



US Army Corps
of Engineers®

Prepared by:
MVS District
MVD Division

Review Plan: Rio Guanajibo Supplemental Project

PREPARED BY:

Engineering Technical Lead
USACE, St. Louis District

APPROVAL
RECOMMENDED:

Levee Safety Officer/Chief, Engineering Division
USACE, Jacksonville District

APPROVAL
RECOMMENDED:

Chief, Engineering and Construction Division
USACE, St. Louis

ENDORSED BY:

Chief, Eastern Division
USACE, Risk Management Center

APPROVAL
RECOMMENDED:

Chief, Engineering and Construction Division
USACE, Mississippi Valley Division

APPROVED BY:

Director, Regional Business
USACE, Mississippi Valley Division

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Last Revision Date: *None*



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Section 1

Introduction

1.1 Purpose

This Review Plan (RP) for Rio Guanajibo Supplemental Project (P2# 477701) at Mayaguez, Hormigueros, and San German, 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" and ER 1110-1-12 "Quality Management". As part of the Project Management Plan this RP establishes an accountable, comprehensive, life-cycle review strategy for Civil Works products and 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, Environmental, and Sustainability (BCOES) Review, Independent External Peer Review (IEPR), and Policy and Legal Compliance Review. Additionally, the ER outlines procedures for quality checks and reviews, PDT reviews; Biddability, Constructability, Operability, Environmental, and Sustainability (BCOES) review; and quality control certification. Further, additional requirement of the BCOES review will be per ER 415-1-11 This RP will be provided to the 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 Jacksonville District Levee Safety Officer (LSO) will be part of the district Quality Control team as this levee will be part of the SAJ levee safety program portfolio. The St. Louis District Chief of Engineering and Construction has responsibility for the quality of design products as the majority of the design is being developed out of this district. The Jacksonville District LSO and St. Louis District Chief of Engineering and Construction have collaborated and 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 7.1. This project is also being coordinated to be consistent in application of design processes and features with the MVK and MVS design teams with the Nigua and Arecibo projects.

1.2 References

- EC 1165-2-217, Review Policy For Civil Works, 20 February 2018
- ER 1110-1-12, Quality Management, 31 Mar 2011
- ER 415-1-11, Biddability, Constructability, Operability, Environmental and Sustainability (BCOES) Reviews, 1 January, 2013
- Project Management Plan (PMP) for study
- MVD Quality Management Plan (QMS100.1-MVD) and MVS Supplement (QMS100.1-MVS)
- ECB 2019-15: Interim Approach for Risk-Informed Designs for Dam and Levee Projects
- ER 1110-1-8159, Dr. Checks
- ER 11-1-321, Army Programs - Value Engineering
- Interim Guidance on Streamlining Independent External Review (IEPR) for Improved Civil Works Product Delivery; 05 April 2019

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 Description

2.1 Project Description

The Río Guanajibo basin is located in southwest Puerto Rico and includes portions of 6 municipalities with a total population over 225,000. The catchment area is 140 square miles. Flooding is a serious threat to life and property in the towns of San German, Hormigueros and Mayaguez. The current estimate of the population at risk estimate during the 1/100 ACE event is 88,467. The recommended project from feasibility includes a channel planned to provide a 10-year level of protection at San German in the upper basin and a system of levees that will provide a 100-year protection for the urban areas at Hormigueros and Mayagüez in the lower basin. The recommended plan consists of 6.26 kilometers of floodwalls and levee system in the vicinity of the residential developments of Guanajibo Homes, San José Estates, Buenaventura, and Valle Hermoso. The plan also consists of channel improvements in San German located 12 kilometers upstream of the levee features. See Figure 1, Figure 2, and Figure 3. As of November of 2019, all listed features will be included in the design effort. These features will therefore be combined into a single plans, specifications, and DDR package, known herein as the Rio Guanajibo Supplemental Project.

