



**DEPARTMENT OF THE ARMY**  
U.S. ARMY CORPS OF ENGINEERS, SOUTH ATLANTIC DIVISION  
60 FORSYTH STREET SW, ROOM 10M15  
ATLANTA, GA 30303-8801

CESAD-RBT

14 October 2019

MEMORANDUM FOR Commander, Jacksonville District, 701 San Marco Boulevard,  
Jacksonville, Florida 32207

SUBJECT: Approval of the Review Plan for the Rio Puerto Nuevo, Contract 2B, San Juan,  
Puerto Rico

1. References:

a. Memorandum, CESAJ-EN-Q, subject as above.

b. Engineering Circular (EC) 1165-2-217, Water Resources Policies and Authorities  
Review Policy for Civil Works, 20 February 2018.

2. The Review Plan (RP) for Rio Puerto Nuevo Contract 2B submitted by the Jacksonville  
District via reference 1.a noted above has been reviewed by South Atlantic Division (SAD). The  
RP was coordinated with and endorsed by the Risk Management Center (RMC). The RP is  
hereby approved in accordance with reference 1.b.

3. The USACE RMC shall be the Review Management Organization (RMO) for this project.

4. SAD concurs with the District's RP recommendation that outlines the requirements for  
District Quality Control (DQC), Agency Technical Review (ATR), and Biddability,  
Constructability, Operability, Environmental, and Sustainability (BCOES) Review and the  
conclusion and recommendation that a Safety Assurance Review/Type II Independent External  
Peer Review is required.

5. The District should take steps to post the approved RP to its website and provide a link to  
CESAD-RBT. Before posting to the website, the names of Corps/Army employees should be  
removed. Subsequent significant changes to this RP, such as scope or level of review changes,  
should they become necessary, will require new written approval from this office.

6. The SAD point of contact is [REDACTED].

Encl

[REDACTED]  
Major General, USA  
Commanding



DEPARTMENT OF THE ARMY  
CORPS OF ENGINEERS, JACKSONVILLE DISTRICT  
701 SAN MARCO BOULEVARD  
JACKSONVILLE, FL32207-8915

CESAJ-EN-Q

MEMORANDUM FOR Commander, South Atlantic Division (CESAD-RBT), 60 Forsyth Street SW, Room 10M15, Atlanta, GA 30303

SUBJECT: Approval of Review Plan for the Rio Puerto Nuevo Project, Contract 2B, San Juan, Puerto Rico

1. References.

- a. Engineering Circular (EC) 1165-2-217, Review Policy for Civil Works, 20 Feb 18.
- b. Flood Control Act of 1946, Public Law 79-526, 24 Jul 46.

2. I hereby request approval of the enclosed Review Plan for the Rio Puerto Nuevo Project, Contract 2B, San Juan, Puerto Rico and concurrence with the conclusion that a Type II Independent External Peer Review (IEPR) of the subject project is required. The recommendation to perform a Type II IEPR is based on the EC 1165-2-217 Risk Informed Decision Process as presented in the Review Plan. The Review Plan complies with applicable policy, provides for Agency Technical Review, and has been coordinated with the CESAD. It is my understanding that non-substantive changes to this Review Plan, should they become necessary, are authorized by CESAD.

3. The district will post the CESAD approved Review Plan to its website and provide a link to the CESAD for its use. Names of Corps/Army employees will be withheld from the posted version, in accordance with guidance.

4. If you have any questions regarding the information in this memo, please feel free to contact POC - [REDACTED].

Encl

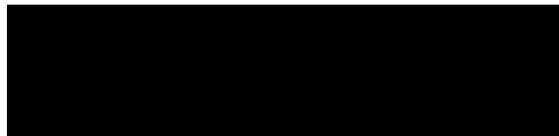


COL, EN  
Commanding

# Preconstruction, Engineering and Design Phase Implementation Documents for Rio Puerto Nuevo, Puerto Rico Contract 2B

## Review Plan

PREPARED  
BY:

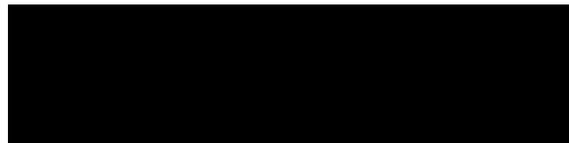


Engineering Technical Lead  
USACE, Jacksonville District

09/25/2019

DATE

ENDORSED  
BY:



Chief, Eastern Division  
USACE, Risk Management Center

09/25/2019

DATE

**MSC Approval Date: 10/15/2019**

**Last Revision Date: 11/01/2019**

# Introduction

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## 1.1 Purpose

This Review Plan (RP) for the Rio Puerto Nuevo Project, Contract 2B will help ensure a quality-engineering project is developed by the U.S. Army Corps of Engineers (USACE) 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 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. This RP will be provided to the Project Delivery Team (PDT), and the 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 5.1. Any levels of review not performed in accordance with EC 1165-2-217 will require documentation in the RP of the risk-informed decision not to undertake that level of review.

