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DRAFT REVIEW PLAN

BLUESTONE DAM SAFETY ASSURANCE PROJECT-DAM SAFETY MODIFICATION REPORT SUPPLEMENT
HINTON, WEST VIRGINIA

HUNTINGTON DISTRICT

November 2010

US Army Corps of Engineers ®

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1. PURPOSE AND REQUIREMENTS

a. Purpose. This document outlines the Review Plan for Bluestone Dam Safety Assurance (Bluestone DSA) Project. Engineer Circular 1165-2-209, dated 31 January 2010, Civil Works Review Policy, provides procedures for ensuring the quality and credibility of U.S. Army Corps of Engineers decision and implementation documents and work products. It establishes a 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 and construction. It also outlines the framework for establishing the appropriate level of independence of reviews as well as detailed requirements, including documentation and dissemination.

The Bluestone DSA Project is in various stages of development. The Project Background section will present a detailed history of the project as well as explain the various stages of study, design and construction. This review plan will outline plans for the anticipated reviews of the Design Documentation Report Updates, Plans and Specifications, and the Dam Safety Modification Report Supplement (DSMRS).

b. References

(1) Engineering Circular (EC) 1165-2-209, Civil Works Review Policy, 31 Jan 2010
(2) EC 1105-2-412, Assuring Quality of Planning Models, Draft, 30 Dec 2009
(3) Engineering Regulation (ER) 1110-2-12, Quality Management, 30 Sep 2006
(4) ER 1105-2-100, Planning Guidance Notebook, Appendix H, Policy Compliance Review and Approval of Decision Documents, Amendment #1, 20 Nov 2007
(5) Bluestone DSA Project #112490 Electronic Project Management Plan (e-PMP) document on https://pmbp.usace.army.mil/portal
(6) LRD Regional ISO 9001 Manual in Qualtrax

c. Requirements. This review plan was developed in accordance with EC 1165-2-209 which establishes the procedures for ensuring the quality and credibility of U.S. Army Corps of Engineers (USACE) decision documents through independent review. The EC outlines three levels of review: District Quality Control, Agency Technical Review, and Independent External Peer Review. In addition to these three levels of review, decision documents are subject to policy and legal compliance review and, if applicable, safety assurance review and model certification/approval.

(1) District Quality Control/Quality Assurance (DQC). All **decision documents** (including supporting data, analyses, environmental compliance documents, etc.) shall undergo DQC. DQC is an internal review process of basic science and engineering work products focused on fulfilling the project quality requirements defined in the Project Management Plan (PMP). The home district shall manage DQC. Documentation of DQC activities is required and should be in accordance with the Quality Manual of the District and the home Major Subordinate Command (MSC).

(2) Agency Technical Review (ATR). ATR is mandatory for all **decision documents** (including supporting data, analyses, environmental compliance documents, etc.). The objective of ATR is to ensure consistency with established criteria, guidance, procedures, and policy. The ATR will assess whether the analyses presented are technically correct and comply with published US Army Corps of Engineers (USACE) guidance, and that the document explains the analyses and results in a reasonably

clear manner for the public and decision makers. ATR is managed within USACE by a designated Risk Management Organization (RMO) and is conducted by a qualified team from outside the home district that is not involved in the day-to-day production of the project/product. ATR teams will be comprised of senior USACE personnel and may be supplemented by outside experts as appropriate. To assure independence, the leader of the ATR team shall be from outside the home MSC.

(3) Independent External Peer Review (IEPR). IEPR may be required for **decision documents** under certain circumstances. 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. A risk-informed decision, as described in EC 1165-2-209, is made as to whether IEPR is appropriate. IEPR panels will consist of independent, recognized experts from outside of the USACE in the appropriate disciplines, representing a balance of areas of expertise suitable for the review being conducted. There are two types of IEPR: Type I is generally for decision documents and Type II is generally for implementation products.

(a) Type I IEPR. Type I IEPR reviews are managed outside the USACE and are conducted on project studies. Type I IEPR panels assess the adequacy and acceptability of the economic and environmental assumptions and projections, project evaluation data, economic analysis, environmental analyses, engineering analyses, formulation of alternative plans, methods for integrating risk and uncertainty, models used in the evaluation of environmental impacts of proposed projects, and an biological opinions of the project study. Type I IEPR will cover the entire decision document or action and will address all the underlying engineering, economics, and environmental work, not just one aspect of the study. For decision documents where a Type II IEPR (Safety Assurance Review) is anticipated during project implementation, safety assurance shall also be addressed during the Type I IEPR per EC 1165-2-209.

b) Type II IEPR. Type II IEPR reviews, or Safety Assurance Reviews (SAR), are managed outside the USACE and are conducted on design and construction activities for hurricane, storm, and flood risk management projects or other projects where existing and potential hazards pose a significant threat to human life. Type II IEPR panels will conduct reviews of the design and construction activities prior to initiation of physical construction and, until construction activities are completed, periodically thereafter on a regular schedule. The reviews shall consider the adequacy, appropriateness, and acceptability of the design and construction activities in assuring public health safety and welfare.

(4) Policy and Legal Compliance Review. All **decision documents** 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. 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 Chief of Engineers. 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.

(5) Cost Engineering Review and Certification. All **decision documents** shall be coordinated with the Cost Engineering Directory of Expertise (DX), located in the Walla Walla District. The DX, or in some circumstances regional cost personnel that are pre-certified by the DX, will conduct the cost ATR. The DX will provide certification of the final total project cost.

(6) Model Certification/Approval. EC 1105-2-412 mandates the use of certified or approved models for all planning activities to ensure the models are technically and theoretically sound, compliant with USACE policy, computationally accurate, and based on reasonable assumptions. Planning models, for the purposes of the EC, are defined as any models and analytical tools that planners use to define water resources management problems and opportunities, to formulate potential alternatives to address the problems and take advantage of the opportunities, to evaluate potential effects of alternatives and to support decision making. The use of a certified/approved planning model does not constitute technical review of the planning product. The selection and application of the model and the input and output data is still the responsibility of the users and is subject to DQC, ATR, and IEPR. EC 1105-2-412 does not cover engineering models used in planning. The responsible use of well-known and proven USACE developed and commercial engineering software will continue and the professional practice of documenting the application of the software and modeling results will be followed. Use of engineering models is also subject to DQC, ATR, and IEPR.

