



US Army Corps  
of Engineers®

Prepared by:

# Los Angeles District South Pacific Division & SPD Dam Safety Production Center

## Santa Ana River Mainstem, Prado Dam Phase II, Prado Dam Spillway Modifications Implementation (NID CA10022) Review Plan

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**MSC Approval Date:**  
**Expiration Date:**  
**Last Revision Date: None**

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**DEPARTMENT OF THE ARMY**  
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CESPD-PD

24 August 2021

MEMORANDUM FOR Commander, Los Angeles District, ATTN: CESPL-EDD-A, Mr. Robert Kwan, 915 Wilshire Boulevard, Los Angeles, CA 90017-3489

Subject: South Pacific Division (SPD) Approval of Review Plan for the Santa Ana River Mainstem, Prado Dam Phase II, Prado Dam Spillway Modifications

1. References:

a. Memorandum, CESPL-EDD-A, 15 July 2021, subject: Santa Ana River Mainstem, Prado Dam Phase II, Prado Dam Spillway Modifications Implementation Review Plan Transmittal, Riverside County, California.

b. ER 1165-2-217, Review Policy for Civil Works, 1 May 2021.

c. ER 1110-2-1156, Safety of Dams – Policy and Procedure, 31 March 2014.

d. Memorandum, CESPD-PDP, 22 January 2019, subject: Delegation of Signature Authority for Review Plans.

2. The Review Plan (RP) for the Santa Ana River Mainstem, Prado Dam Phase II, Prado Dam Spillway Modifications has been developed by the Los Angeles District in accordance with EC 1165-2-217 (Reference a). The RP details a value-added process and describes the scope of review for the implementation documents related to the subject dam safety modification project. The SPD Dam Safety Production Center as well as the USACE Risk Management Center (serving as the Review Management Organization) have reviewed the RP and concur that this document complies with current policy requirements (References b and c) and endorse this RP to be approved by the SPD Commander or delegated official. The undersigned has been delegated to sign the RP on behalf of SPD Commander (Reference d). The enclosed RP has been reviewed by SPD Staff, is found to be sufficient, and is hereby approved.

3. Distribution of the RP and posting on public websites will be performed in accordance with the RP and current policy. For any additional information or assistance, contact Mr. Caleb Conn, CESPD-PDC, (415) 503-6558, Caleb.B.Conn@usace.army.mil.

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JOHN D. MORENO, P.E., SES  
Regional Business Director

# Section 1

## Introduction

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### 1.1 Purpose

This Review Plan (RP) for Santa Ana River Mainstem (SARM) Prado Dam Spillway Modifications Project (P2: 104779), will help ensure a quality-engineering project is developed by the Corps of Engineers in accordance with EC 1165-2-217, "Review Policy for Civil Works". As part of the Project Management Plan this RP establishes an accountable, comprehensive, life-cycle review strategy for Civil Works products, lays out a value-added process, and describes the scope of review for the current phase of work. The EC outlines five general levels of review: District Quality Control/Quality Assurance (DQC), Agency Technical Review (ATR), Biddability, Constructability, Operability, and Sustainability (BCOES) Review, Independent External Peer Review (IEPR), and Policy and Legal Compliance Review. This RP will be provided to Project Delivery Team (PDT), DQC, ATR, BCOES, and IEPR Teams. The technical review efforts addressed in this RP, DQC and ATR, are to augment and complement the policy review processes. The District Chief of Engineering has assessed that the life safety risk of this project is significant; therefore a Type II IEPR/Safety Assurance Review (SAR) will be required, see Paragraph 9.1.

### 1.2 Key References

- ER 5-1-11, USACE Business Process, 21 Jul 2019
- EC 1165-2-217, Review Policy for Civil Works, 20 February 2018
- ECB 2019-15, Interim Approach for Risk-Informed Designs for Dam and Levee Projects, 08 October 2019
- Interim Guidance on Streamlining Independent External Peer Review (IEPR) for Improved Civil Works Product Delivery, 05 April 2019
- ER 1110-1-12, Quality Management, 31 Mar 2011
- ER 415-1-11, Biddability, Constructability, Operability, Environmental and Sustainability (BCOES) Reviews, 1 January 2013
- ER 1110-2-1156, Safety of Dams – Policy and Procedure, 31 March 2014
- ER 1110-1-12, Engineering and Design Quality Management, 31 March 2011
- ER 10-1-55, Organization and Functions, Roles and Responsibilities, Rick Management Center, 30 Jun 2013
- ER 1110-1-8159, Engineering and Design, DrChecks<sup>sm</sup>, 10 May 2011
- ER 1110-2-1150, Engineering and Design for Civil Works Projects, 31 August 1999
- RMC-AD-2019-03 Standard Operating Procedure for Type II Independent External Peer Reviews (Safety Assurance Reviews), 28 January 2019

- ER 1110-1-8, Required Visits to Construction Sites by Design Personnel
- ER 1110-2-112, Required Visits to Construction Sites by Field Personnel, 15 April 1992
- CESP Regulation 1110-1-2, Engineering and Design, Engineering Considerations and Instructions for Field Personnel, 15 August 1986
- CESP Regulation 1110-1-8, Quality Management Plan
- SPLOM-1105-1-2, Appendix B, Engineering Division, Quality Management Plan, 12 September 2003
- SPLOM 1110-2-2, Coordination between District and Field Personnel on Civil Works Projects, 1 April 1982
- Los Angeles District Engineering Division, District Quality Control Policy, Updated April 2018
- Santa Ana River Mainstem, CA, Project Management Plan, Original dated September 1990, Updated Draft dated February 2020: [PMP Update 2020 \(Mega-Project\)](#)
- Review Report on the Santa Ana River Mainstem, including Santiago Creek and Oak Street Drain December 1975
- Phase I General Design Memorandum on the Santa Ana River Mainstem, including Santiago Creek, September 1980
- Phase II General Design Memorandum on the Santa Ana River Mainstem, including Santiago Creek, September 1988
- Supplement No.1 to Design Memorandum No.1 Phase II GDM on the Santa Ana River Mainstem, including Santiago Creek, Seven Oaks, and Prado Dam, Probable Maximum Flood- Update, March 1991
- Model Study of Prado Spillway, California: Hydraulic Model Investigation, Physical Model, Engineering Research and Development Center (ERDC) Coastal and Hydraulics Laboratory, Vicksburg, Mississippi, September 2000
- Limited Reevaluation Report for Prado Dam Separable Element, Prado Basin, & Vicinity, including Stabilization of Bluff Toe at Norco Bluffs Santa Ana River Basin, California, September 2001
- Design Documentation Report No.11, Santa Ana River Mainstem, Prado Dam Spillway, 22 February 2007
- Prado Dam Safety Modification Report (Draft), March 2021.