## 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
- ECB Draft Interim Approach for Risk-Informed Designs for Dam and Levee Projects
- 02611 – SAJ Quality Control In-House Products: Civil Works PED
- 02710 – SAJ Preparation and Submittal of Civil Works Review Plans
- Project Management Plan (PMP) for Rio Puerto Nuevo Project (P2#113454)

## 1.3 Review Management Organization

The USACE Risk Management Center (RMC) is the Review Management Organization (RMO) for this project. Content of this RP has been coordinated with the RMC and South Atlantic Division (SAD), the Major Subordinate Command (MSC). As RMO, the RMC is responsible for assembling the ATR Team in accordance with this RP and USACE guidance.

## Section 2

# Project Description

## 2.1 Project Description

The Rio Puerto Nuevo project was authorized for construction by the Flood Control Act of 1970 Section 204 (PL 91-611) and the Water Resources Development Act of 1986 Section 401 (PL 99-662). The project is located in San Juan, Puerto Rico. The Rio Puerto Nuevo Basin drains 24 square miles, 75 percent of which is highly developed with a population of 250,000 persons. The plan of improvement protects against the 100-year flood by the construction in the Puerto Nuevo River and its tributaries of 1.7 miles of earth lined channel, 9.5 miles of concrete lined channel (5.1 miles of which are high velocity), and two debris basins. The plan will also require the construction of five new bridges, the replacement of 17 bridges, and the modification of eight existing bridges, refer to Figure 1.

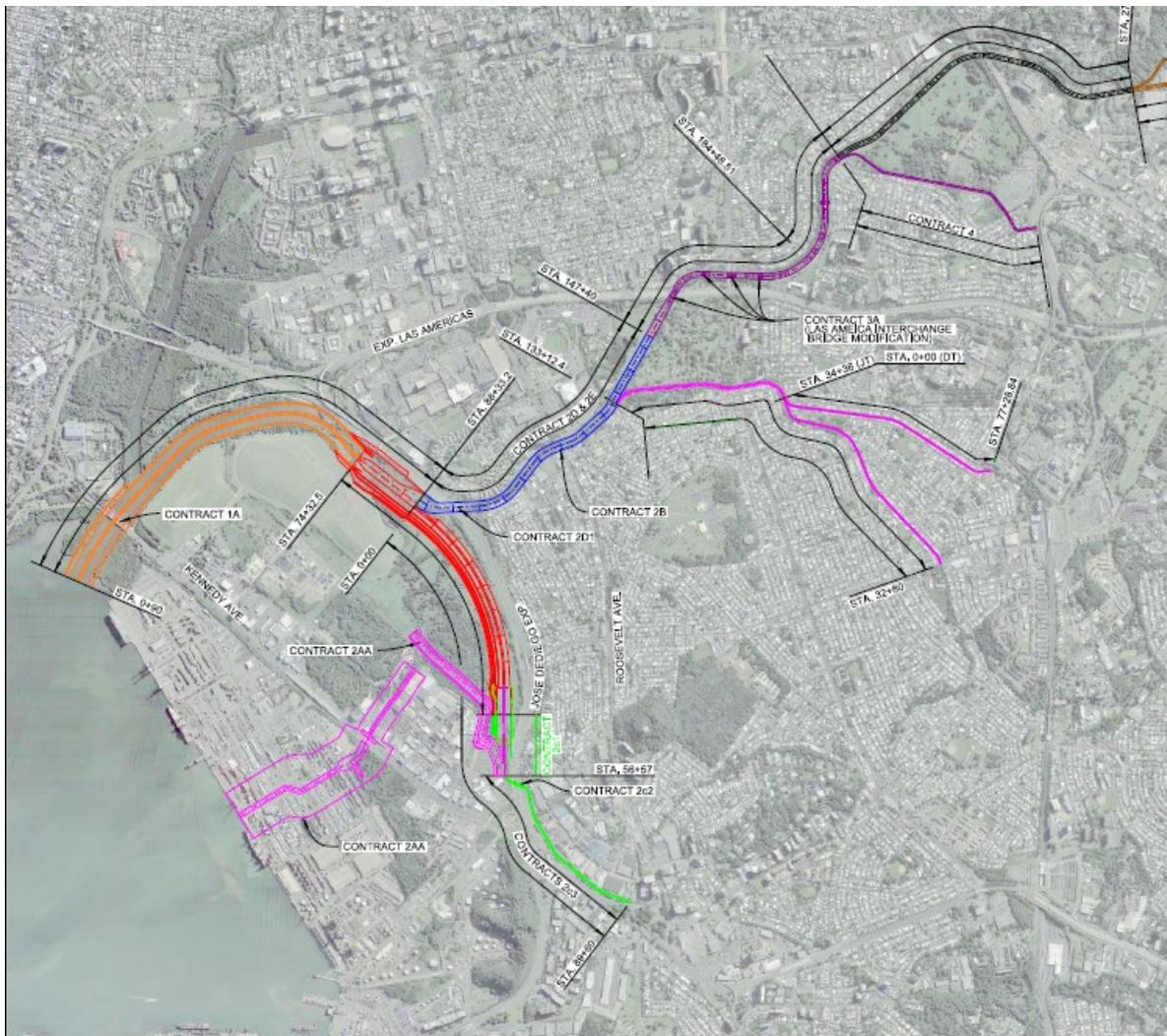


Figure 1: Rio Puerto Nuevo Contract Locations



concrete piles. As-built drawing indicates that the existing piles are approximately 38 feet long and founded in hard pan and disintegrated rock. Construction completion of the westbound lanes was in 1950 with the eastbound lanes following in 1951.