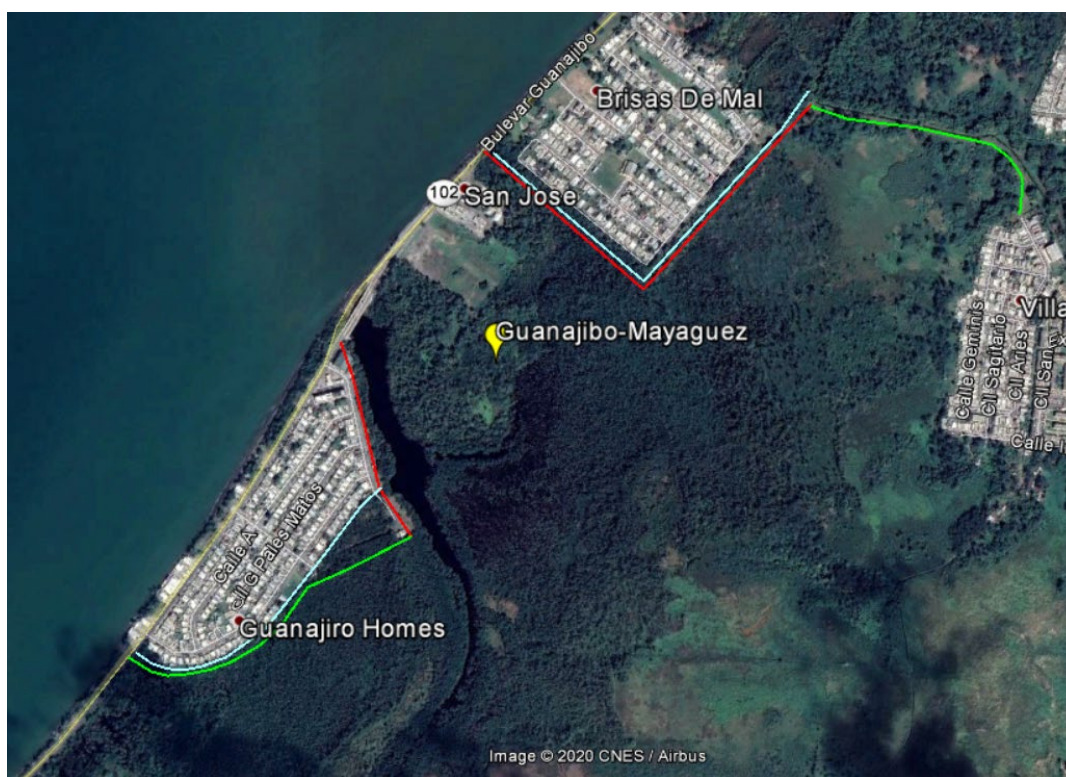


Figure 1- Contract Locations (San Jose and Guanajibo Homes, Mayaguez)

Mayaguez

Both communities (Guanajibo Homes and San Jose) are densely populated primarily with residences and a few commercial and public properties. Their line of protection will consist of a levee or floodwall and protects the community from flooding from the west by the Rio Guanajibo and Caño Merle. Guanajibo Homes is a development along the PR-102 (Boulevard Guanajibo) where planned floodwall and levee features are to protect the community and two radio towers. There is a PRASA wastewater pump station near the northeast side levee alignment that will also be within the line of protection. Most of the lands on the levee alignment are on the edge of forested and saturated/inundated mangrove wetlands. On the northeast side of the development, a floodwall will be constructed where there is little room for a levee footprint between structures and Caño Corazones. The line of protection will tie in to existing features at two locations. The northern tie-in will be to the Caño Corazones PR-102 Bridge left bank abutment and the southern tie-in will be on the coastline at PR-102, just south of the community. An interior drainage culvert will be located in alignment with the interior drainage ditch located between the pump and the radio stations. Near the south side tie-in, there is an existing 36" culvert that will accommodate additional interior drainage.

At the development of San Jose Estates, a levee and drainage ditch will be placed along the southwest and southeast perimeters. A mitigation area will be included to account for project features that encroach into the mangrove wetlands. A levee is planned to extend eastward from the end of the southeast floodwall and continue along the left bank of Sábalo Creek providing both flood protection and an evacuation route in case of tsunami or other emergency. This portion of the levee has a wastewater pipeline along a part of its length that may need to be relocated. The line of protection will tie in to existing features at two locations. The westernmost tie-in will be to the coastline at PR-102. The easternmost tie-in will be to high ground at the dead-end of Calle Tauro in the Villas del Oeste community.