## 1.3 Review Management Organization

The USACE Risk Management Center (RMC) is the Review Management Organization (RMO) for this project. This RP will be updated for additional project phases and for the construction phase.

## Section 2

# Project Background and Description

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## 2.1 Project Background

This section provides an overview of the Prado Dam Spillway Modifications (Project) as part of the ongoing, over-arching Santa Ana River Mainstem (SARM) flood risk management project.

### Project Location

Prado Dam is located in Riverside County, California, approximately 2 miles west of the City of Corona, northeast of the Riverside Freeway (California State Route (SR) 91) and Corona Freeway (SR 71) interchange. Portions of the basin are in Riverside and San Bernardino Counties. It is operated and maintained by the U.S. Army Corps of Engineers (USACE), Los Angeles District.

### Original Project

Prado Dam was originally designed as a flood risk management project in 1941 and subsequently operated with incidental water conservation storage since the 1970's, such that the reservoir provides water conservation benefits to the extent that flood control operations are not jeopardized. Approximately 1.3 to 1.4 million people who live and work between the dam and the ocean will be at risk should the dam breach. Prado Dam is the principal regulating structure on the Santa Ana River (Figure 1). The original dam and reservoir project features consisted of a main embankment, a gated outlet works, and a spillway.

The project was authorized by Public No. 738, 74th Congress (H.R. 8455), approved June 22, 1936, and amended by Public No. 208, 75th Congress, (H.R. 7493), approved July 19, 1937. The primary authorized purpose of this project is flood risk management, followed by authorization for water conservation and recreation.

### Santa Ana River Mainstem Modifications

The Water Resources Development Act of 1986 (P.L. 99-662) authorized modification of the dam to increase the flood storage capacity, as part of the SARM Project. Modifications included enlarging the existing Prado Dam and Reservoir, increasing the release capacity of the outlet works, and improving downstream channel conveyance capacity.

The SR 71 Dike was completed in 2001 and now connects to the main embankment on the west side. In 2002, modifications to the main embankment and construction of the new outlet works began. The main embankment was raised 28 feet and the outlet works was relocated to the left side of the main embankment. By May 2008, the raising of the main embankment was completed, and the new larger capacity outlet works became operational in June 2008 to replace the original outlet works. The outlet works is designed to release water up to 30,000 cubic feet per section (cfs). The Auxiliary Dike and floodwall were constructed to the southeast of the spillway and completed in 2019. The existing spillway chute is a reinforced concrete trapezoidal section, varying in width from 1,000 feet at the ogee crest to 660 feet at the lower end. The spillway chute is 1,147 feet long and has a maximum discharge of 178,000 cfs. Refer to Figure 2. Several dikes within the reservoir are in design, construction, or have been completed. Improvements of the downstream channel conveyance capacity (referred to as Reach 9) are also in construction. The spillway will be the last feature to be modified as part of the SARM Project.



Figure 1 – Santa Ana River Mainstem Project Location Map

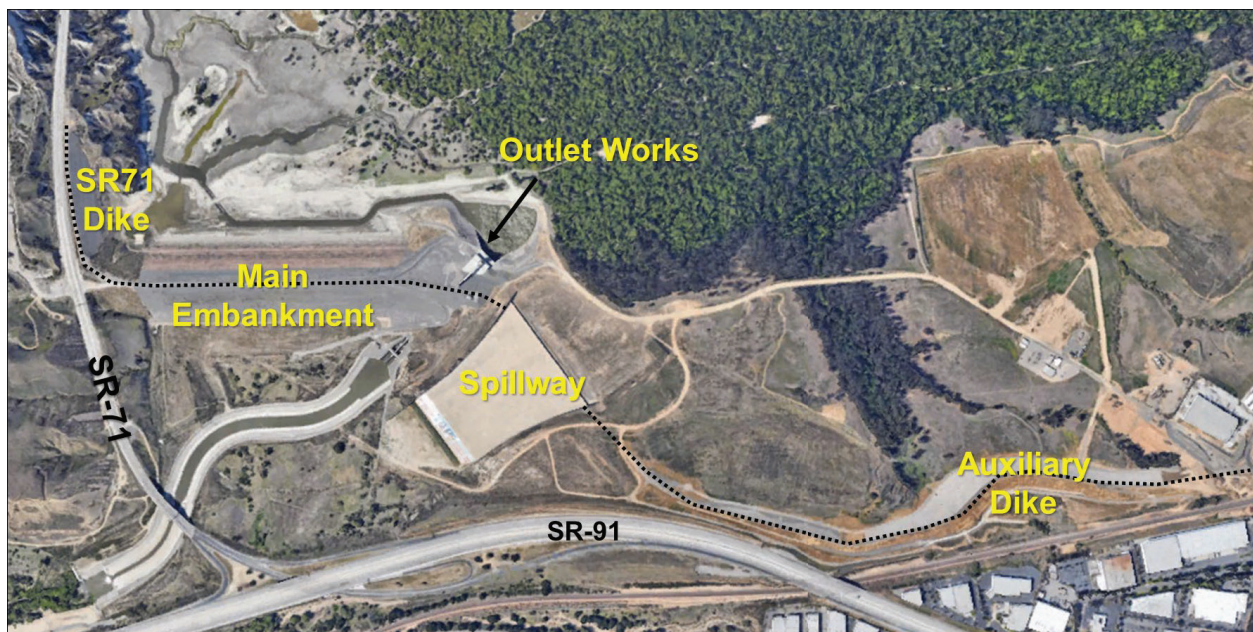


Figure 2: Location of Prado Dam near the intersection of SR 71 and SR 91 in Corona, CA

Funding for the design of the Prado Dam spillway raise modifications was provided by annual appropriations from the original SARM project authority. In October 2018, the Bipartisan Budget Act (BBA) of 2018 (Public Law 115-123), Division B - Supplemental Appropriations for Disaster Relief Requirements, provided funding to complete the remaining elements of the SARM project. Specifically, BBA program funding was requested and received for the design and construction for the Prado Dam spillway raise modifications.