2. REVIEW MANAGEMENT ORGANIZATION (RMO) COORDINATION

The RMO is responsible for managing the overall peer review effort described in this Review Plan. The RMO for decision documents is typically either a Planning Center of Expertise (PCX) or the Risk Management Center (RMC), depending on the primary purpose of the decision document. The RMO for the peer review effort described in this Review Plan is the RMC.

The RMO will coordinate with the Cost Engineering Directory of Expertise (DX) to conduct ATR of cost estimates, construction schedules and contingencies. They will also coordinate and manage the IEPR.

3. PROJECT BACKGROUND

Bluestone Dam and reservoir was authorized by Executive Order 7183 in September 1935 and the Flood Control Acts of 1936 and 1938. Bluestone was authorized for flood control, recreation, fish and wildlife enhancement and hydropower. In planning Bluestone Dam a hypothetical flood was created by shifting the center of the hurricane storm of July 1916 to the New River drainage basin. This hypothetical flood, the design flood, had an estimated peak inflow of 430,000 ft3/s. The Probable Maximum Flood (PMF) has an estimated peak inflow of 1,086,000 ft3/s.

Construction of the Bluestone project was started in January 1942 and continued until March 1944. The War Production Board stopped the project construction for the duration of World War II. The project resumed construction in 1946 and was completed in December 1948. The original plans for Bluestone called for a construction of a combined flood control and hydroelectric development. Extensive wartime electric power development resulted in a

decision to defer power development at the project and use all available storage for flood control. This lowered the elevation of the lake 80 feet from 1,490 to 1,410. The construction costs for Bluestone was $28,600,000. Bluestone Dam is located in southern West Virginia in Summers County on the New River approximately 1 ½ miles upstream of the City of Hinton and ½ mile upstream of the confluence of the New River and Greenbrier River. The project has a 4,600 square mile drainage area.

Bluestone Dam is a straight, concrete gravity structure with an overall length of 2,060 feet and a maximum height of 165 feet above the streambed. Discharge capacity of the existing structure consists of gated sluices and a gated auxiliary spillway. The spillway section is 790 feet long and includes 21 bays with vertical lift gates. The total design discharge capacity is 430,000 cfs. Operation of the reservoir is by 16 gated sluices with a total capacity of 70,000 cfs.

The first Periodic Inspection of Bluestone Dan was completed in 1969 and indicated that a study should be done to determine if a proposed powerhouse excavation would be detrimental to the safety of the dam and to perform a stability check of the concrete sections using current criteria. Hydrologic deficiency was first noted in the 1982 reconnaissance report. The study was suspended, however, pending guidance on performing DSA evaluations. DSA guidance of 1986 outlined the procedures for evaluating dams to compare "with" and "without failure" scenarios. The Bluestone DSA Draft Report, based on this guidance, was completed in 1994 and identified two alternatives: (1) Raise dam (least costly) and (2) Spillway modification. The Reliability Study was complete in 1995 to compare the alternatives. ER-1110-2-1155, dated 12 September 1997, states that that for a project to be under the program that one of the following criteria have to be meet: "New hydrologic or seismic data or changes in state-of-the-art design or construction criteria." Bluestone was determined to have a hydrologic deficiency.

The Bluestone DSA Evaluation Report was approved in 1998. The approved plan, which is currently under construction, modifies Bluestone Dam so that it will withstand the PMF event as authorized in the National Dam Safety Act (PL 92-367) of August 8, 1972. Features of the approved plan include: modification of the 6 hydropower penstocks to supplement the discharge capacity; parapet wall on top of the dam; an additional gravity monolith on the east abutment; a floodgate closure across WV Rt. 20 on the west abutment; removable closures at each end of the spillway; high-strength, multistrand anchors; mass concrete thrust blocks against the downstream face of the dam; and a pavement for scour protection downstream of the penstocks.

Hydroelectric has never been developed at Bluestone Dam. It would be the responsibility of the future hydropower developer to preserve the flood discharge capabilities of the penstocks. The Water Resource Development Act of 2003 provided for the Tri-Cities Power Authority to be the owner and operator of the hydropower facilities and removed hydropower as a project purpose. Tri-Cities has indicated pursuit of development of hydropower at Bluestone will not resume until the DSA Project is complete, which currently is scheduled for 2020.

In July 2008, an Issue Evaluation Study (IES) was performed by the U.S. Bureau of Reclamation and the Corps Risk and Reliability Directorate of Expertise Cadre. The findings of the IES indicated that by the Bureau of Reclamation's Public Protection Guidelines for Portrayal of Risk that Bluestone fell in the range of unacceptable risk after the completion of Phase 2B (work to be completed in that phase is described on the following page) and that

expedited action is needed to reduce risk. The five issues of concern identified during the IES were:

- Scour – Lack of permanent scour protection in the Stilling Basin and Penstock area.

- Factors of Safety - Corps criteria of using a minimum F.S. of 1.1 for extreme events (up to PMF) does not consider the likelihood of the event. With Corps criteria, a factor of safety of 1.1 is actually acceptable for any event above a 300-year return period.

- Rock Strengths - The friction angle (31 degrees) and cohesion (6 psi) selected do not reflect the potential that the actual conditions may be as low as 27 degrees and 0 psi.

- Loss of Life – Concern that the calculation for Loss of Life was too low.

- Flood Frequency Curves - Debris plugging was not considered in the DSA design. This could have the effect of making greater pools occur more frequently due to the reduced spillway capacity.

Construction of the DSA project has been divided into phases, briefly described as follows.

Phase 1 contract was awarded in September 2000 for approximately $20M. Features of Phase 1 included construction of a 2-lane bailey type bridge built over the stilling basin and glory hole for construction traffic. In addition, a mass concrete thrust block was built on the downstream side of monoliths 15-21. Six penstocks were extended and three of the six sacrificial bulkheads were installed. Construction of Phase 1 was complete in 2004.