The line of protection at Hormigueros includes a levee and drainage ditch with up to eight penetrating culverts discharging interior waters to both Río Hondo and Río Guanajibo. The levee and drainage ditch begins to the northwest on high ground near PR-114, and follows the left bank of Río Hondo. The levee and drainage ditch then make a 90 degree left turn along the right bank of the Río Guanajibo. The levee will then tie-in to the elevated community just to the northwest of PR-100. The lands for this portion of levee reach are largely undeveloped.

The levee restarts/ties-in on the south side of PR-100, crossing PR-114 at a road ramp. A gravel/sand processing plant is located near the road ramp for PR-114. Alignment options to accommodate this plant will need to be further analyzed during design. The levee continues toward PR-2 along the south side of PR-309. The planned southeast levee embankment tie-in is located on the opposite side of the creek adjacent to Calle F, approximately half way between the PR-100 and the intersection of PR-309 and PR-2. At least two residences could possibly be affected by this alignment. As an alternative, the levee may be extended to the newly elevated PR-2 intersection and tie-in to high ground on the road ramp. This alignment would also provide additional benefits by protecting a commercial/industrial complex. With exception to the gravel/sand processing plant, the lands for this portion of levee are undeveloped and are either farmed or ranched.

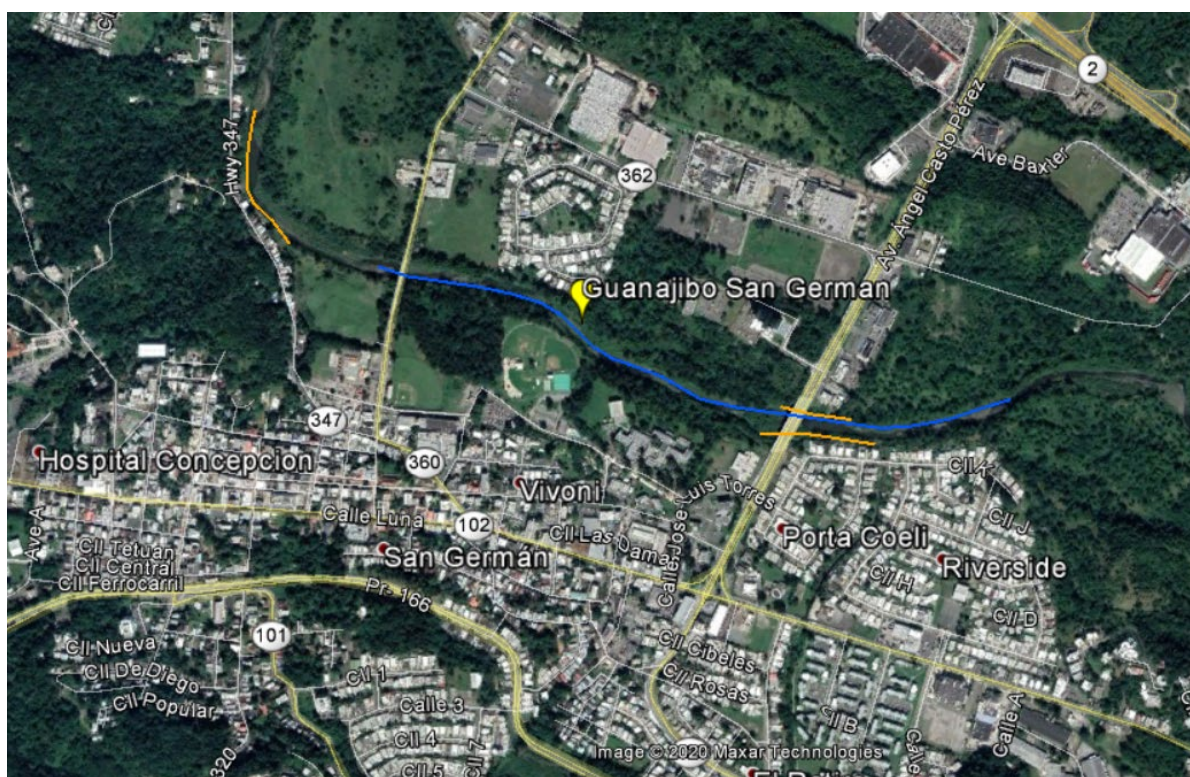


Figure 3- Contract Locations (San German)