## Dam Safety Risk Assessment

A dam safety risk assessment was performed that identified potential failure modes (PFMs) with risks above tolerable guideline values including spillway erosion, overtopping between the main embankment (raise) and the spillway, and instability of the existing spillway weir construction structure during extreme flood loading conditions. The proposed spillway modifications will reduce the dam safety risks associated with the identified potential failure modes bringing post-construction risk to levels below tolerable guidelines.

Interim Risk Reduction Measures (IRRM) including grinding and sealing of spillway chute slab joints, emergency action plan updates, emergency exercises with local emergency management agencies, and coordination with local interests have been or are currently being implemented and will serve to manage risks associated with the project.

## 2.2 Project Description

As a result of the SARM project and dam safety risk assessment findings, the major features of the spillway modification include a replacement of the control structure (weir) and approach channel walls, construction of embankment tie-ins or closure sections, and replacement of the chute slabs and chute walls. Specifically, the major items of work for the spillway modifications as shown on Figure 3 include:

- a reinforced concrete labyrinth weir,
- right and left concrete gravity approach channel walls,
- two earthen embankment tie-ins with slope protection to connect the modified spillway to the existing (2008 raised) Prado Dam main embankment on the west and the Auxiliary Dike embankment on the east,
- reinforced concrete chute slabs with anchors and an underdrain system, and
- reinforced concrete cantilever spillway chute walls.

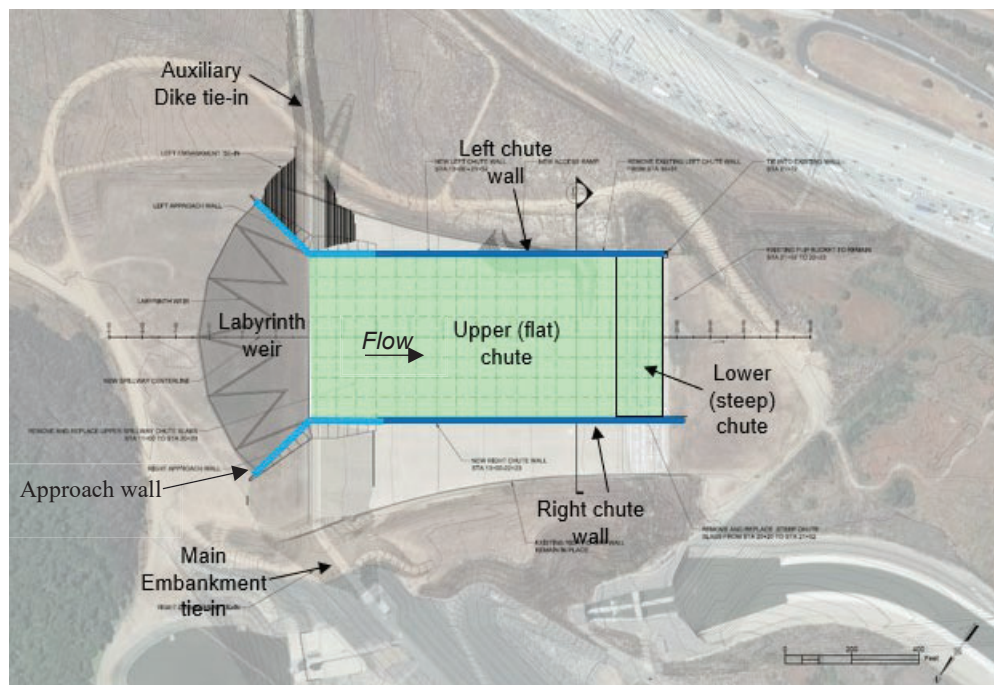


Figure 3 – Spillway Modifications Conceptual Design



The estimated cost for the project ranges from \$380 million to \$460 million at the FY21 price level with an estimated duration of 2 to 3 years. The estimated total population at risk (PAR) due to dam breach is 1.4 million with an incremental PAR of approximately 210,000; this estimate will be updated as refinements are made during future risk assessment efforts.

The design and review process will utilize an enterprise wide PDT within USACE under the leadership of South Pacific Division's regional Dam Safety Production Center and the Risk Management Center. A-E service contracts will supplement USACE enterprise wide team in hydraulic modeling and geotechnical investigations. Project deliverables from the A-E will follow District's quality control management policy for independent reviews and certification.

## 2.3 Project Sponsor

Products and analyses provided by non-Federal sponsors as in-kind services are subject to DQC, ATR, policy and legal compliance, BCOES, and SAR reviews. There will not be in-kind contributions for this effort. Sponsor will participate in the design review of the project as applicable to all lands, easements, relocations, rights-of-way and disposal materials (LERRD) and operation and maintenance requirements.

The non-federal sponsor is Orange County Flood Control District based in Santa Ana, CA. As the non-federal sponsor, they are responsible for LERRD. As such, the non-federal sponsor will coordinate with the local utility agencies/ parties to relocate or protect-in place all utilities that will be impacted by the spillway raise modifications within the reservoir.

The utilities at the spillway modification site will be coordinated for relocation by the District due to the government having prior rights in the existing easement agreements with the utility companies. The agreements require the utility companies to relocate their assets at their expense.

Additionally, the sponsor would have to acquire new fee or flowage easement for the reservoir increase from elevation 556.0 feet NGVD29 (558.3 NAVD88) to the new acquisition line of elevation 566.0 feet NGVD29 (568.3 NAVD88). The 2018 Bipartisan Budget Act (BBA) funding program provides potential reimbursement to the local sponsor for all LERRD activities subject to determination of compensability.

## 2.4 Project Work Products

This section identifies the work products to be developed for the Prado Spillway Modification Project.

- Design Data and Criteria Report (DDCR). The Design Data and Criteria Report for the Prado Dam Spillway Modifications will be a comprehensive document that identifies available design data and establishes design criteria to be used for completion of design modifications to the Prado Dam spillway. These design criteria have been developed with the intention of meeting or exceeding the requirements of United States Army Corps of Engineers (USACE) applicable design standards and guidelines and industry-accepted best practices
- Design Documentation Report (DDR). The Design Documentation Report for the Prado Dam Spillway Modifications will serve as the record which captures the progress of the design, alternatives considered, investigations performed, analysis conducted as well as the recommendations for the development of the contract plans and specifications. It will contain a full record of design decisions, assumptions, and methods.
- Plans and Specifications (P/S). The plans and specifications will include contract performance and standards requirements for the contractor to construct the Spillway Modifications.

