applicable USACE Regulations. The CQAP is a working document and can be modified by the Resident Engineer during construction.

Quality Control for Engineering During Construction is detailed in the Quality Control Plan for the East Branch Dam Cutoff Wall Contract. This Quality Control Plan defines

how quality control will be executed. During construction the engineering PDT will conduct site visits, review and approve of transmittals, review shop drawings, and review as-built drawings.

The PIE DQC will be performed by designated individuals from the senior staff that have a familiarity with the project but did not take an active role in the PIE or preparing the PIE Memorandum. DQC will be performed in accordance with EC 1165-2-217 and LRD Regional Business Processes (08504LRD-QC/QA procedures for Civil Works Engineering and Design Products). Documentation of the DQC process will be conducted through DrChecks. The members of the PIE DQC team, along with the Lead DQC are included in Attachment 1.

b) **Agencey Technical Review (ATR):** The objective of the ATR is to ensure the proper application of established criteria, regulations, laws, codes, principles and professional practices. The ATR will assess whether the analyses presented are technically correct and comply with published USACE guidance and that the documents clearly and coherently explain the analyses and results. ATR will be conducted in accordance with EC 1165-2-217 and LRD Regional Business Processes (08504LRD-QC/QA procedures for Civil Works Engineering and Design Products).

ATR during construction will provide an independent check of the necessity, validity, and accuracy of significant contract modifications. The ATR team may also be utilized as a resource by leadership teams throughout the megaproject governance structure to better inform the decision making process associated with those modifications. The Lead Engineer is responsible for engaging the ATR team for review of these products.

ATR will be conducted on the PIE memorandum and any accompanying attachments. The RMO has assigned an ATR team comprised of USACE personnel with expertise and experience with similar projects and work products to ensure a comprehensive, independent technical review. The ATR Team is identified in Attachment 1. The ATR Lead for the PIE is the same ATR Lead for the rest of the project. Documentation of the ATR process will be conducted through DrChecks. An MSC technical review will take place concurrent with the ATR. The members of the ATR Team listed in Attachment 1, comprise the following specialized disciplines:

Discipline	Expertise Required
ATR Lead/Geotechnical	The ATR team leader will be a senior USACE dam safety professional and will have experience leading and conducting ATR for similar projects and work products. The ATR lead will direct the scope and focus of the review efforts by each discipline. The ATR team leader will be from outside the home MSC (RMC) and will have the necessary skills and experience to lead a virtual team through the ATR process. The ATR Lead will also serve as a reviewer for the Geotechnical discipline, and will have experience in the design, construction, and evaluation of embankment dams, potential failure mode analysis, and dam safety risk analysis. The geotechnical engineer will have experience in subsurface investigations, rock and soil mechanics, internal erosion evaluation,

	slope stability evaluation, earthwork construction, drilling and grouting, and cutoff wall design and construction.
Hydraulic Structural Engineer	The structural engineer will have experience evaluating the design, construction, and evaluation of hydraulic structures for dams (including spillways and outlet works), potential failure mode analysis, and dam safety risk analysis.
Construction Engineer	The construction engineer will have experience in USACE construction practices for Dam Safety Modifications (specifically drilling and grouting and cutoff walls), potential failure mode analysis, and dam safety risk analysis.

c) **Independent External Peer Review (IEPR):** A Type II IEPR (SAR) shall be conducted on construction activities (per EC 1165-2-217) for any project where potential hazards pose a significant threat to human life (public safety).This applies to new projects and to the major repair, rehabilitation, replacement, or modification of existing facilities. An IEPR will not be conducted on the PIE as it is not required in accordance with ER 1110-2-1156, 31 March 2014.

i) East Branch Dam Safety Project Type II IEPRs During Construction. A Type II IEPR (SAR) is being conducted on the East Branch Dam Safety Modification during the construction phase. This IEPR considers the adequacy, appropriateness, and acceptability of construction activities in assuring public health, safety, and welfare.