San German

At San German channel improvements upstream of PR-122 to the confluence of Retiro Creek with Río Guanajibo and the left bank just downstream of PR-122 has been constructed utilizing gabion revetment. This work needs to be evaluated for condition and functionality. Additionally, evaluation is needed of the previously constructed confluence wall as it appears shorter in length than presented in the plans. The Puerto Rico Highway Authority has also reinforced the channel under the PR-122 Bridge. Areas where the channel has not been improved are highly vegetated with areas showing active erosion, including vertical sheer or slope failure. The channel just downstream of the PR-360 Bridge abutment has not been reinforced and the right bank is in a damaged or failing condition. The proposed project ends in a transitional area downstream of the PR-360 Bridge.

Downstream of the project boundary, gabions have been installed along the left bank by Department of Natural and Environmental Resources (DNER). The backside of houses on PR-347 were flooded by Maria when the river overtopped the gabions crest elevation by approximately 4 feet. Gabions were in fair condition with slight slumping in some areas.

A Semi Quantitative Risk Assessment (SQRA) will be performed as part the review effort on the design as required by the ECB 2019-15 on Risk Informed Design.

2.2 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. However, there will not be in-kind contributions for this effort.

The non-Federal sponsor for this project is the Puerto Rico Department of Natural and Environmental Resources (DNER).

Section 3

Project Delivery Team

3.1 Requirements

The PDT will be led by an experienced Project Manager (PM) who has led PDTs in successful completion of similar work. Other PDT members assigned will have extensive professional and technical experience in their assigned areas of responsibility. PDTs will include the use of Regional Technical Specialists (RTSs) when appropriate based on the visibility and/or complexity of the design products. Should future requirements require the application of different skills or experience than initially planned, appropriate additional personnel will be added to the PDT. Individual PDT members will be listed in the PMP for the project as it is developed and will be restated in this plan via the individual project PDT table to enhance execution of project planning.

See Attachment 1, Table 6 for the PDT member list.

Section 4

Customer Involvement

4.1 Requirements

The Program Team and the PDTs will engage and involve other appropriate USACE organizations, Federal agencies, state and local governments, local utility and infrastructure agencies, and local citizens groups and associations, to keep them informed and to solicit their feedback and assistance. This involvement includes formal meetings and presentations, formal reviews, informal meetings and discussions, teleconferences, emails and telephone conversations. Customer involvement at all levels is vital to instill confidence that the customers' needs are being addressed and the flood risk reduction design efforts are of high quality. The PDT is strongly encouraged to include personnel from the local sponsor's staff and from other Federal agencies. Partnering with the local sponsor is a key element during the design of a project. Our customers are key members of the PDT. Partnering shall occur during all phases of project development. At minimum, discussions will be held with the customers during the onsite PDT meetings and at the reviews. Other meetings with the customers will be held as necessary, to ensure complete engagement and resolution of issues or concerns.

See Attachment 1, Table 7 for the list of project customers.

Section 5

District Quality Control

5.1 Requirements

All project documents including the Plans, Specifications, DDR, Hydraulics Report, Geotechnical Report, and risk assessment reports shall undergo DQC in accordance with EC 1165-2-217 and ER 1110-1-12. The District shall perform these minimum required reviews in accordance with the MVD Quality Management Plan (QMS100.1-MVD) and the MVS Supplement (QMS100.1-MVS). Both documents are stored on the USACE Quality Management System (QMS) Portal. In addition to this, red dot checking or equivalent method will be used to check all documents per guidance EC 1165-2-217. DQC will be performed on all early release decision information (i.e., loading conditions, geotechnical parameters, hydraulic conditions, etc.) and certified complete prior to incorporation into the design.

See Attachment 1, Table 8 for the DQC Lead, reviewers, and reviewer's disciplines. The review plan will be revisited by the district, MSC and RMC after the design risk assessment is completed to assess if the reviewers are appropriate.