- Operation and Maintenance (O&M) Manual. The update to the existing Operation and Maintenance manual for Prado Dam and Appurtenances will be prepared during final design and through the duration of the spillway modifications construction. Operation and Maintenance responsibilities will remain with USACE, Los Angeles District. The operation of the modified spillway will be addressed in an update to the Water Control Plan.
- Update to the Water Control Manual (WCM). The final update to the Water Control Manual, which will include the spillway modifications, will be completed when funding is available from the SARM project. The update can take up to two years to complete as it requires a Section 7 Consultation with US Fish and Wildlife Services and updates from other disciplines. This document will have a separate Review Plan with different DQC and ATR team members. The document is mentioned here to provide awareness for a coordinated review.
- Engineering Considerations & Instruction For Field Personnel (ECIFP). The ECIFP will provide a summary on the design, design intent, and selected materials including any features requiring special attention to enable effective administration of the construction contract by field personnel. The document will provide insight and background necessary to review submittals and resolve minor construction problems without compromising design intent.
- Design Risk Assessment Report. The purpose of the Design Risk Assessment Report is to provide documentation regarding the risk reduction associated with the proposed dam safety modifications.

Other Project Documents include, but are not limited to:

- Environmental Assessment; Habitat Restoration Plan
- Utility Relocation and Abandonment Plans by Others at spillway, including, Southern California Gas Co Underground Pipeline, AT&T Overhead Communication Line, Southern California Edison Overhead Power Line
- Utility Relocation or Protection Plan by Others within the Reservoir
- Technical Memoranda; Meeting Notes
- Acquisition Plan; Procurement Packages
- Architect-Engineer Services Contract Scopes of Work and Deliverables
- Emergency Action Plan
- Project Management Plan
- Construction Shop Drawings, Request for Information, Submittals, Request for Equitable Adjustments, Contract Letters

## Section 3

# Risk Assessment During Design

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Risk assessments during design will be performed in accordance with ECB 2019-15. The reviews of the risk assessments are included in this RP. Once the risk assessment during design is completed, this RP will be re-visited by the District, MSC, and RMC to determine if the review requirements need to be revised. Additional information on the risk assessment is available in Attachment 2. The design risk assessment will be reviewed by a small team composed of the DSOG representative and consequence specialist, as well as other subject matter experts as deemed appropriate for the project, to determine if there will likely be a design deviation request, if there is a controversial process being used, or if there is a major risk concern. The district DSO will be part of the District Quality Control team for risk assessments. The RMC will coordinate with the DSOG as needed for decisions when appropriate. DSOG members from the relevant disciplines may participate as members of the vertical team, technical review or policy review teams as necessary.

The risk review will be performed just after the 60% ATR review scheduled in Mar 2022 once key comments from the ATR review have been addressed. The review recommendations provided by the risk cadre will be addressed and incorporated as appropriate into the 90% design.

The risk assessment completed near the end of construction will be reviewed by the full risk assessment review team, the review team will be composed of a Lead, Geotechnical Engineer, Hydraulics and Hydrology Engineer, Structural Engineer, and Consequence specialist; the same review team will be used for the risk assessment, design, and construction documents to the maximum extent possible. The final risk assessment products and decision documents will be presented to DSOG as deemed necessary, the timing of this submission to DSOG will be coordinated with the RMC.

## Section 4

# Project Delivery Team Reviews

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PDT Reviews are in addition to the independent DQC Reviews described in Section 5. The PDT Reviews are to ensure consistency and effective coordination across all project disciplines for the work product. For example, the PDT will perform a complete reading of any reports and accompanying appendices prepared by the PDT to assure the overall coherence and integrity of the report, technical appendices, and the recommendations before approval. The PDT will normally include a variety of stakeholders, each with his/her own important project requirements and a different, but interlocking, review responsibility. The PDT Review may also include a plans-in-hand review at the end of development.

The PDT supervisors will review and provide comments on the product after the review of the Project Delivery Team leadership team. The Section Chief of each PDT member are responsible for supervising that team member's work and is ultimately responsible for the technical adequacy and quality of the products produced by their staff.

PDT and Supervisor reviews, as an extension of the DQC, will be conducted as an Enterprise effort as directed in the MSC/District QMS processes. These reviews are recorded using documentation management provided by DrChecks review management system as explained in SPL OM 1105-1-2.

## Section 5

# District Quality Control

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### 5.1 Requirements

The Prado Dam spillway modifications are being completed by a PED team that includes team members from throughout the USACE Enterprise. Specifically, team members are located in Los Angeles (SPL), Denver (RMC), Sacramento (SPD-DSPC, SPK), Tulsa (SWT), and Huntington (LRH). As a result, the team will be responsible for its own quality control by assigning a PED team member to complete a detailed check of all analyses and design documentation (Quality Checks process). This team member will be designated the deliverable “checker.” All calculation packages will include a calculation cover sheet that will be signed off on by the designer, the checker and the discipline lead. Following completion of the detailed check, the deliverable will undergo a peer review by the designated “peer reviewer.” The peer reviewer will focus their review more on approach and methods used to develop the work product rather than the details reviewed by the checker. The checker and peer reviewer cannot be the same person as the author or developer of the work product. Final PED team approval of the work product prior to being submitted to formal milestone review outside of the PED team will be by the Lead Engineer.

All design documents and deliverables (including supporting data, analyses, reports, environmental compliance documents, etc.) will undergo DQC in accordance EC 1165-2-217. DQC/DQA will be performed in parallel with the ATR milestone review. The District will perform milestone reviews in accordance with the following documents that are also available upon request from the Project Lead Engineer at [stephen.j.dominic@usace.army.mil](mailto:stephen.j.dominic@usace.army.mil):

- [b.1 SPL OM 1105-1-2, ED Quality Management Plan \(20030912\) \(TRANSFER:\RMC\RMC\Prado Dam\Review Plan\SPLOM\)](#)
- [b.2 ED District Quality Control Policy \(20180331\) \(TRANSFER:\RMC\Prado Dam\Review Plan\DQC\)](#).