Phase 2A contract was awarded May 2004 for approximately $7.5M. Work included a swing gate closure across State Route 20, upgrade of the access roadway to stilling basin, installation of a new handicap fisherman pier on the west abutment, adding an east abutment gravity wall and relocating primary power and telephone lines. Construction of Phase 2A was complete in 2006.

Phase 2B contract was awarded for $31M in May 2005 but didn't start construction until June 2006. To date 150 out of the required 150 high capacity anchors on the east and west abutment in the non-spillway monoliths have been installed. In addition, the thrust block was completed and the three remaining sacrificial bulkheads on the three penstocks in monoliths 16, 17 and 18 were installed. Construction was originally scheduled to be complete in December 2009. However, a modification to the contract has been negotiated to add an additional 50 anchors to the contract and extend the completion date to April 2011. Eight of those additional 50 anchors have been installed for a total of 158.

Phase 3 contract is scheduled to be awarded in September 2010. The purpose of this phase is to reduce the energy of the discharge from the penstocks to reduce the risk of scour and threat to the stability of the dam in the event the penstocks are used to increase discharge capacity.

Phase 4 contract is scheduled to be awarded in 2012. This phase of work includes installing 60 high strength steel strand anchors in the spillway monoliths. A government furnished platform will be used to install the anchors.

Phase 5 will be the name used for the design and construction activities associated with the recommendations of the DSMRS. Generally this phase will address the concerns identified during the IES relative to the spillway and stilling basin areas of the dam. Preliminary schedule estimates for completion of this phase of construction is 2020.

Given the various stages of development of the Bluestone DSA project, the remainder of this RP will be organized by type of document, phase and required reviews for each document. This review plan will specifically cover documents and reviews for phases 3, 4 and 5. Prior phases are either complete or near completion.

4. IMPLEMENTATION DOCUMENTS – Phase 3 & 4

The Phase 3 and Phase 4 DDR is currently under development. The Phase 3 P&S are scheduled to be awarded in September 2010 and Phase 4 P&S are scheduled to be awarded in FY12.

5. DISTRICT QUALITY CONTRL (DQC) – Phase 3 & 4

DQC is an internal review process of basic science and engineering work products focused on fulfilling the project quality requirements defined in the Project Management Plan (PMP). Basic quality control tools include a Quality Management Plan providing for seamless review, quality checks and reviews, supervisory reviews, and Project Delivery Team (PDT) reviews throughout the life of the project. DQC efforts will include the necessary expertise to address compliance with published Corps policy.

6. AGENCY TECHNICAL REVIEW (ATR) – Phase 3 & 4

a. General. ATR will be managed and performed outside of the Huntington District. EC 1165-2-209 requires the USACE Risk Management Center (RMC) to serve as the RMO for Dam Safety Modifications projects. At the time the RMC was not staffed or organized to support ATR. In the interim, the Great Lakes & Ohio River Division has managed the ATR. There shall be appropriate coordination and processing through CoPs; relevant PCXs, and other relevant offices to ensure that a review team with appropriate independence and expertise is assembled and a cohesive and comprehensive review is accomplished. The ATR shall ensure that the product is consistent with established criteria, guidance, procedures, and policy. The ATR will assess whether the analyses presented are technically correct and comply with published USACE guidance, and that the document explains the analyses and the results in a reasonably clear manner for the public and decision makers. Members of the ATR team will be from outside the Huntington District. The ATR lead will be from outside the Great Lakes & Ohio River Division.

b. Products for Review. The ATR team will be reviewing the DDR and Plans & Specifications for Phases 3 and 4.

c. Required ATR Team Expertise. ATR teams will be comprised of senior USACE personnel (Regional Technical Specialists (RTS), etc.), and may be supplemented by outside experts as appropriate. The disciplines represented on the ATR team will reflect the significant disciplines involved in the planning, engineering, design, and construction effort. These disciplines include civil, geotechnical, geology, structural, hydraulics and hydrology, materials, and cost engineering. To assure independence, the leader of the ATR team is Steve Jirousek from CENWK. A list of the ATR members and disciplines is provided in

ATTACHMENT 1. The chief criterion for being a member of the ATR team is knowledge of the technical discipline and relevant experience.

d. Documentation of ATR. DrChecks review software will be used to document all ATR comments, responses and associated resolutions accomplished throughout the review process. Comments should be limited to those that are required to ensure adequacy of the product. The four key parts of a quality review comment will normally include:

(1) The review concern – identify the product's information deficiency or incorrect application of policy, guidance, or procedures;
(2) The basis for the concern – cite the appropriate law, ASA (CW)/USACE policy, guidance or procedure that has not been properly followed;
(3) The significance of the concern – indicate the importance of the concern with regard to its potential impact on the plan selection, recommended plan components, efficiency (cost), effectiveness (function/outputs), implementation responsibilities, safety, Federal interest, or public acceptability; and
(4) The probable specific action needed to resolve the concern – identify the action(s) that must take to resolve the concern.

In some situations, especially addressing incomplete or unclear information, comments may seek clarification in order to then assess whether further specific concerns may exist. The ATR documentation in DrChecks will include the text of each ATR concern, the PDT response, a brief summary of the pertinent points in any discussion, including any vertical coordination, and lastly the agreed upon resolution. The ATR team will prepare a Review Report which includes a summary of each unresolved issue; each unresolved issue will be raised to the vertical team for resolution. Review Reports will be considered an integral part of the ATR documentation.

ATR may be certified when all ATR concerns are either resolved or referred to HQUSACE for resolution and the ATR documentation is complete. Certification of ATR should be completed, based on work reviewed to date, for the draft and final report.