ii) East Branch Dam Safety Type II IEPR SAR Review Team. Type II IEPR Review Team for the construction phase was established, in consultation with the RMC, through one of four contracts maintained by the Louisville District. The Review Team was selected based on their technical qualifications and experience. Specialized disciplines include:

Discipline	Expertise Required
Cut-off Wall Expert	The Cut-off Wall Expert shall have experience in the field of geotechnical engineering, analysis, design, and construction of embankment dams and levees. The Earthwork/Cutoff Wall Expert shall be recognized as an expert in cutoff wall design and construction and dam safety. The Earthwork/Cutoff Wall Expert shall have extensive knowledge of cutoff wall design and construction, including experience with various methods of cutoff wall construction, relevant equipment capabilities and experience of cutoff wall excavation of depths greater than 100 feet. The Earthwork/Cutoff Wall Expert shall have experience in subsurface investigations, soil mechanics, seepage and internal erosion, slope stability evaluations, and earthwork construction. The Earthwork/Cutoff Wall Expert shall have knowledge and experience in the forensic investigation of seepage, settlement, stability, and deformation problems associated with embankments constructed on weathered and jointed rock, alluvial soils, and colluvium. The Earthwork/Cutoff Wall Expert shall have

	knowledge of dam safety risk assessment and experience in evaluating risk reduction measures for dam safety modification projects. For the East Branch Dam Cutoff Wall Rehabilitation Project, the Earthwork/Cutoff Wall Expert is to be considered an expert in cutoff wall design and construction, as well as an expert in dam safety.
Grouting Expert	The Grouting Expert shall have extensive experience with grouting applications and shall be recognized as an expert in grouting applications. The Drilling and Grouting Expert shall be proficient in assessing seepage and internal erosion through and beneath dams constructed on or within various geologic environments, including but not limited to fractured and faulted rock, as well as alluvial (including open-work gravels) and colluvial (including boulders and cobbles) materials. The Drilling and Grouting Expert shall be familiar with identification of geological hazards, exploration techniques, field and laboratory testing, and instrumentation. The Drilling and Grouting Expert shall be experienced in the design of grout curtains and must be knowledgeable in grout mix designs, cutoff wall slurry applications, grout rheology, and other materials used in foundation seepage barriers. For the East Branch Dam project, the Drilling and Grouting Expert is to be considered an expert in grouting applications, materials, and methods.
Construction Manager	The Construction Manager shall be a registered engineer or geologist with a minimum of 5 years construction management experience related to the above discipline descriptions. The Construction Manager shall have extensive knowledge of USACE dam safety policies and procedures, risk-informed dam safety decision-making, and USACE contracting procedures. This person shall have extensive knowledge of USACE construction management policies and procedures, including both Quality Management and Contract Management. The Construction Manager shall have recent and relevant experience on multi-million dollar projects verifying the constructability of the proposed designs and then verifying that these projects were being constructed per the Plans and Specifications. The proposed construction manager may be from any of the level 3 Expert Reviewer labor categories.
Concrete Materials Expert	This team member must have extensive knowledge in concrete mix designs associated with tremie concrete for cutoff walls. Experience with admixtures, especially water reducers and anti-washout, is critical. Knowledge of deep tremie placement practices is also essential.

The Review Team is independent of USACE and free of conflicts of interests. The Review Team is able to evaluate whether the interpretation of analyses and conclusions are reasonable. The Review Team is given the flexibility to bring important issues to the attention of decision makers. The Review Team has

experience in design and construction of projects similar in scope to the East Branch Dam Safety Modification Project. The same Review Team has been retained for each phase of construction and will be retained through project completion (OMRR&R).

iii) Documentation of IEPR. Dr Checks review software is used to document IEPR comments and aid in the preparation of the Review Report. Comments address the adequacy and acceptability of the economic, engineering and environmental methods, models, and analyses used. IEPR comments should generally include the same four key parts as described for ATR comments in Section 3. The IEPR team prepares a Review Report that will accompany the publication of the final report for the project and may:

(1) Disclose the names of the reviewers, their organizational affiliations, and include a short paragraph on both the credentials and relevant experiences of each reviewer
(2) Include the charge to the reviewers prepared by the review team
(3) Describe the nature of their review and their findings and conclusions.
(4) Include a verbatim copy of each reviewer's comments (either with or without specific attributions), or represent the views of the group as a whole, including any disparate and dissenting views.

iv) IEPR Schedule and Costs. The review schedule milestones and schedule is as follows:

TYPE II IEPR MILESTONES AND SCHEDULE FOR CONSTRUCTION PHASE	
MILESTONES	DATE
Safety Assurance Review NTP	29SEP2015
Drilling and Grouting	26AUG2016
Cut Off Wall Demo. Section	15JUN2017
Critical Area Demo. Area	05APR2018
Construction Progress Review	01NOV2018
95% Construction Review	25JUL2019
Final Report and OMRR&R Review	09DEC2020

The costs to date for the Type II IEPR SAR for the Construction phase is as follows:
(1) IDIQ Task Order to Gannett Fleming - $726K

d) DSOG Review. Post Implementation Evaluation (PIE) work products will undergo a review by the Dam Safety Senior Oversight Group (DSOG). The DSOG is provided an advanced copy of the final memorandum approximately two weeks prior to the DSOG Panel Discussion, or as directed by the Program Manager. The PDT will prepare DSOG Briefing Slides summarizing the project Risk, the report findings and recommendations. These slides will be reviewed by the Program Manger prior to presentation to DSOG for clarity and conciseness.

At the conclusion of the DSOG briefing, a memo will be prepared by the DSOG Chairperson that summarizes the risk characterization of the dam, confirms or adjusts the recommended DSAC, proposes Dam Safety and Operations and Maintenance (O&M) actions to reduce risk, and is signed by the Headquarters Dam Safety Officer.

e) **Policy and Legal Compliance Review:** All PIE products will be reviewed throughout the study process for their compliance with law and policy. Guidance for policy and legal compliance reviews is addressed in Appendix H, ER 1105-2-100 and Chapter 8 of ER 1110-2-1156. These reviews culminate in determinations that the recommendations in the reports and the supporting analyses and coordination comply with law and policy, and warrant approval or further recommendation to higher authority by the home MSC Commander. DQC and ATR augment and complement the policy review processes by addressing compliance with pertinent published Army policies, particularly policies on analytical methods and the presentation of findings in decision documents. Initial and final policy compliance reviews will be conducted concurrently by the MSC and HQUSACE.

f) **Post Implementation Evaluation (PIE).** Post Implementation Evaluation (PIE) will be conducted to verify the successful implementation of the risk reduction measures in accordance with ER-1110-2-1156 Appendix X, upon completion of the primary construction contract. Reviews of the PIE will include DQC and ATR as discussed in Section 5(a) and 5(b) of this review plan.

i) Roles and Responsibilities: The following are the roles and responsibilities of the members of the PIE Team:

(1) Risk Management Center (RMC). The RMC will provide support by assigning a facilitator and risk cadre that will assist the dam safety production center (DSPC) and the district in performing the PFMA and risk estimate. The RMC is responsible for coordinating and managing agency technical review (ATR) of the PIE reports in accordance with the current review policy. The RMC will coordinate the review of the scope of work for the PIE with the vertical team and will be the approving office of the scope of work.

(2) Risk Cadre. A risk cadre and an approved PFMA facilitator, with support from the dam safety production center (DSPC) and the district, will be responsible for conducting and documenting the results of the PFMA and quantitative risk assessment results and findings. The risk cadre will also perform a quality control review of the final PIE report prior to the agency technical review.

(3) Dam Safety Production Center. The DSPC is responsible for the technical lead and execution of the PIE. This includes providing the Lead Engineer for the PDT. The DSPC is responsible for assisting in the preparation of the PIE Memorandum with the cadre and District PDT.

(4) District. The District Project Manager is responsible for the overall management of the PDT as directed in ER 5-1-11. The district will be in a support role to the DSPC for execution of the PIE. The district will provide PDT members from the construction field engineering and geology staff, the resident engineer (or representative), and district dam safety engineers/geologist.