The DQC Review is a formal review of the Final Draft submittals of each product performed by a DQC Review Team. The DQC Review Team is an Enterprise effort made up of qualified individuals not involved in the day-to-day production of a project/design. The DQC Review is a holistic, comprehensive review of the complete engineering product. Each DQC review team member reviews the product for consistency across the various disciplines of the project, as well as review of their discipline's elements and how they impact and align with the project's functions. DQC Review Team members will typically include the same disciplines as the PDT involved in performing the design. DQC reviews are recorded using documentation management provided by DrChecks review management system as explained in SPL OM 1105-1-2. A DQC Certificate is signed when all the comments have been adequately addressed and all the necessary changes are made in the final product. The DQC Certificate will be approved by the Engineering Division Chief and the Engineer of Record.

The PDT is developing the Plans & Specifications (P&S) and a Design Documentation Report (DDR) for the proposed spillway modifications. Previous geotechnical field investigations, geotechnical engineering and design support activities were contracted to an Architect/Engineer (AE) and were completed between January 2019 and October 2020. The draft geotechnical report documenting the results of previous field investigations will be used as a reference along with supplemental investigations performed by USACE for the final design of the spillway modifications. The AE had developed a quality control plan included in Attachment 5.1 to this Review Plan. Additional AE engineering services are anticipated. The RP will be updated to include the AE's quality control plan.

See Attachment 1, for the DQC Manager reviewers, and reviewer's disciplines.

## 5.2 Products to Undergo DQC Team Review

a. Description of Work Products. The work products to undergo DQC for the Prado Dam Spillway Modifications Project include:

- Design Documentation Report
- Plans and Specifications
- Operation and Maintenance Manual
- Update to the Water Control Manual (as noted previously, this documents will have a separate Review Plan with different DQC and ATR team members with a schedule to be determined)
- Engineering Considerations & Instruction For Field Personnel
- Design Risk Assessment Report

## 5.3 DQC Schedule and Estimated Cost

The following milestone reviews are scheduled as shown in Table 1. The cost for the DQC is approximately \$526,000 (see Attachment 4 for a detailed cost breakdown). DQC will occur concurrently with ATR.

*Table 1 DQC Schedule*

Project Phase/Submittal	Review Start Date	Review End Date
DQC 15% Design Review	1-Jul-21	16-Jul-21
DQC 30% Design Review	1-Oct-21	31-Oct-21
DQC 60% Design Review	1-Apr-22	1-May-22
65% Design Risk Assessment Report	9-May-22	20-May-22
DQC 90% Design Review	1-Aug-22	30-Aug-22
Final Design Risk Assessment Report	1-Aug-22	30-Aug-22
DQC Final Draft O&M Manual Review	1-Sep-25	1-Oct-25
DQC Final ECIFP Review	1-Feb-23	1-Mar-23

## Section 6

# Agency Technical Review

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### 6.1 Requirements

All implementation documents (including supporting data, analyses, reports, environmental compliance documents, water control manuals, etc.) shall undergo Agency Technical Review (ATR) in accordance EC 1165-2-217. ATR reviews will occur seamlessly, including early involvement of the ATR team for validation of key design decisions, and at the scheduled milestones as shown in Section 6.5. A site visit will be scheduled for the ATR Team at the very beginning of the 30% milestone review. The default position for life safety projects is that a site visit is required early in design and periodically in a risk-informed manner during construction, especially for those disciplines that assess life safety risk. Documentation of ATR will occur using the four-part comment structure and the use of DrChecks<sup>SM</sup>.

The ATR team will fulfill the requirements as described in EC 1165-2-217 as all members will be from outside of the South Pacific Division. Scope for the ATR would include over-the-shoulder reviews in addition to formally scheduled 15/30/60/90/Final design reviews.

Coordination with the RMC informed the established “**Charge**” for the ATR team would be as follows:

Review the Design Data and Criteria Report:

15% Conceptual Design Review:

- Review preliminary 15% concept including key general arrangement draft drawings
- Review conceptual design cost estimate (updated as necessary)
- Review updated Design Data & Criteria Report (DD&CR)

30% (Preliminary) Design Review:

- Review preliminary 30% concept
- Review drawing set including all general plan sheets and key profile, sections, and details sheets
- Review draft specifications list
- Review development of a draft list of construction pay items with preliminary Rough Order of Magnitude (ROM) cost estimate.
- Review all Memoranda for Record (MFR) for all critical decisions affecting the approved 30% concept and items identified above
- Review draft Design Documentation Report (DDR) based on progress changes to the DD&CR
- Review update to project design schedule from 30% concept approval through construction completion.

60% Design Review:

- Review 60% DDR, plans, specifications, and construction pay items/schedule.
- Review MFRs completed between the 30% and 60% milestones.
- Review the Design Risk Assessment Report

90% Design Review:

- Review 90% DDR, drawings, specifications, and construction pay items/schedule.

Review the Water Control Manual (as noted previously, this documents will have a separate Review Plan with different DQC and ATR team members with a schedule to be determined)

Review the Operations and Maintenance Manual

## Review the Design Risk Assessment Report

Additional “**Charge**” to the ATR team would include participation of In Progress Reviews (IPR) on design decisions during final design development. Use of IPR would integrate the ATR team into the decision-making process early on to minimize impact to review schedule and rework, while maintaining independence from the PDT. The ATR would be included on key PDT decisions to ensure the following:

- Consistency with project authorization;
- Consistency with USACE policy;
- Consistency with USACE business processes;
- Consistency with current state-of-practice;
- Assess technical design and constructability risks.

## 6.2 Products to Undergo ATR

The work products for the Prado Dam Spillway Modifications Project include:

- DD&CR
- MFRs
- DDR
- Plans and Specifications
- Operation and Maintenance Manual
- Update to the Water Control Manual (as noted previously, this documents will have a separate Review Plan with different DQC and ATR team members with a schedule to be determined)
- Engineering Considerations & Instruction For Field Personnel
- Design Risk Assessment Report

## 6.3 Required Team Expertise and Requirements

ATR teams will be established in accordance with EC 1165-2-217. The following disciplines will be required for ATR of this project. Team members and discipline expertise were assigned by the RMC:

**ATR Lead:** The ATR team lead is a senior professional outside the home MSC with dam safety design and evaluation experience including preparation of Civil Works construction documents and conducting ATRs for similar projects and work products. The lead has the necessary skills and experience to lead a virtual team through the ATR process. The ATR lead may also serve as a reviewer for a specific discipline. The ATR Lead will be a professional engineer with a strong dam/levee safety background.