7. TYPE II INDEPENDENT EXTERNAL PEER REVIEW (IEPR) – Phase 3 & 4

a. General. In accordance with EC 1165-2-209 a Type II IEPR (SAR) shall be conducted on design and 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. WRDA 2007, Section 2035, Safety Assurance Review, requires a review of the design and construction activities prior to initiation of physical construction and periodically thereafter until construction activities are completed. This review will be on a regular schedule sufficient to inform the Chief of Engineers on the adequacy, appropriateness, and acceptability of the design and construction activities for the purpose of assuring public health, safety and welfare. SARs will be conducted on the Design Documentation Report (DDR) and intermittently throughout the construction phases. The purpose of the SAR is to ensure that good science, sound engineering, and public health, safety and welfare are the most important factors that determine a project's fate. The SAR shall focus on whether the assumptions made for hazards remain valid as additional knowledge is gained and the state-of-the-art evolves. Additionally, the SAR team shall advise whether project features adequately address redundancy, robustness, and resiliency; and findings during construction reflect the assumptions made during design.

b. Decision on Type II IEPR. In accordance with EC 1165-2-209, a Type II IEPR (SAR) shall be conducted on design and construction activities for flood risk management projects. This applies to new projects and to the major repair, rehabilitation, replacement, or modification of existing facilities.

c. Products for Review. Type II IEPR will be performed on the 50% & 100% Design Documentation Report (DDR), during the midpoint of the construction, and before substantial completion of construction. Due to the routine nature of the Phase 3 type of work (mass concrete) and the Phase 4 type of work (rock anchors), a Type II IEPR will not be performed on the plans and specifications.

d. IEPR Review Team. Type II IEPR Review Team will be established, in consultation with the RMC, through a contract with Battelle that is administered by the Army Research Organization (ARO). The public, scientific or professional societies will not be asked to nominate potential reviewers. The Review Team will be selected based on their technical qualifications and experience. The Review Team should be independent of USACE and free of conflicts of interests. The Review Team will be able to evaluate whether the interpretation of analysis and conclusions based on analysis are reasonable. The Review Team will be given the flexibility to bring important issues to the attention of decision makers. However, the Review Team will be instructed to not make a recommendation on whether a particular alternative should be implemented, as the Chief of Engineers is ultimately responsible for the final decision on a planning or reoperations study. The Review Team may, however, offer their opinion as to whether there are sufficient analyses upon which to base a recommendation. The Review Team will have experience in design and construction of projects similar in scope to the Bluestone Dam Safety Assurance Project. The Review Team shall be registered professional engineers in the United States, or similarly credentialed in their home country. The Review Team must also have an engineering degree. A Master's degree in engineering is preferable, but not required, as hands-on relevant engineering experience in the listed disciplines is more important. The Review Team shall have a minimum of 15 years experience and responsible charge of engineering work. See ATTACHMENT 1 for the required experience in the required disciplines.

e. Documentation of IEPR. Dr Checks review software will be used to document IEPR comments and aid in the preparation of the Review Report. Comments should 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 Contractor (Battelle) will be responsible for compiling and entering comments into DrChecks. The IEPR team will prepare a Review Report that will accompany the publication of the final report for the project and shall:

- Disclose the names of the reviewers, their organizational affiliations, and include a short paragraph on both the credentials and relevant experiences of each reviewer;
- Include the charge to the reviewers prepared by the Contractor (Battelle);
- Describe the nature of their review and their findings and conclusions; and
- 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.

8. REVIEW SCHEDULES AND COSTS – Phase 3 & 4

a. DQC Schedule and Cost. The cost for DQC is included in the costs for PDT activities and is not broken out separately. DQC will occur seamless during throughout the DDR and the P&S. Quality checks and reviews occur during the development process and are carried out as a routine management practice. Multiple PDT Reviews of the DDR and P&S where completed in 2009 and 2010.

b. ATR Schedule and Cost. The estimated cost for ATR is $85,000. ATR will occur during key stages in the DDR and P&S. The ATR team is invited to take part in weekly team meetings and monthly vertical team meetings. ATR of the 50% DDR, 70% Phase 3 P&S, and 70% Phase 4 P&S is complete. ATR of the 100% Phase 3 P&S is complete. ATR of the 100% DDR is scheduled to begin in FY2011. ATR of the 100% Phase 4 P&S is scheduled to occur in FY2012.

ATR Milestones	
50% DDR Review	Complete
70% Phase 3 &4 P&S Review	Complete
100% Phase 3 P&S Review	Complete
100% DDR Review	September 2011
100% Phase 4 P&S Review	FY 2012

c. IEPR Schedule and Cost. The estimated cost for Type II IEPR (SAR), including the cost for the RMO to administer and manage the review, is in the range of $300,000 to $400,000. The Type II IEPR (SAR) that is currently underway for the DDR is approximately $300,000. This is through an ARO contract with Battelle. Type II IEPR (SAR) for the Phase 3 and Phase 4 Construction has not been scheduled at this time, but will occur in FY2011 and FY2013.

IEPR (SAR) Milestones	
50% DDR Review	Complete
100% DDR Review	September 2011
Phase 3 Construction Midpoint	April 2012
Phase 3 Construction before substantial completion of construction	FY 2013
Phase 4 Construction Midpoint	FY 2013
Phase 4 Construction before substantial completion of construction	FY2014

9. STUDY INFORMATION – Phase 5

a. Decision Document. The decision document for Phase 5 will be the Bluestone Dam Safety Modification Report Supplement. The DSMRS will serve as a supplement to the original DSA study. Bluestone is classified as a Dam Safety Action Class (DSAC) classification of II, which is described as "Urgent". A dam with this classification is considered to have a failure initiation foreseen or very high risk. Since no additional authorization by Congress is required to address dam safety issues this report will be prepared in accordance with Draft ER 1110-2-1156, 16 Jul 2009. This study will evaluate alternatives to address the areas of concern identified in the IES. An Environmental Assessment (EA) is expected to be prepared to support the DSMRS. Should an alternative that would directly impact the New River downstream of the dam be considered in detail, mitigation for such actions are anticipated to be those that would impact aquatic habitat and would be imposed by statute and regulation therefore making an EA the appropriate level of documentation..