5.2 Documentation

Documentation of project DQC activities is required and will be implemented by utilizing Dr. Checks in addition to the processes referenced in paragraph 5.1. At the conclusion of the project DQC effort, the Technical Lead will prepare a DQC certification memo. In addition, a separate Quality Certification document will be developed for early release decision information. The final quality report will be prepared in accordance with EC 1165-2-217 and included in the DDR. The certificate templates for project DQC and early release certificates are located in Attachment 3.

5.3 DQC Schedule and Estimated Cost

Although DQC is always seamless, the following milestone reviews are scheduled in Table 1.

Project Phase/Submittal	Review Start Date	Review End Date
Hydrology 50% DQC Review	6/24/20	7/7/20
Hydraulics 50% DQC Review	1/15/21	2/9/21
H&H 95% DQC Review	TBD	TBD
Geotechnical Report DQC	11/30/21	12/13/21
DQC 35% Geotech Report P&S/DDR Review	3/21/22	4/1/22
DQC 65% Geotech Report P&S/DDR/SQRA Review	10/14/22	10/27/22
DQC Final Geotech Report P&S/DDR/SQRA Review	6/7/23	6/20/23

Table 1 DQC Schedule

Section 6

Agency Technical Review

6.1 Requirements

All project documents including the Plans, Specifications, DDR, Hydraulics Report, Geotechnical Report, and risk assessment reports shall undergo 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 6.6. An ATR team site visit will only be scheduled as deemed necessary and be evaluated for each discipline to determine if an in-person review of current site conditions, features, and assessment of life safety is required to ensure the quality and credibility of the government's scientific information. Additional data required by the ATR team will be gathered by PDT members during plan in hand visits, by USACE personnel stationed in Puerto Rico, or by non-federal team members. The information will be reviewed and disseminated to the ATR team by the PDT. If a reviewer requires a site visit for their review, one may be allowed upon coordination and approval by the PM.

See Attachment 1, Table 9 for the list of ATR reviewers. The review plan will be revisited by the district, MSC and RMC after the design risk assessment is completed to assess if the reviewers are appropriate.

6.2 Documentation of ATR

Documentation of ATR will occur using the requirements of EC 1165-2-217. This includes the four part comment structure and the use of DrChecksSM.

6.3 Products to Undergo ATR

Products that will undergo ATR include the Plans, Specifications, DDR, Hydraulics Report, Geotechnical Report and risk assessment reports. The ATR for the cost was completed during cost certification. The certified project cost will not need further update or review unless significant scope changes occur. Additional cost estimate DQC reviews will be performed during product reviews as it is refined during each design phase.

6.4 Required Team Expertise and Requirements

ATR teams will be established utilizing senior highly experienced experts in accordance with EC 1165-2-217. All ATR members shall be registered with CERCAP as a reviewer, unless approved separately, with qualifications matching the project requirements and their perspective roles. Risk experience is needed with at least one of the review team members. The following disciplines will be required for ATR of this project:

ATR Lead: The ATR team lead shall be a senior professional outside both responsible MSCs (SAD and MVD) with extensive experience in preparing Civil Works documents and conducting ATRs. The lead shall have 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. This individual shall have a strong levee safety background, as the project involves life safety and requires a SAR.

Geotechnical Engineer – The Geotechnical Engineer shall be a senior level, professionally registered engineer with experience with design of levees and floodwalls within populated areas. The team member shall be familiar with dealing with poor soil conditions in both riverine and coastal environments and the

development of pile capacities. The team member shall have an understanding of graduate level soil mechanics, to include: soil shear strength, soil-structure interaction, deep foundations, slope stability, in addition to other methodologies required by the project.

Civil Engineer – The Civil Engineer shall be a senior level, professionally registered engineer with experience designing levees, floodwalls, channels, drainage structures, and closure structures within populated areas. Additionally, the team member shall have experience with utility relocations and real estate drawings.

Structural Engineer – The Structural Engineer shall be a senior level, professionally registered engineer with experience in pile founded floodwall design, especially with poor soil conditions in both riverine and coastal environments and in high seismic zones. The team member shall also have experience with design of culverts.

Geologist – The Geologist shall be a senior level, and professionally registered with extensive experience in developing sampling procedures for efforts pertaining to levee safety projects, specifically with the construction of levees and pile founded floodwalls.

Hydraulic Engineer – The Hydraulic Engineer shall be a senior level, and professionally registered with experience with engineering analysis related to flood risk management and levee safety projects. The team member shall demonstrate knowledge and experience with the routing of inflow hydrographs.