**Engineering Geologist** - shall have experience in assessing complex geologic, groundwater, and seismic environments for the design and construction of concrete spillways and dam embankments constructed on unconsolidated deposits and low strength sedimentary bedrock formations. The engineering geologist shall be familiar with identification of geological hazards, fault shear zones, exploration techniques, field and laboratory testing, correlation of performance of foundations with engineering and geologic properties, and instrumentation. The engineering geologist will have specialized experience with design and construction of dam embankments and concrete-lined spillways with associated foundation treatment of the structures

founded on low strength bedrock, shear zones, and alluvium/fill similar to conditions found in the southern California region.

**Geotechnical Engineer** - shall have experience in the field of geotechnical engineering, analysis, design, and construction of embankment dams and spillways. The geotechnical engineer shall have experience in subsurface investigations, bedrock and soil mechanics (including erosion characteristics of soil and low strength, poorly indurated bedrock), internal erosion (seepage and piping), slope stability evaluations, dewatering, deep excavations, passive tie down anchors, shoring design, erosion protection design, seismic evaluation, and earthwork construction. The geotechnical engineer shall have knowledge and experience in the forensic investigation of seepage, settlement, stability, and deformation problems associated with flood risk management dams and appurtenances constructed on low strength bedrock and soil foundations. The geotechnical engineer will have specialized experience with design and construction including the associated foundation treatment of dam embankments and concrete-lined spillways founded on low strength bedrock, shear zones, and alluvium/fill similar to conditions found in the southern California region.

**Hydraulics and Hydrology Engineer** – The hydraulics and hydrology engineer will have experience in the analysis and design of hydraulic structures related to dams (e.g., spillways, outlet works, and stilling basins). The hydraulic engineer shall be knowledgeable and experienced with the routing of inflow hydrographs through multipurpose flood control reservoirs utilizing multiple discharge devices, Corps application of risk and uncertainty analyses in flood damage reduction studies, physical modeling, development of the flood hazard/loading (i.e., stage-frequency and duration relationships), USACE hydrologic and hydraulic modeling, and breach and non-breach inundation analysis.

**Structural Engineer** – The structural engineer will have experience in the analysis, design, construction, and evaluation of hydraulic structures for dams (e.g., concrete lined spillway including, control structures, chute slabs and walls, anchors, shoring, drainage systems, and stilling basin), and dam safety risk evaluation. The structural engineer will be proficient in performing stability analysis, strength design, numerical analysis, and seismic time history studies.

**Construction Engineer** – The construction engineer will have a minimum of 10 years of experience. Reviewer should be a senior level, professionally registered engineer with extensive experience in the engineering construction field with particular emphasis on dam safety projects.

See Attachment 1, Table 12 for list of the Agency Technical Review Lead, reviewers, and disciplines.



Table 2 ATR Teams for Milestone Reviews

Milestone Reviews	Geotech	Geologist	Materials	H&H	Structural	Cost	Construction	Water Manager
ATR Design Data and Criteria Report	X	X		X	X		X	
ATR 15% Design Review	X	X		X	X	X	X	
ATR 30% Design Review	X	X	X	X	X	X	X	
Design Risk Assessment Report	X	X		X	X		X	
ATR 60% Design Review	X	X	X	X	X	X	X	X
ATR 90% Design Review	X	X	X	X	X	X	X	X
Final Risk Assessment Report	X	X		X	X	X	X	
ATR ECIFP	X	X	X	X	X		X	
ATR O&M Manual	X	X	X	X	X			X
ATR Key Decision and In-Progress Reviews	X	X	X	X	X		X	

## 6.4 Statement of Technical Review Report

At the conclusion of each ATR effort, the ATR team will prepare a review report with a completion and certification memo. The report will be prepared in accordance with EC 1165-2-217.

## 6.5 ATR Schedule and Estimated Cost

The preliminary ATR milestone schedule is listed in Table 3. The cost for the ATR is approximately \$674,000 (see Attachment 4 for a detailed cost breakdown). ATR will occur concurrently with DQC.

Table 3 ATR Schedule

Project Phase/Submittal	Review Start Date	Review End Date	Site Visit
ATR Design Data and Criteria Report	1-Mar 21	12-Mar-21	
ATR 15% Design Review	1-Jul-21	16-Jul-21	
ATR 30% Design Review	1-Oct-21	31-Oct-21	1
ATR 60% Design Review	1-Apr-22	1-May-22	
ATR 90% Design Review	1-Aug-22	30-Aug-22	
Final Design Risk Assessment Report	1-Aug-22	30-Aug-22	
ATR ECIFP	1-Aug-22	30-Aug-22	
ATR O&M Manual	1-Aug-22	30-Aug-22	
ATR Key Decision and In-Progress Reviews	As needed	As needed	As needed

## Section 7

# Constructability Evaluation

ER 1110-2-1156 requires a constructability evaluation (CE) to ensure dam safety risks are adequately addressed by the designs and that all construction-related risks are fully identified and mitigated to an acceptable level. The CE will be conducted right after the 60% design milestone review.

The PDT has coordinated with the DSMMCX to identify the CE team, ATR members may also serve on this team. The CE will be performed in accordance with section 22.2.6.1 of ER 1110-2-1156. The PDT may need to brief the CE team on the potential failure modes mitigated by construction and on potential failure modes that may be present during construction activities. A Constructability Evaluation Report will be prepared by the CE team, reviewed, and approved by the regional DSPC. The CE review is tentatively scheduled for June 2022.

See Attachment 1 for the CE reviewers. The estimated cost of the CE is approximately \$42,000 (see Attachment 4 for a detailed cost breakdown).

## Section 8

# BCOES Review

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### 8.1 Requirements

All implementation documents (including supporting data, analyses, reports, environmental compliance documents, water control manuals, etc.) shall undergo biddability, constructability, operability, environmental, and sustainability (BCOES) review in accordance ER 415-1-11 and ER 1110-1-12. BCOES reviews are done during design for a project using the design-bid-build (D-B-B) method or during development of the request for proposal (RFP) for a design-build (D-B) project. The BCOES review results are to be incorporated into the procurement documents for all construction projects. The BCOES review will be documented as described below. The BCOES reviewers are encouraged to include local sponsors' facility operators and maintenance staff. The BCOES roster is provided in Attachment 1, Table 14.