The DSMRS will be signed by the District Commander after completion of all DQC, ATR and IEPR. The DSMRS will then be submitted to CELRD, the RMC, and HQUSACE for concurrent Policy Compliance Review. The Risk Management Center will review the risk management recommendations and verify the estimated risk reductions.

The District Dam Safety Officer (DSO), CERLD DSO and the Chairman, HQUSACE Dam Safety Senior Oversight Group will sign the approval memorandum once all policy compliance review comments are resolved. This approval memorandum will state that all agency requirements, certifications, and reviews have been completed and the EA and signed Finding of No Significant Impact (FONSI) have been satisfactorily completed and signed. The DSMRS will then be sent to the HQUSACE DSO for concurrence, approval and transmittal to the Assistant Secretary of the Army for Civil Works indicating that the design phase of the project will be initiated. The intended outcome of this document is approval to initiate additional risk reduction action at Bluestone Dam.

b. Study Description. The project background, description of the study area and results of the IES that identify the need for this DSMRS are previously described in Section 2, PROJECT BACKGROUND. The report will document the selection of a recommended alternative to safely pass the PMF. The peak Spillway Design Flood discharge through the spillway has increased from 430,000 cfs at a peak pool elevation of 1523 to 792,000 cfs spillway flow combined with 71,000 cfs sluice discharge and 148,000 cfs penstock discharge for a combined discharge of 1,011,000 cfs at a peak pool elevation of 1542.2 based on current PMF criteria. This study will evaluate alternative improvements to the spillway and stilling basin to prevent failure of the dam during a PMF event. Potential issues include significant scour of the spillway stilling basin and cavitation of the spillway.

To date the District has utilized a multi-agency and discipline team to develop possible solutions. That list has been narrowed down based on multiple factors such as cost, environmental impacts, constructability, acceptability and duplication. The remaining alternatives will be tested using a physical model at the Corps' Engineering Research and Development Center (ERDC). Alternatives include various modifications to the weir, crest gates, adding flip buckets and/or additional weir, cut-off wall and a side channel spillway. Model test results will further refine the list of alternatives. At this stage in the study effort,

an estimated cost for a potentially recommended project has not been developed. Bluestone Dam was constructed prior to the enactment of any cost-sharing regulations. The operation and maintenance of this Federally-owned dam is a 100 percent Federal responsibility.

c. Factors Affecting the Scope and Level of Review. Alternatives under consideration for Phase 5 such as flip bucket, raising the weir elevation, adding a secondary weir and armoring the spillway floor are not novel measures. These measures alone are not high risk and would not need high levels of review but when considered with respect to the overall dam safety issues may need additional consideration. The remainder of this section will present information regarding the factors affecting the appropriate scope and level of review.

- Bluestone Dam has unacceptable risks of failure and an Imminent Failure Flood (IFF) is currently well below design level. The hydropower penstocks have been retrofitted with sacrificial bulkheads to provide additional discharge capacity for the dam. As previously mentioned, this modification of the dam was part of the approved DSA project. In the event that the penstocks must be used to increase discharge capacity to reduce the possibility of reaching of exceeding the IFF, currently about a 21-year event, control of the dam cannot be regained until the pool reaches the invert of the penstock. Without modification of the spillway to address scour and cavitation concerns, the probability of utilizing the penstocks is unacceptably high. Currently the dam functions well below design level.
- Experience gained from the more than 10 years in planning, design and construction of the BLN DSA project have not proven controversial to the public except with certain very local issues primarily concerning construction traffic and similar effects. Other agency interests have been typical of any Water Resource project (e.g. fish and wildlife, recreation, etc.). Due to relatively recent recognition of risks with the dam, emergency services agencies have been continually apprised of the project and of course interested.
- Failure of the Bluestone Dam would have significant economic, environmental and social effects. Dam failure at a PMF event is estimated to have significant loss of life. There is a large downstream population primarily in the Kanawha Valley along with critical facilities and infrastructure. The impacts associated with inundation at chemical facilities would have devastating effects both economically and to health and human safety.
- Planning and design of the project will use models and methods common to USACE practices.
- Phase 5 construction is scheduled to commence as soon as Phase 4 is completed; therefore no overlapping of construction phases or contractors is anticipated at this time.

d. In-Kind Contributions. Not Applicable

10. DISTRICT QUALITY CONTROL (DQC) – Phase 5

a. Documentation of DQC. DQC will be accomplished per the PMP and the Quality Control Plan. Documentation of the DQC will be accomplished in DrChecks. The use of DrChecks will facilitate the availability of the DQC to the ATR team.

b. Products to Undergo DQC. The following work products will require independent peer review: Alternative Screening, Preliminary DSMRS/NEPA Document (Prior to public review), Preliminary Final DSMRS/NEPA Document (After consideration of public comments), and the decision document (FONSI or ROD). A senior level planner will

accomplish the QC reviews. The purpose is to ensure completeness and compliance with agency regulation, guidance, and statute.

11. AGENCY TECHNICAL REVIEW (ATR) – Phase 5

a. Products for Review. The draft DSMRS/NEPA Document along with technical appendices will require ATR. Additional review of key interim products will be undertaken as necessary. The ATR of the project cost estimate, construction schedules and contingencies will be coordinated with the Cost Engineering Directory of Expertise.

b. Required ATR Team Expertise. The ATR team will be comprised of senior USACE personnel (Regional Technical Specialists (RTS), etc.), and may be supplemented by outside experts as appropriate. The disciplines represented on the ATR team will reflect the significant disciplines involved in the planning and engineering and design effort. These disciplines include plan formulation, environmental, economics, geotechnical, geology, hydrology & hydraulics and cost engineering. To assure independence, a leader will be chosen from a division other than LRD. A list of the ATR members, disciplines and required expertise will be provided once identified by the RMO. The chief criterion for being a member of the ATR team is knowledge of the technical discipline and relevant experience.

c. Documentation of ATR. Documentation of ATR. DrChecks review software will be used to document all ATR comments, responses and associated resolutions accomplished throughout the review process. Comments should be limited to those that are required to ensure adequacy of the product. The four key parts of a quality review comment will normally include:

(1) The review concern – identify the product's information deficiency or incorrect application of policy, guidance, or procedures;
(2) The basis for the concern – cite the appropriate law, policy, guidance, or procedure that has not be properly followed;
(3) The significance of the concern – indicate the importance of the concern with regard to its potential impact on the plan selection, recommended plan components, efficiency (cost), effectiveness (function/outputs), implementation responsibilities, safety, Federal interest, or public acceptability; and
(4) The probable specific action needed to resolve the concern – identify the action(s) that the reporting officers must take to resolve the concern.