The Roosevelt Avenue Bridge Replacement will consist of dual, three span cast in place concrete bridges with an open median. Each bridge has three traffic lanes, sidewalks, and median curbs. The twin bridges are separated by an open median. Utility conduits/ductbank (i.e. electrical power, cable TV and a telephone ductbank) are spanning the river and are supported on brackets throughout the open median.

This project will cover the demolition of the existing bridges, clearing and site restoration, bridge replacement, scour protection, roadways and drainage, utility relocation, lighting, channel improvements, construction staging, construction sequencing, water diversion plan (e.g. berm, sheetpile, temporary cofferdam, etc.), right-of-way and temporary construction easements. In order to maintain the current traffic level of service, a detour using a temporary bridge is required for the construction of the permanent bridge. Currently, the permanent bridge is proposed to be constructed in three phases to accommodate traffic. Preliminary configuration of the permanent bridge consists of three lanes of traffic in each direction with raised sidewalks on each side and a raised, closed median. Roadway barriers shall be provided on each side of the bridge. The superstructure shall consist of a concrete deck slab supported on prestressed concrete beams. The substructure shall consist of a pile bent supported on steel H-piles or drilled shafts. The height of the bridge is designed to accommodate a 100-year storm event with a minimum vertical clearance of 3 feet to the low member of the permanent bridge. The permanent bridge is going to be designed for seismic loadings in accordance with applicable AASHTO Standards and Specifications. In addition to the AASHTO standards, the bridge design shall conform to the Puerto Rico Highway and Transportation Authority (PRHTA) Highway Design Manual (HDM) and other PRHTA design documents. The bridge structure shall be designed for HL-93 loadings and for PRHTA requirements.

The temporary bridge will be located on the south (upstream) side of the existing bridge (eastbound lanes of traffic). The recommended configuration is a three-lane temporary bridge. To maintain the current level of traffic, the permanent bridge shall be constructed in phases. The temporary bridge superstructure shall be a modular steel, pre-fabricated panel bridge (Acrow or similar). The low member of the temporary bridge shall be set at approximately the same elevation of low member of the existing bridge. Temporary bridge shall be designed to the same standards as the permanent bridge, as described above.

**Channel Improvements:** A channel wall system will be constructed from RPN Station 118+50 to Station 121+00. Walls will be either independent from or integrated into the Roosevelt Bridge Replacement. An erosion protection system will be installed on the bottom of the channel and tie into the channel work being performed under RPN Contract 2D.

## 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 IEPR reviews. However, there will not be in-kind contributions for this effort. The non-federal sponsor is the Puerto Rico Department of Natural and Environmental Resources (DNER).

## Section 3

# District Quality Control

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### 3.1 Requirements

All implementation documents (including supporting data, analyses, reports, environmental compliance documents, water control manuals, etc.) shall undergo DQC in accordance EC 1165-2-217. The A-E shall prepare a Design Quality Control Plan (DQCP) which includes a design delivery schedule and the quality control (QC) review team, see Attachment 3. SAJ shall performed Quality Assurance Review (QAR) in accordance with District Quality Control (DQC) activities for engineering products stipulated in ER 1110-1-12, Engineering & Design Quality Management, EC 1165-2-217 Review Policy for Civil Works and SAJ EN QMS 02611. The following EN QMS Procedures define related DQC activities for CESAJ-EN and can be found on the CESAJ intranet site via the following website ([https://intranet.usace.army.mil/sad/saj/engineering/Documents/QMS/02611\\_QualityControlInHouseCWPED.pdf](https://intranet.usace.army.mil/sad/saj/engineering/Documents/QMS/02611_QualityControlInHouseCWPED.pdf)).

See Attachment 1, Table 6 for the QA Team, reviewers, and reviewer's disciplines.

### 3.2 Documentation

Documentation of DQC activities is required and will be implemented by the process described in paragraph 3.1.

### 3.3 DQC Schedule and Estimated Cost

Although DQC is always seamless, the following milestone reviews for the A-E Contract and SAJ QA are schedule in Table 1. The cost for the DQC is approximately \$50,000.00.

Project Phase/Submittal	Review Start Date	Review End Date
DQC 30% P&S and DDR - AE	7/12/2019	8/30/2019
DQC 30% - SAJ QA	July 2019	August 2019
DQC 60% P&S and DDR Review – SAJ QA	10/25/2019	12/11/2019
DQC 60% P&S and DDR Review – SAJ QA	October 2019	December 2019
DQC Final P&S and DDR Review	5/6/2020	6/17/2020
DQC Final P&S and DDR Review – SAJ QA	May 2020	June 2020

*Table 1 DQC Schedule*

## Section 4

# Agency Technical Review

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### 4.1 Requirements

All implementation documents (including supporting data, analyses, reports, environmental compliance documents, water control manuals, etc.) 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 4.6. A site visit will be scheduled for the ATR Team.