(5) Project Delivery Team. The PDT will collect, compile, and present project data in support of the PFMA and risk assessment; support the risk assessment

cadre during the PFMA, the risk estimate. The makeup of the PDT is critical to the expeditious accomplishment of the PIE. The PDT should include as a minimum the Lead Engineer, members of the construction field engineering and geologist staff, the resident engineer (or representative), and DSPC and district dam safety engineers/geologist.

ii) PIE Process. The following is a breakdown of the activities that will occur as part of the PIE:

(1) Construction Documentation Review: The Risk Cadre will review construction records, design documentation reports, DSMR, Dam Safety Documents, and instrumentation records to prepare for the initial assessment.
(2) Initial Assessment: This will include a site visit to East Branch Dam followed by a potential failure mode analysis and risk assessment in the LRP district office while construction of the cutoff wall is still in progress. The level of risk assessment is determined by the RMC advisor.
(3) Post Initial Assessment: Following the Initial Assessment the Risk Cadre will direct any additional analyses or studies needed to support or refine the risk assessment and conduct an out brief to senior level RMC, District, and Division management. This phase will also include a follow-up visit or teleconference between the Risk Cadre and the District PDT at Cutoff Wall Completion to confirm that the final portions of the cutoff wall were constructed based on the assumptions made during the Initial Assessment.
(4) PIE Memorandum Preparation: The Risk Cadre and District PDT will prepare a memorandum detailing the post implementation evaluation. The draft of this memorandum will undergo District Quality Control (DQC) and once the memorandum is finalized it will be transmitted to the ATR team. The PIE memorandum will also be transmitted at this time to the LRD Dam Safety Program Manager for concurrent MSC review. ATR will be certified prior to transmittal to the vertical team. No Quality Control and Consistency review (QCC) will be performed on this product.
(5) Presentation to the Dam Senior Oversight Group (DSOG): After ATR certification, the results and recommendations of the PIE will be presented to the DSOG. The DSOG will review the PIE and after any comments are addressed will provide a recommendation to the USACE DSO for any changes to the current DSAC.

iii) Schedule of PIE:

POST-IMPLEMENTATION EVALUATION MILESTONES AND SCHEDULE	
MILESTONES	DATE
Construction Documentation Review	1 Mar–22 Apr 2019
Initial Assessment	22 – 26 Apr 2019
Post-Initial Assessment and PIE Memorandum Preparation (Including DQC)	1 May–30 July 2019
ATR and MSC Review	19 Aug-15 Sep 2019
Transmit to Dam Safety Oversight Group	11 Oct 2019
DSOG (Fall 2019)	29 Oct 2019

iv) Cost of PIE: Costs associated with the PIE for District PDT will be included in the EDC and S&A forecasts for the fiscal year that they will occur in. The cost estimate received for the Risk Cadre and RMC Advisor total $185,000 for this task. The anticipated cost of ATR is $30,000.

g) **Additional Documentation and Reviews Required for Project Closeout.** As a result of the installation of the risk reduction measures, several documents will need to be created/updated and reviewed. All of these documents will undergo DQC. The documents that will need to be reviewed includes but are not limited to:

i) Reservoir Filling Plan
   (1) Led by LRP Geotechnical Engineering, Hydraulics and Hydrology and Dam Safety Sections
   (2) Reviewed and approved by District Dam Safety Officer (DSO) and provided for information to the MSC Dam Safety Officer

ii) Water Control Manual
   (1) Led by LRP Water Management Section
   (2) Reviewed and approved by MSC
   (3) Posted for Public Review

iii) Operation, Maintenance, Repair, Replacement and Rehabilitation (OMRR&R Manual)
   (1) Led by LRP Engineering and Construction Division
   (2) Reviewed and approved by MSC

iv) Emergency Action Plan
   (1) Led by LRP Dam Safety Section
   (2) Reviewed and approved by MSC

v) Schedule and Costs for Closeout Documents
   (1) The schedule for the update and completion of each required report is highly dependent on the completion of the primary risk reduction measure, completion of the cutoff wall.
   (2) Costs associated with updating these documents will be included in the EDC and S&A forecasts for the fiscal year in which they will occur.