In some situations, especially addressing incomplete or unclear information, comments may seek clarification in order to then assess whether further specific concerns may exist.

The ATR documentation in DrChecks will include the text of each ATR concern, the PDT response, a brief summary of the pertinent points in any discussion, including any vertical team coordination (the vertical team includes the district, RMO, MSC, and HQUSACE), and the agreed upon resolution. If an ATR concern cannot be satisfactorily resolved between the ATR team and the PDT, it will be elevated to the vertical team for further resolution in accordance with the policy issue resolution process described in either ER 1110-1-12 or ER 1105-2-100, Appendix H, as appropriate. Unresolved concerns can be closed in DrChecks with a notation that the concern has been elevated to the vertical team for resolution.

At the conclusion of each ATR effort, the ATR team will prepare a Review Report summarizing the review. Review Reports will be considered an integral part of the ATR documentation and shall:

- Identify the document(s) reviewed and the purpose of the review;
- Disclose the names of the reviewers, their organizational affiliations, and include a short paragraph on both the credentials and relevant experiences of each reviewer;
- Include the charge to the reviewers;
- Describe the nature of their review and their findings and conclusions;
- Identify and summarize each unresolved issue (if any); and
- 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.

ATR may be certified when all ATR concerns are either resolved or referred to the vertical team for resolution and the ATR documentation is complete. The ATR Lead will prepare a Statement of Technical Review certifying that the issues raised by the ATR team have been resolved (or elevated to the vertical team). A Statement of Technical Review should be completed, based on work reviewed to date, for the AFB, draft report, and final report. A sample Statement of Technical Review is included in Attachment 2.

12. TYPE I INDEPENDENT EXTERNAL PEER REVIEW (IEPR) – Phase 5

a. Decision on IEPR. A Type I IEPR will be conducted on the Bluestone DSMRS based upon the criteria set forth in EC 1165-2-209. The guidance states that Type I IEPR is mandatory if any of several factors are true. The first factor of “significant threat to human life” triggers the mandatory requirement for Bluestone. Therefore, a Type I IEPR is necessary on the DSMRS including NEPA/environmental compliance documentation and technical appendixes.

b. Products for Review. Type I IEPR will be preformed on the entire DSMRS including NEPA/environmental compliance documentation and technical appendixes.

c. Required IEPR Panel Expertise. The disciplines required for the IEPR team will reflect the significant disciplines involved in the planning and engineering and design effort. These disciplines include plan formulation, environmental, economics, geotechnical, geology, hydrology & hydraulics and cost engineering. Detailed descriptions of the required expertise will be provided once the study has clearly identified a final list of alternatives to be evaluated.

d. Documentation of IEPR. . The IEPR panel will be selected and managed by an Outside Eligible Organization (OEO) per EC 1165-2-209, Appendix D. Panel comments will be compiled by the OEO and should address the adequacy and acceptability of the plan formulation, 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 4.d above. The OEO will prepare a final Review Report that will accompany the publication of the final decision document and shall:

- Disclose the names of the reviewers, their organizational affiliations, and include a short paragraph on both the credentials and relevant experiences of each reviewer;

- Include the charge to the reviewers;
- Describe the nature of their review and their findings and conclusions; and
- 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.

a. The final Review Report will be submitted by the OEO no later than 60 days following the close of the public comment period for the draft decision document. USACE shall consider all recommendations contained in the Review Report and prepare a written response for all recommendations adopted or not adopted. The final decision document will summarize the Review Report and USACE response. The Review Report and USACE response will be made available to the public, including through electronic means on the internet.

13. MODEL CERTIFICATION AND APPROVAL - Phase 5

a. General. The use of certified or approved models for all planning activities is required by EC 1105-2-407. This policy is applicable to all planning models currently in use, models under development and new models. The appropriate PCX will be responsible for model certification/approval. The goal of certification/approval is to establish that planning products are theoretically sound, compliant with USACE policy, computationally accurate, and based on reasonable assumptions. The use of a certified or approved model does not constitute technical review of the planning product. Independent review of the selection and application of the model and the input data and results is still required through conduct of DQC, ATR, and, if appropriate, IEPR. Independent review is applicable to all models, not just planning models. Both the planning models (including the certification/approval status of each model) and engineering models used in the development of the decision document are described below:

b. Planning Models. The following planning models are anticipated to be used in the development of the decision document:

Model Name and Version	Brief Description of the Model and How It Will Be Applied in the Study	Certification / Approval Status
HEC-FDA 1.2.4 (Flood Damage Analysis)	The Hydrologic Engineering Center's Flood Damage Reduction Analysis (HEC-FDA) program provides the capability for integrated hydrologic engineering and economic analysis for formulating and evaluating flood risk management plans using risk-based analysis methods. The program will be used to evaluate and compare the future without- and with-project plans for dam safety at Bluestone Dam and aid in selecting a recommended plan to manage risk.	Certified
HEC-FIA Version 2.1 Beta: HEC-FIA (Flood Impact Analysis)	GIS-based software program that estimates direct damages (structure damage, content damage, and car damage), population at risk, and loss of life (daytime and nighttime) for a range of events (both dam failure and non-failure). The program uses inundation depth grids,	Pending Certification

	river cross sections, and hydrographs to estimate flood depths and arrival times for each individual structure. Damage and population estimates are then determined using depth-damage curves, Census data, and the LifeSim methodology developed by the Utah State University's Institute for Dam Safety Risk Management. The program is currently under development by the Corps of Engineers Hydraulic Engineering Center.	
Habitat Evaluation Procedure (HEP) & Habitat Suitability Indices (HIS)	The purpose of HEP/HSI is to document the quality and quantity of available habitat for selected wildlife species. HEP and HSI may be used to evaluate direct in-stream impacts that would occur should an alternative be considered that would directly impact the New River (e.g. construct weir downstream of current stilling weir).	Certified
Additional models will be added as identified.		