### 4.2 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 DrChecks<sup>SM</sup>.

### 4.3 Products to Undergo ATR

The ATR Team will review the Intermediate (60%) and Final (100%) Plans & Specs along with the Intermediate (60%) and Final (100%) DDR for Contract 2B – Roosevelt Avenue Bridge Replacement, to include those products design by A-E Firm(s). All ATR reviews and tentative time frames are outlined in Table 2.

### 4.4 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:

**ATR Lead.** The ATR lead shall be a senior professional with experience in flood risk management projects and conducting ATR. ATR lead shall also have the necessary skills and experience to lead a virtual team through the ATR process. A minimum of 10 years of related project design/construction experience is required. ATR lead shall have experience with risk assessments for life safety disciplines. ATR Team Leader may be a co-duty to one of the review disciplines.

**Civil Engineer.** The team member shall be a registered professional engineer with experience in civil/site work on flood control projects that includes earthwork operations, site drainage, embankments and utilities relocation. A minimum of 5 years of related project design/construction experience is required.

**Construction Management.** The team member shall have 5 years of construction management experience with bridge in heavy highway construction.

**Electrical Engineering.** The team member shall have a minimum of 10 years of specialized experience in the electrical engineering field and shall be a registered professional electrical engineer. The Electrical Engineering panel member expertise shall include bridge, traffic electrical and lighting systems design and a minimum of 5 projects of similar scope.

**Geotechnical Engineer.** The team member shall be a registered professional with experience in design and analysis of flood wall foundations and channel slope stability evaluations, erosion protection, sheet pile retaining structures, bridge foundations, and earthwork construction to support the development of the Plans and Specifications. A minimum 10 of years of related project design/construction experience is required.

**Hydraulic Engineer.** The team member shall be a registered professional with experience in earth and concrete channel design and flood wall design with super critical flow to support the development of the Plans and Specifications. A minimum of 5 years of related project design/construction experience is required.

**Structural Engineer.** The team member shall be a registered professional with experience in concrete channels and walls composed of drill shaft, sheet pile type structures and bridge construction/modifications. A minimum of 5 years of related project design/construction experience is required.

## 4.5 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.

## 4.6 ATR Schedule and Estimated Cost

The preliminary ATR milestone schedule is listed in Table 2. The cost for the ATR is approximately \$45,000 - \$55,000.

Project Phase/Submittal	Review Start Date	Review End Date	Site Visit
ATR 60% P&S and DDR Review	11/14/2019	1/30/2020	January 2020
ATR Final P&S and DDR Review	6/18/2020	7/30/2020	

*Table 2 ATR Schedule*

## Section 5

# Safety Assurance Review

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### 5.1 Requirements

A SAR, also known as a Type II Independent External Peer Review (IEPR), may be required for implementation documents and construction activities for hurricane, storm, and flood risk management projects or other projects where existing and potential hazards pose a significant threat to human life. A risk-informed decision, as described in EC 1165-2-217, is made as to whether a SAR is appropriate. SARs are managed outside the USACE and shall consider the adequacy, appropriateness, and acceptability of the design and construction activities, assuring public health safety and welfare.

### 5.2 Decision on SAR

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. This decision is due to the high volume of traffic that make daily use of the bridge and would be subject to earthquake loading and frequent flooding which would pose a threat to human life and cause significant economic damage of the surrounding area.

### 5.3 Products to Undergo SAR

The SAR Panel will review the Intermediate (60%) Plans, Specifications, and DDR relevant to the Contract 2B – Roosevelt Avenue Bridge Replacement, as well as construction documents at the mid-point of construction.

### 5.4 Required SAR Panel Expertise

SAR panels will be established in accordance with EC 1165-2-217. Panels will consist of independent, recognized experts from outside the USACE in the appropriate disciplines, representing a balance of areas of expertise suitable for the review being conducted. The selection of SAR review panel members will be conducted using the National Academy of Science (NAS) Policy, which sets the standard for “independence” in the review process.

The following disciplines will be required for SAR of this project:

**SAR Panel Lead.** The SAR Team Lead shall be a registered professional engineer with a minimum of 15 years of experience in flood risk management projects, and bridge design and construction. The SAR-Panel-Lead will be the liaison/POC for the panel. The SAR-Panel-Lead can be one of the panel members described below if they possess the combined experience. The SAR-Panel-Lead shall have extensive knowledge of risk-based bridge safety analysis, bridge safety procedures and construction for projects similar in size to the Roosevelt Avenue Bridge Replacement.

**Civil/Traffic/Transportation Engineer.** Panel member shall have a minimum of 10 years of specialized experience in civil, traffic and transportation engineering; and shall be a registered professional engineer. The panel member expertise shall include civil, bridge, traffic, and transportation systems design; and a minimum of 5 projects of similar scope. The member shall also have experience designing bridges in Puerto Rico and be familiar with the “PRHTA Highway Design Manual” and Puerto Rico Aqueduct and Sewer Authority (PRASA) technical requirements.