The BCOES review will be documented using DrChecks<sup>SM</sup>. The BCOES reviewers will include local sponsor's facility operators and maintenance staff, as well as construction, operations, and environmental staff to improve the BCOES aspects of designs. The BCOES roster is provided in Attachment 1. Names of the reviewers will be populated in the future. See Attachment 4, Table 22 for an estimated cost for the review.

### 8.2 Products to Undergo BCOES

The work products to be reviewed by the BCOES reviewers include:

- DDR
- Plans and Specifications
- ECIFP

### 8.3 Schedule for BCOES

The BCOES review will be at the 60% design and 90% design milestones as indicated in Table 4. It is expected that the review recommendations from each design phase will be addressed and incorporated into the final design.

*Table 4 BCOES Review Schedule*

Project Phase/Submittal	Review Start Date	Review End Date	Site Visit
60% Design Review (DDR, P/S)	1-Apr-22	1-May-22	
90% Design Review (DDR, P/S, ECIFP)	1-Aug-22	30-Aug-22	1

## Section 9

# Safety Assurance Review

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### 9.1 Decision on SAR

A SAR will be conducted on design and construction activities where potential hazards could pose a significant threat to human life (public safety). The District Chief of Engineering has made a risk-informed decision that this project poses a significant threat to human life (public safety) and therefore a SAR will be performed for the implementation documents to include the DDR and Plans and Specifications. In accordance with EC 1165-2-217, the following response was determined to support the risk-informed decision:

- The spillway modifications are a major rehabilitation of a flood risk management project for a densely populated area;
- The spillway modifications during construction could introduce new potential failure modes or lead to higher risks for existing potential failure modes;
- The spillway modifications design requires redundancy, resiliency, and robustness.

### 9.2 Products to Undergo SAR

a. Description of Work Products. The work products for the Prado Dam Spillway Modifications Project include:

- DDR
- Plans and Specifications
- Design Risk Assessment Report
- Construction Documents and Site Visits

b. Required Level of Review. Design products including the DDR, and contract Plans and Specifications (P&S) for spillway modifications work will undergo a Type II IEPR (SAR) review.

c. Excluded Review: A risk-informed decision was made to exclude SAR review for the Operation & Maintenance Manual for SAR review due to the following:

- Per CECW-CE Memorandum, dated 5 April 2019, Subject: Interim Guidance on Streamlining Independent External Peer Review (IEPR) for Improved Civil works Product Delivery, SAR reviews should be scalable to the project risk. SAR review is a strategic level review, not all documents will be evaluated or reviewed in their entirety. Reviewers should be looking at the portions of the project that are driving the life safety risks or areas of technical complexity of the project. The O&M Manual would not cause to drive the life safety risks or would be technically complex to implement.
- The O&M Manual will document operation and maintenance requirements based on completed design and construction documents of the spillway modifications that would have already been reviewed by the SAR team as there would not be any potential failure modes that would pose a significant threat to human life during operation and maintenance of the project;

- The O&M Manual will document the interim risk reduction measures implemented before completion of the spillway modifications. These IRRM action items further reduce the risk of potential failure modes during operation and maintenance of the project.

## 9.3 Required SAR Panel Expertise

SAR panels will be established in accordance with EC 1165-2-217. The following disciplines and corresponding level of expertise are expected to be required for SAR of this project:

**Geotechnical Engineer** – Geotechnical Engineer panel member shall be a registered professional geotechnical engineer from an Architect-Engineer or consulting firm, a public agency, or academia with 20 years of demonstrated experience in the specific field of dams engineering in evaluating, designing, and constructing large embankment dams (>150 feet high) for water storage or large levees embankments; and with a minimum BS degree or higher in geotechnical engineering. Active participation in related profession societies is encouraged. The panel member shall have knowledge and experience in analyses of seepage, settlement, stability, and deformation problems associated with embankments constructed on weathered and jointed bedrock and alluvial soils in areas with the potential for large seismic ground motions. The panel member should have experience in geotechnically focused potential failure mode analysis, risk assessment of embankment dams, spillways, outlet works, and evaluating risk reduction measures for dam safety assurance projects. The panel member shall have familiarity with preparing plans and specifications for dam safety rehabilitation projects, knowledge of USACE design and construction procedures and policies, and USACE dam safety assurance policy and guidance.

**Hydraulics Engineer** – Hydraulics Engineer panel member shall be an industry recognized hydraulics engineer from an Architect-Engineer or consulting firm, a public agency, or academia with 20 or more years of demonstrated experience in hydraulic engineering with an emphasis on large public works projects, with extensive background in hydraulic theory and practice, and spillway hydraulics, with a minimum BS degree or higher in Civil or Hydrology and Hydraulics engineering. Active participation in related professional engineering and scientific societies is encouraged. The distinguished panel member shall have experience associated with flood risk management projects, and the analysis and design of hydraulic structures related to flood control projects including the design of hydraulic structures such as outlet works, spillways, and stilling basins, flood control channels and levees, diversion channel design, and large river control structures. Direct experience with designing and construction labyrinth spillways is required. The panel member 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. The panel member 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. The panel member shall be familiar with USACE application of risk and uncertainty analyses in flood damage reduction studies and also have a familiarity with standard Corps hydrologic and hydraulic computer models (such as HEC-1, HEC-HMS, HEC-2, HEC-RAS, FLO-2D, and HEC-DSS) used in drawdown studies, dam break inundation studies, hydrologic modeling and analysis for dam safety investigations. The panel member shall have familiarity with preparing plans and specifications for dam safety rehabilitation projects, knowledge of USACE design and construction procedures and policies, and USACE dam safety assurance policy and guidance. The panel member shall have experience in evaluating risk reduction measures for dam safety assurance projects.

**Structural Engineer** – The Structural Engineer panel member shall be a registered professional civil engineer from an Architect-Engineer or consulting firm, a public agency, or academia with 20 or more years of demonstrated experience, with a minimum BS degree or higher in engineering. Active participation in related profession societies is encouraged. The distinguished panel member shall have extensive experience in the design and construction of hydraulic structures for large and complex civil works projects

including spillways, outlet works, and flood walls. The panel member should be a recognized expert in stability analysis and structural design of reinforced concrete scour protection and stilling features including the design of baffles, end sills, and training walls; seismic design, the determination and evaluation of dynamic site-specific response spectra analysis, and the evaluation of soil-structure interaction; and the design and construction of T-wall and L-wall retaining wall design. The panel member shall have familiarity with preparing plans and specifications for dam safety rehabilitation projects, knowledge of USACE design and construction procedures and policies, and USACE dam safety assurance policy and guidance. The panel member shall have experience in evaluating risk reduction measures for dam safety assurance projects.