c. Engineering Models. The following engineering models are anticipated to be used in the development of the decision document:

Model Name and Version	Brief Description of the Model and How It Will Be Applied in the Study
HEC-RAS 4.0 (River Analysis System)	The Hydrologic Engineering Center's River Analysis System (HEC-RAS) program provides the capability to perform one-dimensional steady and unsteady flow river hydraulics calculations. The program will be used for steady flow analysis to evaluate the future without- and with-project conditions along the New River and its tributaries. [For a particular study the model could be used for unsteady flow analysis or both steady and unsteady flow analysis. The review plan should indicate how the model will be used for a particular study.]
HEC-GeoRAS 4.9.2	The Hydrologic Engineering Center's Geo River Analysis System (HEC-GeoRAS) is a set of procedures, tools, and utilities for processing geospatial data in ArcGIS that allows the preparation of geometric data for import into HEC-RAS for unsteady dam break analysis.
Physical Model – Sectional	The sectional physical model for Phase 5 consists of a 114-ft-wide section through the spillway section of the dam (2 full spillway gate bays, 3 piers, and 2 half spillway gate bays), a 1,200-ft reach of the tailrace and a 1,000-ft reach of the upper pool at an undistorted linear 1:36 scale. The model is constructed of sheet metal, aluminum, acrylic, plastic and wood. The left side of the flume was made of acrylic to allow for flow visualization. The model was initially designed and used with a fixed bed channel bottom for earlier Phases of the DSA project to provide measurement of pressures on the upstream and downstream faces of the baffle

	blocks and upstream and downstream of the end sills for both basins. Pressures were measured in the channel bottom between the upper basin and the stilling weir and downstream of the lower basin. Pressures were also measured at the toe of the spillway and on the stilling weir. The fixed channel bottom downstream of the upper end sill was removed and then replaced with erodible material to demonstrate scour potential. For Phase 5, the same sectional physical model is being used to evaluate alternatives for preventing scour of the bedrock downstream of the spillway section of the dam to ensure that the stability of the structure is not compromised.
Physical Model - General	The general physical model was designed to accommodate reproduction of the Bluestone Dam structures, a 2,200-ft reach of the tailrace and a 1,000-ft reach of the upper pool topography at an undistorted linear 1:65 scale. All pertinent topography was reproduced with molded cement mortar over sand. The structures were constructed of sheet metal, acrylic, and wood. The model is used to document surface current patterns and velocities. These data are used to assist in evaluation of effectiveness of potential alternatives.
Micro Computer Aided Cost Estimating System (MCACES), Second Generation (MII) Version 3	MII is used for development of detailed cost estimates.
Additional models will be added as identified.	

14. REVIEW SCHEDULES AND COSTS - Phase 5

a. ATR Schedule and Cost. The draft DSMRS is scheduled to be completed in January 2012. ATR would be required following completion of the draft report. The estimated cost for ATR is $85,000.

b. IEPR Schedule and Cost. Based upon similar Type I IEPR cost estimates, the Bluestone IEPR should cost between $200,000 and $350,000. The process should take 3 to 4 months to complete. The Type I IEPR will start after ATR is complete.

c. Model Certification/Approval Schedule and Cost. Once a complete list of models has been identified, the cost of certification will be estimated.

15. PUBLIC PARTICIPATION

The nature of risk identified and associated with the Bluestone Dam has required public meetings throughout the basin on a regular basis. The District has been proactive in keeping the public and stakeholders informed and involved. Given the continued risk to life and safety

until the completion of the DSA project, it is anticipated that regular public meetings will continue to be held.

16. REVIEW PLAN APPROVAL AND UPDATES

The Great Lakes and Ohio River Division Commander is responsible for approving this Review Plan. The Commander's approval reflects vertical team input (involving district, MSC, RMO, and HQUSACE members) as to the appropriate scope and level of review for the decision document. Like the PMP, the Review Plan is a living document and may change as the study progresses. The home district is responsible for keeping the Review Plan up to date. Minor changes to the review plan since the last MSC Commander approval are documented in Attachment 3. Significant changes to the Review Plan (such as changes to the scope and/or level of review) should be re-approved by the MSC Commander following the process used for initially approving the plan. The latest version of the Review Plan, along with the Commanders' approval memorandum, should be posted on the Home District's webpage. The latest Review Plan should also be provided to the RMO and home MSC.

17. REVIEW PLAN POINTS OF CONTACT

Questions and/or comments on this review plan can be directed to the following points of contact:

- [redacted], Huntington District, Project Manager, 304-399-5545
- [redacted], Great Lakes and Ohio River Division, Dam Safety Program Manager, 513-684-5067
- [redacted], Risk Management Center, Risk Program Manager, 913-787-5356

ATTACHMENT 1: TEAM ROSTERS

Project Delivery Team Members			
Name	**Functional Responsibility**	**E-Mail Address**	**Telephone**
[redacted]	Project Manager	[redacted]	304-399-5545
[redacted]	Lead Project Engineer	[redacted]	304-399-5035
[redacted]	Geologist	[redacted]	304-399-5234
[redacted]	Structural Engineer	[redacted]	304-399-5278
[redacted]	Hydraulics Engineer	[redacted]	304-399-5811
[redacted]	Cost Engineer	[redacted]	304-399-5205
[redacted]	Geotech Engineer	[redacted]	304-399-5248
[redacted]	Environmental/Lead Planner	[redacted]	304-399-5870
[redacted]	Economist	[redacted]	304-399-5842

Phase 3 & 4 Agency Technical Review Team		
NAME	**DISCIPLINE**	**OFFICE**
[redacted]	Engineering Geology /Team Leader	CENWK
[redacted]	Civil/Site	CELRP
[redacted]	Hydrology and Hydraulics	CELRP
[redacted]	Structural	CESWG
[redacted]	Materials	CELRL
[redacted]	Cost Engineering	CENWW
[redacted]	Geotechnical / Soils	CELRL