**Geotechnical Engineer.** Panel member shall have a minimum of 15 years of specialized experience in the geotechnical engineering field and shall be a registered professional engineer. The distinguished Geotechnical panel member shall be a recognized expert in earthquake engineering for critical flood risk management infrastructure and expert in analysis, design, and construction of bridge foundations, subsurface investigations, and soils mechanics, including a minimum of 3 projects of similar scope. The experience shall include designing bridges in Seismic Zone 3 as defined in the AASHTO LRFD Bridge Design specifications. The member shall also have experience designing bridges in Puerto Rico and be familiar with the “PRHTA Highway Design Manual”.

**Hydrology and Hydraulics Engineer.** Panel member shall have a minimum of 15 years of specialized experience in the Hydrologic and Hydraulics (H&H) engineering field and shall be a registered professional engineer. The H&H panel member shall have experience in river hydraulics, storm water systems, flood analysis, hydraulic analysis and design of flood control projects, bridges, and hydraulic structures, and bridge scour and stream instability analysis and countermeasures design. The H&H panel member must have experience with USACE’s hydrologic and hydraulic computer numerical models (HEC and ERDC software), the application of data from physical model testing (journals, research, etc.), and the ability to coordinate, interpret, and explain computed results with other engineering disciplines, particularly structural engineers, geotechnical engineers, and civil engineers. The H&H panel member shall be familiar with USACE Engineer Manuals for hydraulic design and have a familiarity with FHWA and PRHTA design guidance.

**Structural Engineer.** Panel member shall have a minimum of 15 years of specialized experience in the structural engineering field and shall be a registered professional engineer. Active participation in related profession societies is encouraged. The Structural Engineering panel member shall be proficient in performing stability analysis using limit equilibrium analysis; design and construction of deep sheet pile walls; design and construction of tangent drilled shaft walls; and cofferdam design. The Structural Engineering panel member must have performed work in bridge demolition, bridge design and deep foundations design including truck loadings, wind loadings, seismic loadings, and soil loadings. The experience shall include designing bridges in Seismic Zone 3 as defined in the AASHTO LRFD Bridge Design specifications as well as designing prestressed concrete bridges. The member shall also have experience designing bridges in Puerto Rico and be familiar with the “PRHTA Highway Design Manual”.

## 5.5 Documentation of SAR

Documentation of SAR (Type II IEPR) will be managed by an organization that meets the criteria set forth in EC 1165-2-217. DrChecks<sup>sm</sup> review software should be used to document the SAR comments and aid in the preparation of the Review Report.

The SAR panel will prepare a Review Report that will accompany the publication of the final report for the project and shall:

- Disclose the names of the reviewers, their organizational affiliations, and include a short paragraph on both the credentials and relevant experiences of each reviewer;
- Include the charge to the reviewers;
- Describe the nature of their review and their findings and conclusions; and
- Include a verbatim copy of each reviewer’s comments (either with or without specific attributions), or represent the views of the group as a whole, including any disparate and dissenting views;
- Milestone Review Summary report(s) will be provided to the District following each milestone review along with the submission of a single document following the final milestone, which will include all include all previous milestone SAR reviews and summary documents;
- The District Chief of Engineering will submit the panel’s report and the District’s responses to the RMC and MSC Chief of Business Technical Division for final review and concurrence.

Written responses to the SAR Review Report will be prepared to explain the agreement or disagreement with the views expressed in the report, the actions undertaken or to be undertaken in response to the report, and the reasons those actions are believed to satisfy the key concerns stated in the report (if applicable). These comment responses will be provided to the RMO for concurrence. The revised submittal will be provided to the RMO with the USACE response and all other materials related to the review.

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

The SAR's will be performed in accordance with EC 1165-2-217 and as shown in Table 3. The estimated cost for the SARs of this project are in the range of \$120,000 to \$150,000. This estimate will be refined when the Scope of Work for the SAR contract is completed.

Milestone Reviews	SAR Panel	Geotech	H&H	Structural	Civil/Traffic/ Transportation	Site Visit Duration (days)	Review Start Date	Review End Date
Intermediate (60%) P&S and DDR	X	X	X	X	X	1	11/14/2019	11/21/2019
Midpoint of Construction		X		X			TBD	TBD

*Table 3: SAR Schedule with Required Reviewers and Site Visit Duration*

## Section 6

# Public Posting of Review Plan

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As required by EC 1165-2-217, the approved RP will be posted on the District public website (<https://www.saj.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 7

# Review Plan Approval and Updates

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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 2, Table 8 RP Revisions. 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 8

# 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
Conspan by Leap Software	Latest version	
Geomath by Leap Software	Latest version	
STAAD.Pro V8i by Bentley	Latest version	
FB-Multiplier, Bridge Software Institute (BSI)	v2018 or later	
Seisab by Imbsen & Associates	Latest version	
LPILE	v2018 or later	
GROUP	v2018 or later	
PYWall	v2015 or later version	
SHAFT	v2017 or later version	
CWALSHT, COM624G and CWALSSI	Latest version	
GRLWEAP 2010	v2010	
SPT94 Department of Civil Engineering	Latest version	
Sap 2000 by Computers & Structures Inc.	Latest version	
RAM Element 13, RAM Concrete, RAM Steel, RAM Connection by Bentley	Latest version	