**Construction Engineer** – The Construction Engineer panel member shall be a registered professional civil engineer from an Architect-Engineer or consulting firm, a public agency, or academia with 20 or more years of experience and have extensive experience in the design, layout, and construction of major flood control structures including dams, levees, diversion channels, and other hydraulic structures, with a minimum BS degree or higher in engineering. Active participation in related professional engineering and scientific societies is encouraged. The distinguished panel member should have demonstrated extensive experience in the engineering concrete construction field in Roller Compacted Concrete or Conventional Mass Concrete with particular emphasis on dam safety projects. The panel member shall have familiarity with preparing plans and specifications for dam safety rehabilitation projects, knowledge of USACE design and construction procedures and policies, and USACE dam safety assurance policy and guidance.

Documentation of SAR review will occur using the requirements of EC 1165-2-217.

## 9.4 Scope, Schedule, and Estimated Cost of SAR's

The SAR's will be performed in accordance with EC 1165-2-217. SAR reviews will occur at the milestones shown in Table 5. The estimated costs for the SAR's of this project are estimated to be \$304,000. This estimate will be refined when the Scope of Work for the SAR task order is completed. Milestone reviews for the SAR are at the draft design (60% milestone) and 90% milestone; at the midpoint of construction, prior to final inspection, or at any critical design or construction decision milestones as noted below.

*Table 5 Scheduled Milestone Reviews with Required Reviewers and Site Visit Duration*

Milestone Reviews	Geotech	Hydraulics	Structural	Construction	Site Visit or Conference Call Duration (days)	Review Start Date	Review End Date
Labyrinth Physical Model		X	X		1	July 2021	July 2021
30% Design	X	X	X	X	1	Oct 2021	Nov 2021
60% Design	O	O	O	O		Apr 2022	May 2022
90% Design	O	O	O	O		Aug 2022	Sep 2022
Foundation Excavation, Cofferdam	X	O	X	X	1	2023	
Labyrinth Weir	X	X	X	X	1	2024	

Milestone Reviews	Geotech	Hydraulics	Structural	Construction	Site Visit or Conference Call Duration (days)	Review Start Date	Review End Date
Dam Tie-in, Chute walls and apron, Flip Bucket	X	X	X	X	1	2024-25	
End of Construction	X	X	X	X	1	2026	

(X - Indicates attendance at the site visit. O - Indicates participation via conference call.)

## Section 10

# Policy and Legal Compliance Review

EC 1165-2-217 informs requirements for Policy and Legal Compliance Reviews for all decision documents throughout the study process for their compliance with law and policy. Guidance for policy and legal compliance reviews of decision documents 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.

Legal review will be undertaken for appropriate documents such as environmental commitments and Findings of No Significant Impact (FONSI) statement, contract acquisition plans, real estate and relocation compensability determinations

This RP addresses review quality management of implementation documents, ie. Design Documentation Report, Plans & Specifications, and Operation & Maintenance Manual. The DQC and ATR reviews will 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.

The EC also informs that when policy and/or legal concerns arise during DQC or ATR efforts that are not readily and mutually resolved among the PDT members and the reviewers, the District will seek issue resolution support from the MSC and HQUSACE consistent with the appropriate guidance. Unresolved comments involving disagreement between the DQC, or ATR Team and the PDT will be closed with the notation that the comment has been elevated for resolution. Any such issues will be explicitly listed on (or attached to) the ATR certification form prior to being routed for signature.

## Section 11

# Public Posting of Review Plan

As required by EC 1165-2-217, the approved RP will be posted on the District public website (<https://www.spl.usace.army.mil/Missions/Civil-Works/Review-Plans/>). This is not a formal comment period and there is no set timeframe for the opportunity for public comment. If and when comments are received, the PDT will consider them and decide if revisions to the RP are necessary.

## Section 12

# Review Plan Approval and Updates

The MSC Commander, or delegated official, is responsible for approving this RP. The Commander's approval reflects vertical team input (involving the District, MSC, and RMC) as to the appropriate scope, level of review, and endorsement by the RMC. The RP is a living document and should be updated in accordance with 1165-2-217. All changes made to the approved RP will be documented in Attachment 3. The latest version of the RP, along with the Commanders' approval memorandum, will be posted on the District's webpage and linked to the HQUSACE webpage. The approved RP should be provided to the RMO.

## Section 13

# Engineering Models

The use of certified, validated, or agency approved engineering models is required for all activities to ensure the models are technically and theoretically sound, compliant with USACE policy, computationally accurate, and based on reasonable assumptions. 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. 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, BCOES, policy and legal review, and SAR. Where such approvals have not been completed, appropriate independent checks of critical calculations will be performed and documented. The following engineering models, software, and tools are anticipated to be used:

*Table 6 Models and Status*

Model Name	Version	Validation Date
Hydraulics CFD – Flow 3-D by Flowscience	V 11.2	11/29/16
HEC RAS	6.0	December 2020
SAP2000	22.1.0	6/23/20
HEC HMS	4.5	5/1/20
MCACES Second Generation (MII)	4.4.2	7/9/2020
MicroStation V8i (Select Series 3)	08.11.09.459	6/10/20
Geostudio 2019	10.0.0.17401	December 2018
Holebase SI	1.3	6/9/20
Geostudio 2020	10.2.1	11/26/20
Openground	v1.0.0.171	3/11/21
FLAC	8.1	2/18/21
FLAC3D	7.00.119	5/15/20
Corel Draw Graphic Suite	2018	8/7/18
CorpsCon	V 6.0	6/17/20



## Section 14

# Review Plan Points of Contact

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*Table 7 RP POC's*

<b>Title</b>	<b>Organization</b>	<b>Phone</b>
Civil Design Task Lead Engineer	CESPL-EDD-A	213-452-3639
Lead Engineer	CEIWR-RMC-WD	303-963-4543
Project Manager	CEIWR-RMC-W	913-787-5356
Senior Reviewer	CELRH-PM-PP-P	304-399-5720

# ATTACHMENT 3

## Review Plan Revisions

*Table 17 RP Revisions*

Revision Date	Description of Change	Page/Paragraph Number

## ATTACHMENT 5

# AE Quality Control Plans

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The following link can be used to access applicable AE Quality Control Plans:

[AECOM QC Plan](#)