h) **Public Participation.** Since initiation of the East Branch Dam Safety Modification Study in February 2008, numerous public meetings have been conducted. Public meetings were conducted to inform the public of the current condition of the East Branch Dam. The last public meeting was held on 10 January 2019. The next public meeting will be an open house on the dam site on 1 June 2019. Upon MSC approval of this Review Plan, it will be posted on the Pittsburgh District Internet for Public Review (https://www.lrp.usace.army.mil/Missions/Planning-Programs-Project-Management/Project-Review-Plans).

i) **MSC Approval.** The Great Lakes and Ohio River Division is responsible for approving the review plan. The MSC Commander provides final approval. Approval should reflect vertical team input (including district, MSC, RMC, and HQUSACE members) as to the appropriate scope and level of review for the project. Like the PMP, the Review Plan is a living document and may change as the study progresses. Changes to the Review Plan should be approved by following the process used for initially approving the plan.

6) **REVIEW SCHEDULE AND BUDGET.** Schedule and Cost. QA and QC for EDC occurs seamlessly during construction. The cost for QA during construction or Supervision and Administration (SA) is provided for previous years and estimated for future years in the following table (The costs of QC for Engineering activities is not broken out separately from EDC cost).

FY	S &A	EDC
14	$770k (Actual)	$1.7 M (Actual)
15	$1.8 M (Actual)	$2.8 M (Actual)
16	$2.1 M (Actual)	$3.0 M (Actual)
17	$2.5 M (Actual)	$3.2 M (Actual)
18	$4.1 M (Actual)	$3.3 M (Actual)
19	$3.2 M (Forecast)	$3.9 M (Forecast)
20	$3.1 M (Forecast)	$4.2 M (Forecast)

7) **REVIEW PLAN POINTS OF CONTACT.** Questions and/or comments on this review plan can be directed to the following points of contact:

(1) [redacted] Pittsburgh District, Project Manager
(2) [redacted] Pittsburgh District, Area Engineer
(3) [redacted] ittsburgh District, Resident Engineer
(4) [redacted] Pittsburgh District, Chief of Construction
(5) [redacted] Pittsburgh District, Dam Safety Project Manager
(6) [redacted] Huntington District, Lead Engineer, Phases 2, 3, & 4
(7) [redacted] reat Lakes and Ohio River Division, Dam Safety Program Manager
(8) [redacted] Risk Management Center

8) APPROVED BY SIGNATURE

Jeanine Hoey, P.E., P.M.P.
Chief, Engineering and Construction Division

ATTACHMENT 1 - TEAM MEMBERS

Table 1 lists the overall project PDT members. The table also designates which overall PDT members are also part of the PIE PDT. There are members of the overall project PDT that will serve as PIE DQC because of their extensive knowledge of the project.

Table 1 – PDT Members

Role	**Team Member**
Project Manager	[redacted]
Technical Lead/Lead Engineer (PIE PDT)	
Dam Safety Program Manager	
Geotechnical Engineer (PIE PDT)	
Structural Engineer (PIE PDT)	
Geologist (PIE PDT)	
Cost Engineer	
Materials Engineer (PIE PDT)	
Civil/Site Engineer	
Operations	
Area Engineer	
Resident Engineer	
Contracting Officer	
Construction Engineer/ Geologist (PIE PDT)	
Dam Safety Coordinator (PIE PDT)	
PIE DQC Team Role	
Geotechnical (DQC Lead)	
Geotechnical	
Geologist	
Structural	

Table 2 – PIE/ LRL Risk Cadre

Role	
Cadre Lead	
Geotechnical Engineer	
Engineering Geologist	

Table 3 – RMC Advisors

Role	
RMC Technical Advisor	

Table 4 – PIE ATR Team

Role	
ATR Lead/Geotechnical	
Hydraulic Structures Engineer	
Construction Engineer	

Table 4A – PIE MSC Review Concurrent with PIE ATR

Role	Team Member
MSC DSPM	[redacted]