*Table 4 Models and Status*

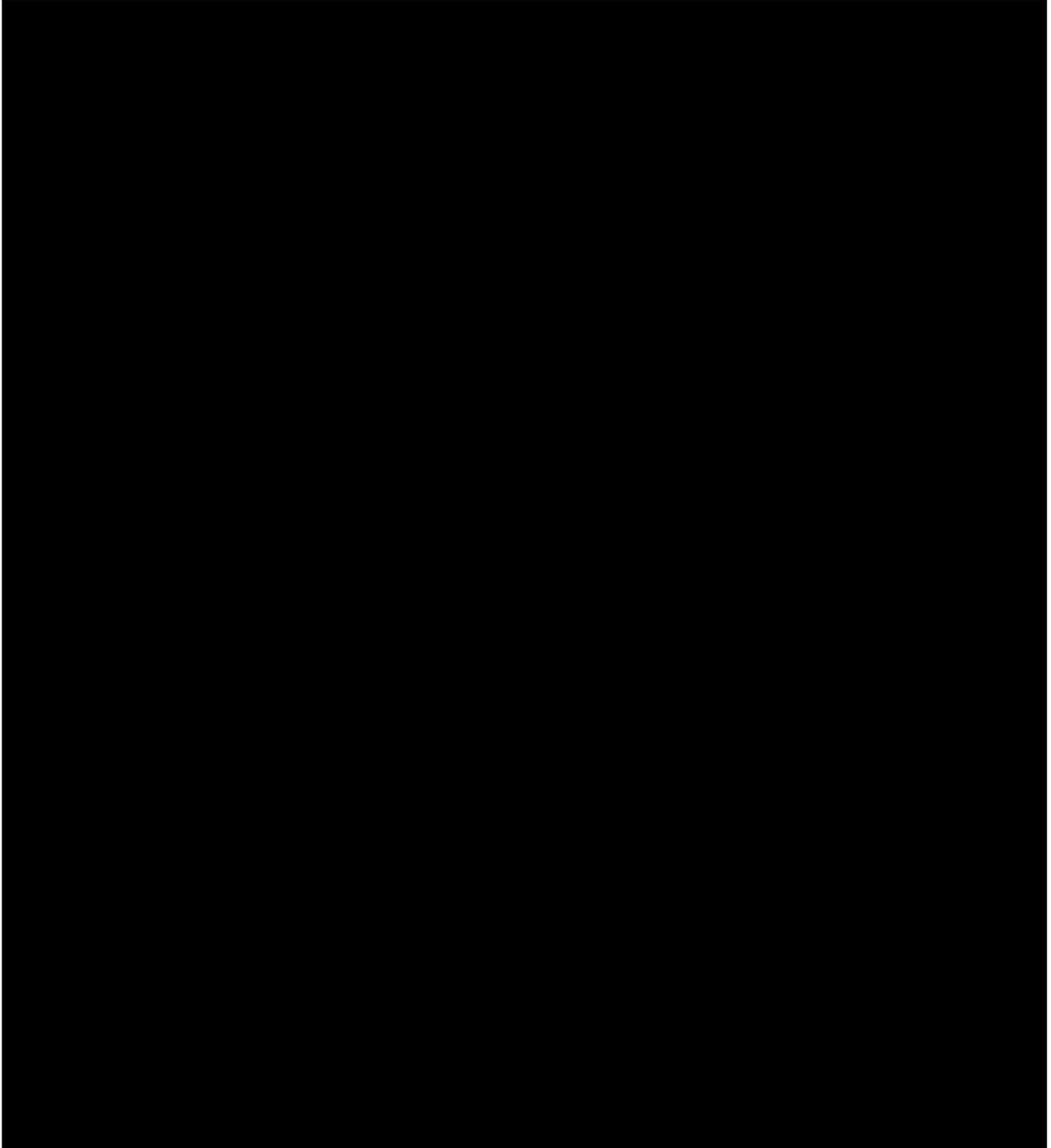
## Section 9

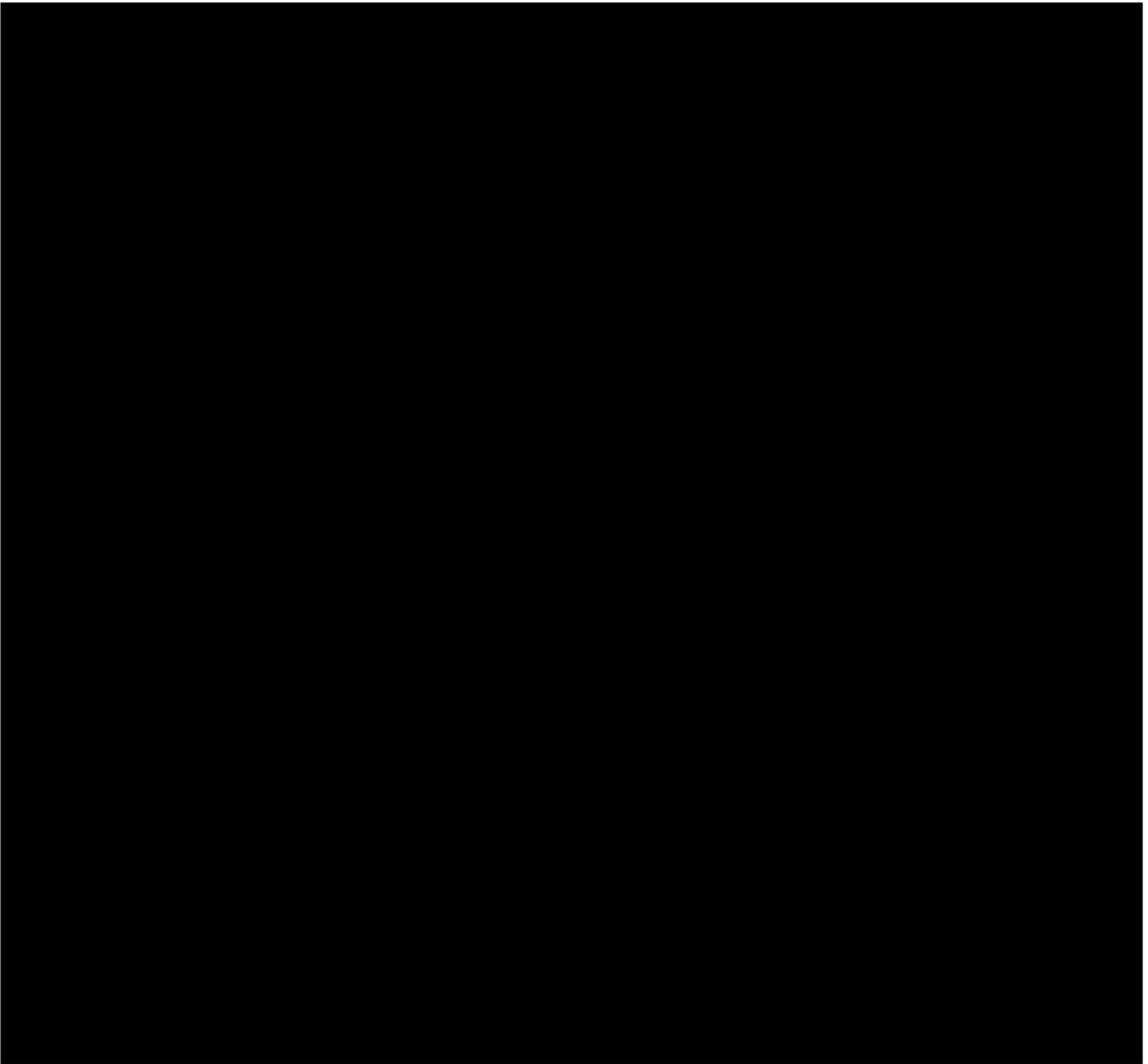
# Review Plan Points of Contact