Phase 5 Agency Technical Review Team		
NAME	**DISCIPLINE**	**OFFICE**
TBD		

Phase 3 & 4 Independent External Peer Review Expert Reviewers		
NAME	**DISCIPLINE**	**EXPERIENCE**
[redacted], P.E., PND Engineers Inc.	Geotechnical Engineer	Recognized expert in the field of geotechnical engineering analysis, design and construction of embankment dams and levees on alluvial foundations with extensive experience in subsurface investigations, soil mechanics, retaining wall design, erosion protection design and construction and earthwork construction. The Geotechnical Engineer shall be a licensed professional engineer.
[redacted] P.E., GENTERRA Consultants Inc.	Structural Engineer	Senior-level person with extensive experience in the type of work being performed. The Structural Engineer shall be proficient in performing stability analysis using limit equilibrium analysis and in the design of post tensioned high strength steel anchors to stabilize mass concrete gravity dams and structures. The Structural Engineer shall be experienced in the stability analysis and structural design of mass concrete scour protection and stilling features including the design of baffles, endsills, and training walls. The Structural Engineer shall have a working knowledge of all applicable Corps of Engineers design criteria and shall be a licensed Professional Engineer.
[redacted], Dr-Ing. Henry T. Falvey & Associates, Inc.	Hydraulic Engineer	Extensive experience in the analysis and design of hydraulic structures related to flood control reservoirs. The Hydraulic Engineer must have performed work in hydrologic analysis and design of hydraulic structures including spillways, outlet works, and stilling basins. The Hydraulic Engineer must demonstrate knowledge and experience with physical modeling and the application of data from physical model testing to the design of stilling basins and scour protection, and in the ability to coordinate, interpret, and explain testing results with other engineering disciplines, particularly structural engineers, geotechnical engineers, and geologists. In regard to

		hydrologic analysis, the Hydraulic Engineer must demonstrate knowledge and experience with the routing of inflow hydrographs through multipurpose flood control reservoirs utilizing multiple discharge devices, including gated sluiceways and gated spillways.
[redacted], P.G., Kent State University	Engineering Geologist	Senior-level person with extensive experience in the type of work being performed. The Engineering Geologist shall be proficient in assessing rock strengths and evaluating uplift for performing stability analyses using limit equilibrium. The Engineering Geologist shall be experienced in the design of post tensioned high strength steel anchors to stabilize mass concrete gravity dams and structures. The Engineering Geologist shall have a working knowledge of all applicable Corps of Engineers design criteria and shall be a licensed Professional Geologist.
[redacted], P.E., Ayres Associates Inc.	Civil Engineer	Extensive experience in the design, layout, and construction of flood control structures including dams and levees. Demonstrated knowledge regarding hydraulic structures, erosion control, earthwork, concrete placement, design of access roads, and relocation of underground utilities. The Civil Engineer shall be a licensed Professional Engineer, familiar with USACE regulations and industry building codes.
[redacted], P.E., CTL Group	Materials Engineer	Registered professional engineer or professional geologist with a minimum of Master's Degree in Materials Engineering. The Materials Engineer must have extensive knowledge in mix designs and materials for mass concrete placements. He shall also have experience in preparing plans and specifications and field applications of mass concrete placements.

Phase 5 Independent External Peer Review Expert Reviewers		
NAME	**DISCIPLINE**	**EXPERIENCE**
TBD		
TBD		
TBD		
TBD		
TBD		
TBD		
TBD		

Vertical Team

The Vertical Team consists of members of the HQUSACE and Great Lakes & Ohio River Division Offices. The Vertical Team plays a key role in facilitating execution of the project in accordance with the PMP. The Vertical Team is responsible for providing the PDT with Issue Resolution support and guidance as required. The Vertical Team will remain engaged seamlessly throughout the project via monthly telecons as required and will attend In Progress Reviews and other key decision briefings as required. The District Liaison [redacted], CELRD-PDS-H, is the District PM's primary Point of Contact on the Vertical Team.

ATTACHMENT 2: SAMPLE STATEMENT OF TECHNICAL REVIEW FOR DECSION DOCUMENTS

COMPLETION OF AGENCY TECHNICAL REVIEW

The Agency Technical Review (ATR) has been completed for the *<type of product>* for *<project name and location>*. The ATR was conducted as defined in the project's Review Plan to comply with the requirements of EC 1165-2-209. During the ATR, compliance with established policy principles and procedures, utilizing justified and valid assumptions, was verified. This included review of: assumptions, methods, procedures, and material used in analyses, alternatives evaluated, the appropriateness of data used and level obtained, and reasonableness of the results, including whether the product meets the customer's needs consistent with law and existing US Army Corps of Engineers policy. The ATR also assessed the District Quality Control (DQC) documentation and made the determination that the DQC activities employed appear to be appropriate and effective. All comments resulting from the ATR have been resolved and the comments have been closed in DrChecks[sm].

SIGNATURE _____ _____

Name Date
ATR Team Leader
Office Symbol/Company

SIGNATURE _____ _____

Name Date
Project Manager
Office Symbol

SIGNATURE _____ _____

Name Date
Architect Engineer Project Manager[1]
Company, location

SIGNATURE _____ _____

Name Date
Review Management Office Representative
Office Symbol

CERTIFICATION OF AGENCY TECHNICAL REVIEW

Significant concerns and the explanation of the resolution are as follows: *Describe the major technical concerns and their resolution.*

As noted above, all concerns resulting from the ATR of the project have been fully resolved.

SIGNATURE _____ _____

Name Date
Chief, Engineering Division
Office Symbol

SIGNATURE _____ _____

Name Date
Chief, Planning Division
Office Symbol

[1] Only needed if some portion of the ATR was contracted

ATTACHMENT 3: REVIEW PLAN REVISIONS

Revision Date	Description of Change	Page / Paragraph Number