Hydrologic Engineer – The Hydrologic Engineer shall have experience in in RMC-RFA, HEC-SSP, HEC-HMS, and HEC-RAS successfully using those methods and tools in Flood Risk Management Studies and Semi-Qualitative Risk Assessments. The hydrologic engineer shall also have experience in hydrologic design considerations for tropical environments and small basin design storms.

Risk Reviewer – The team member shall have experience performing consistency reviews of SQRA's on levee safety projects.

Consequence Reviewer – The team member shall have experience performing consistency reviews of consequence modeling that support SQRA's on levee safety projects.

6.5 Statement of Technical Review Report

At the conclusion of the 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. The RMC's Statement of Technical Review Report template shall be used with the ATR Completion of Agency Technical Review showing the Chief of Eastern Division and CEIWR-RMC-E signing for the RMO. See latest template here: [Pre-Construction Engineering and Design](#)

6.6 ATR Schedule and Estimated Cost

Although ATR is always seamless, the preliminary ATR milestone schedule is listed in Table 2.

Project Phase/Submittal	Review Start Date	Review End Date	Site Visit
Hydrology 50% ATR Review	7/15/20	7/28/20	NA

Hydraulics 50% ATR Review	2/9/21	3/2/21	NA
H&H 95% ATR Review	TBD	TBD	TBD
Geotechnical Report ATR	1/6/22	1/20/22	NA
ATR 35% Geotech Report/ P&S/DDR Review	4/11/22	4/29/22	TBD
ATR 65% Geotech Report /P&S/DDR/SQRA Review	11/21/22	12/13/22	NA
ATR Final Geotech Report/P&S/DDR/SQRA Review	7/20/23	8/2/23	NA

Table 2 ATR Schedule

Section 7

Safety Assurance Review

7.1 Decision on SAR

The following evaluations indicate whether or not a Type II IEPR (SAR) is recommended for the features within this project currently entering the PED Phase. The SAJ Levee Safety Officer and MVS Chief of Engineering and Construction have made a risk-informed-decision that certain features associated with this work pose a significant threat to human life (public safety). Therefore, a SAR will be performed for the work included in this effort.

Project features include:

The scope for this phase of the project includes the construction of levees, floodwalls, and interior drainage features for the Guanajibo Homes, San Jose, and Hormigueros reaches. Channel improvements and revetment are planned for the San German reach.

Decision on Type II IEPR: In consideration of the factors described in Paragraph 15 of EC 1165-2-217, Risk Informed Decisions, as they relate to Type II IEPR, it is the determination of the SAJ Levee Safety Officer and MVS Chief of Engineering and Construction that a Type II IEPR for this work is required based on the following information:

(1) Does failure of the project pose a significant threat to human life?

This work involves the design and construction of a system of floodwalls and levees. Flood risk reduction will be provided to an estimated population at risk of 88,467. Sudden failure of the risk reduction features would endanger the lives and property of those in the path of the resulting inundation.

(2) Does the project involve the use of innovative materials or techniques?

Construction of this contract will utilize standard methods and procedures used by the Corps of Engineers on other similar work.

(3) Does the project design require redundancy, resiliency, or robustness?

The project design does not require the addition of redundant project features, however, specific features along the project may need further consideration. Resiliency or robustness incorporated into design features are a function of normal civil works design criteria and are not in excess of customary practice.

(4) Does the project have a unique construction sequencing or a reduced or overlapping design construction schedule?

The design is not innovative and is not using design or construction techniques that are precedent setting; nor is the project using unique construction scheduling or ECI delivery systems.

7.2 Products to Undergo SAR

Products that will undergo SAR include the Plans, Specifications, DDR, Hydraulics Report, Geotechnical Report and construction documents during the construction phase of the SAR.

7.3 Required SAR Panel Expertise

SAR panels will be established utilizing senior highly experienced experts in accordance with EC 1165-2-217. The following disciplines will be required for SAR of this project:

Geotechnical Engineer – The Panel Member shall be a senior level, professionally registered engineer with experience with design of levees and floodwalls within populated areas. The team member shall be familiar with dealing with poor soil conditions in both riverine and coastal environments and the development of pile capacities. An understanding of graduate level soil mechanics, to include: soil shear strength, soil-structure interaction, deep foundations, slope stability, in addition to other methodologies, is required. The Panel Member shall have experience in failure mode analysis, risk assessment of embankment dams, and evaluating risk reduction measures for dam safety assurance projects.