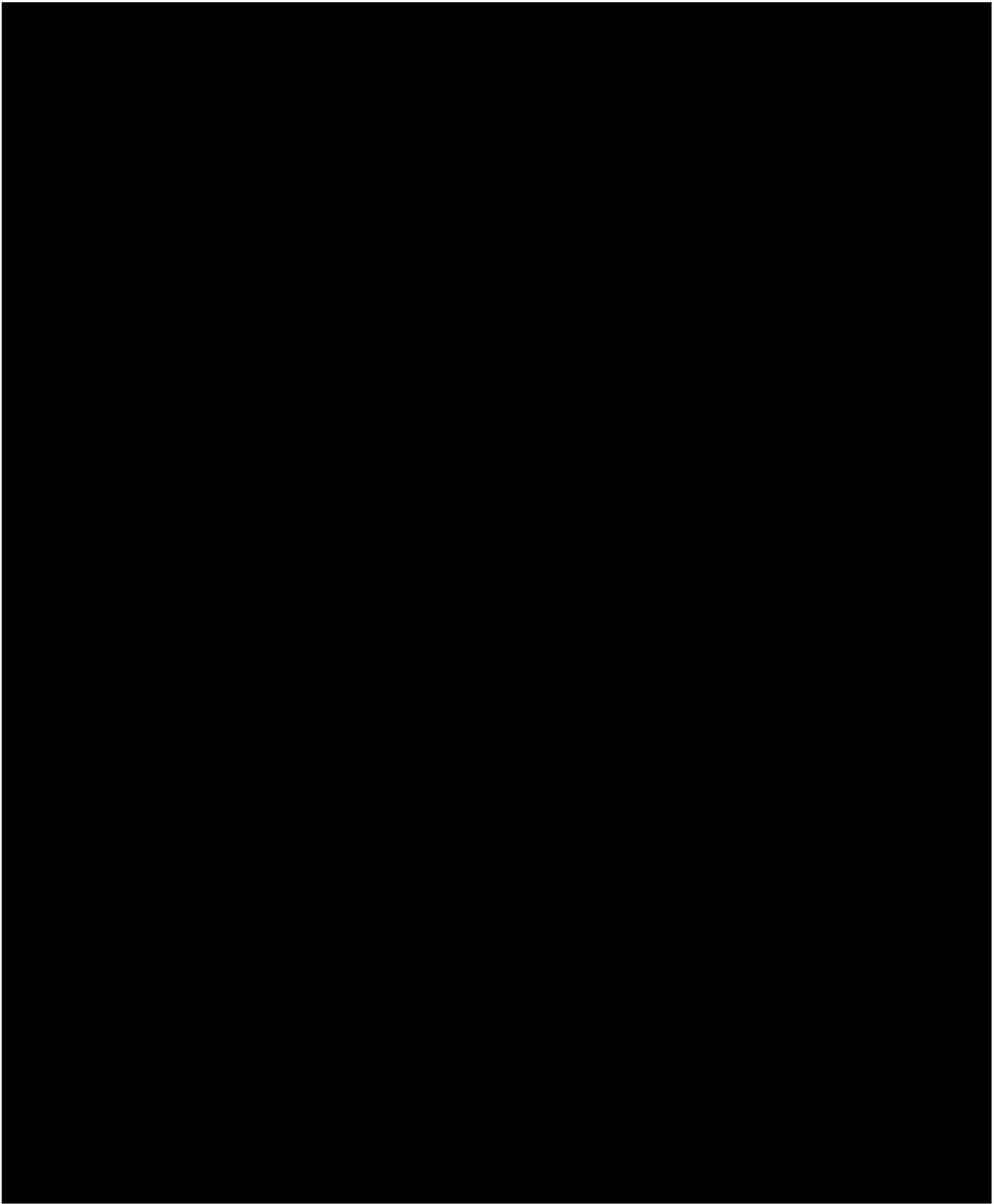
Title	Organization	Phone
Review Manager	CESAJ-EN-Q	[REDACTED]
Senior Reviewer	CEIWR-RMC	[REDACTED]
Quality Manager	CESAD-RBT	[REDACTED]