Structural Engineer – The Panel Member shall be a senior level, professionally registered engineer with experience in pile founded floodwall design, especially with poor soil conditions in both riverine and coastal environments and in high seismic zones. The team member shall also have experience with design of short span reinforced concrete bridges and culverts with traffic loading.

Hydraulic Engineer – The Panel Member shall be a senior level, professionally registered engineer with experience with engineering analysis related to flood risk management and levee safety projects. The Panel Member shall demonstrate knowledge and experience with the routing of inflow hydrographs.

See Attachment 1, Table 10 for the list of SAR reviewers.

7.4 Documentation of SAR

Documentation of SAR will be prepared in accordance with EC 1165-2-217. See RMC SAR Report template.

7.5 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 3. This estimate will be refined when the Scope of Work for the SAR task order is completed. Milestones to consider for a SAR are at the midpoint and final design in the Design Documentation Report; at the completion

of the plans, specifications, and cost estimate; at the midpoint of construction for a particular contract, prior to final inspection, or at any critical design or construction decision milestones.

Based on project need, selected review periods are as shown in the schedule below. One review during design was determined to be sufficient based on a combination of factors. It is noted that the project has a high Population at Risk and likely resulting in at least a moderate consequence potential. However, those risks are anticipated to mostly be due to the overtopping failure mode. This project is limited in authorization to a 1/100 ACE, therefore overtopping risk will not change through design. As stated in Section 7.1, it is anticipated that there are no complex or innovative features needed to be implemented for the flood protection system. All flood protection features, utilities crossings, and transitions can be accommodated by applying established USACE criteria.

As discussed in Section 8 and Attachment 2, the design SQRA review to be performed after the 35% product submittal will identify features contributing to project risk. Details on mitigating these identified risks will be incorporated into the project by the design team and will generally be presented with the 65% submission. A review of the 65% product submittal will allow SAR reviewers to evaluate a fully developed picture of the project and better identify items not addressed through the design and SQRA process.

If unexpected critical risks are noted through the design SQRA or at the 65% product SAR review, consideration will be made to add an additional SAR review at the 95% product submission.

Milestone Reviews	Geotech	H&H	Structural	Site Visit Duration (days)	Review Start Date	Review End Date
65% P&S/DDR	X	X	X	1	7/20/22	8/30/22
Midpoint of Levee Construction	X			1	TBD	TBD
Midpoint of Wall Construction	X		X	1	TBD	TBD
End of Construction	X		X	1	TBD	TBD

Table 3 Scheduled Milestone Reviews with Required Reviewers and Site Visit Duration

Section 8

Design SQRA and Risk Characterization

8.1 Requirements

Risk-informed design decisions and supporting information, such as risk assessments, will be documented and incorporated into the Design Documentation Report (DDR). An abbreviated Semi Quantitative Risk

Assessment (SQRA) will be performed at the onset of the 35%-65% design phase as part the review effort on the design as required by ECB 2019-15 on Risk Informed Design. The SQRA will be performed on the entire Rio Guanajibo Flood Control Project, assuming all of the Supplemental Contract features are constructed per the design plans and specifications. See Attachment 2 for additional details and schedule. Due to the required timeline of these design products, a standalone ATR will be performed on the SQRA report. The SQRA ATR team will be comprised of a member of the Design ATR team that has risk based experience. If deemed necessary, additional SQRA ATR team members will be identified and assigned by the RMC to fit into the scheduled review period of the project and may include members of the Levee Senior Oversight Group (LSOG). The interim SQRA Document, along with documentation of the SQRA review, will be included with the project's DDR for reference throughout the remainder of the project. This review of the design SQRA report will be considered the final review during design phase unless an issue warrants further oversight, in which case a review by the entire LSOG may be recommended.

Near the end of the construction phase an initial risk characterization assessment will be performed. The team will update the abbreviated SQRA performed during the design to incorporate any changes or issues identified of the nearly complete construction project. The RMO will coordinate with the appropriate Planning Center of Expertise and LSOG as needed for decisions, when appropriate. LSOG members from the relevant disciplines will participate as members of the vertical team, technical review or policy review teams, as appropriate. The final risk assessment products and decision documents will be reviewed by the LSOG.

Section 9

BCOES Review

9.1 Requirements

The Technical Lead is the review leader for all BCOES reviews and, as such, is responsible for managing all BCOES reviews and assuring all DrChecks comments are resolved and closed. BCOES reviews are done during design for a project using design-bid-build (D-B-B) method. The BCOES review will be performed in accordance with ER 415-1-11 and ER 1110-1-12 on all implementation documents (including supporting data, analyses, reports, environmental compliance documents, water control manuals, etc.) to ensure:

- (1) Clarity of the acquisition documents, the soundness of the government's evaluation and selection criteria for negotiated acquisitions, and the ease of bidders or proposers to understand the government's requirements, allowing the submission of a competitive bid or proposal that is responsive to the government's requirements.
- (2) Ease of constructing a specified or designed project according to the government's requirements, including the proposed construction duration, and the ease of understanding and administering the contract documents during their execution.
- (3) Ability to efficiently operate and maintain a facility or facilities over their life cycle when the facility or facilities are built according to the project's plans and specifications.
- (4) Ability to best achieve stewardship of air, water, land, animals, plants, and other natural resources when constructing and operating the project, and complying with the Environmental Impact Statement or Assessment or other environmental related project requirements. The USACE Environmental Operating Principles (EOPs) in ER 200-1-5 provide direction on achieving synergy between the environment and the execution of projects. The Environmental part of a BCOES review shall address all EOPs including compliance with all applicable local, state, and Federal environmental requirements.

- (5) The design is using methods, systems, and materials that optimize incorporation of a site's natural land, water, and energy resources as integral aspects of the development and minimize or avoid harm to the air, water, land, energy, human ecology and nonrenewable resources on- and off-site of the project.

See Attachment 1, Table 11 for the list of BCOES reviewers.

9.2 Documentation

Engineering Considerations and Instructions (ECIs) will be included with the documents reviewed during BCOES. The designer will resolve comments from the BCOES review. All comments and comment resolutions will be performed and documented in DrChecks as per ER 1110-1-8159.

A BCOES review focusing on Construction, Environmental, and Contracting will be performed during the 65% design review period. The final BCOES review, incorporating all required facets, will occur at the 95% P&S submittal level after all ATR comments are resolved and the ATR is completed and certified. The start of the final BCOES review is currently scheduled for May of 2023. Upon completion of a BCOES review and prior to final approval of the P&S, the Technical Lead will document all comments, resolutions and identify the actual personnel who performed the BCOES review. A BCOES certification will be completed in accordance with ER 415-1-11. The certificate template is located in Attachment 3.

Section 10

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.mvs.usace.army.mil/Missions/Programs-Project-Management/Plans-Reports/>). 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 11

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 will be updated in accordance with EC1165-2-217 and ER 1110-1-12. All changes made to the approved RP will be documented in Attachment 4, Table 12 RP Revision. Addition of project phases, including the future construction phase, will require re-approval. The latest version of the RP, along with the Commander's approval memorandum, will be posted on the District's webpage and linked to the HQUSACE webpage. The approved RP will be provided to the RMO.

Section 12

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 (if required). 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:

Model Name	Version	Validation Date
Microstation	V8i SS4	
STAAD	Pro SS6	
MathCad	Prime 3.1	
Ensoft Group	2016	
CASE CPGA	2011	
Geoslope Geostudio	2018	
Open Roads Designer	2018 release 2	
Ensoft Lpile	2016	
SMS	13.0	
ArcPro	2.2 or Higher	
HEC-RAS	5.0.7	
FDA	1.4.2	
AdH	Version 4.6	
HEC-LifeSim	2.0	

Table 4 Models and Status

Section 13

Review Plan Points of Contact

Title	Organization	Phone
Review Manager/Lead Engineer	CEMVS-EC	314-331-8235
Senior Reviewer	CEIWR-RMC	304-399-5217

Table 5 RP POC's