*Table 5 RP POC's*

## ATTACHMENT 1









## ATTACHMENT 2

# Review Plan Revisions

Revision Date	Description of Change	Page/Paragraph Number
11/01/2019	Remove Electrical Engineering discipline	Section 5.4 Page 9

*Table 9 RP Revisions*

# ATTACHMENT 3

## Design Quality Control Plan

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**US Army Corps  
of Engineers** ®

## **DESIGN QUALITY CONTROL PLAN**

ARCHITECT-ENGINEER SERVICES FOR PLANS, SPECIFICATIONS AND DESIGN  
DOCUMENT REPORT

CONTRACT 2B: Rio Puerto Nuevo Roosevelt Avenue Bridge Replacement / Existing  
Facility Demolition

Rio Puerto Nuevo Project, San Juan, Puerto Rico  
Contract No. W91278-17-D-0018

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June 18, 2019

## DESIGN QUALITY CONTROL PLAN

A-E Miscellaneous Design Services  
Contract No. W912EQ-17-D-00018

Prepared for:

U.S. Army Corps of Engineers

Prepared by:

Arcadis U.S., Inc.

10352 Plaza Americana Drive

Baton Rouge

Louisiana 70816

Tel 225 292 1004

Fax 225 218 9677

Our Ref.:

W9127817.BRDG

Date:

June 18, 2019

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██████████ Project Manager

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██████████ Design Coordinator

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██████████ Quality Control Manager

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Appendix C - Quality Control Review Certificate of  
Compliance

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Appendix F – Government Furnished Information (List)

Appendix G – USACE Engineering Regulations  
Reference

Appendix H – USACE Engineering Manuals (Reference)

Appendix I – Applicable USACE Engineer Technical Letters  
Reference

## 1 INTRODUCTION

This Design Quality Control Plan (DQCP) is developed for the U.S. Army Corps of Engineers (USACE) in response to Contract No. W9127817D0018, A-E Miscellaneous Services to support the District Planning and Design for the Civil Works Program. Arcadis U. S., Inc. (Arcadis), is committed to providing quality engineering services and has adopted a quality management philosophy to ensure that quality processes are successful on every project. The Arcadis quality mission is to facilitate our commitment to quality and client satisfaction by providing high-value systems and tools that: 1) enhance our ability to efficiently deliver accurate, appropriate, and consistent work and work products for our clients; and 2) support our culture of continuous improvement and focus on quality performance.

The purpose of this DQCP is to outline the management of quality procedures and demonstrate those measures that will be undertaken by Arcadis and its subcontractors to provide effective quality control throughout the performance of the contract. The approach to quality management includes documentation control, communications management, design coordination and checking procedures, and managerial continuity as described within this DQCP.

## 2 SCOPE OF WORK

This plan covers any work performed by Arcadis for USACE for the subject contract. This particular scope of work includes, but is not limited to engineering design and preparation of Plans and Specifications for support for preparation of design reports, condition assessment of existing utilities, value engineering, preparation of conceptual and contract drawings, computer aided drafting, cost estimating, preparation of contract specifications and performing design analyses. Work shall be accomplished in English and/or metric units as directed. Professional design experience in civil, structural, geotechnical, hydraulic, hydrologic, sanitary, mechanical and electrical engineering and surveying and mapping, CAD, architecture, and cost estimating is required. Capability and experience is required for design of floodwall projects including channels, levees, weirs, grade control structures, drainage structures (pipes and culverts), gated structures, and pump stations; and other projects including channel stabilization, site development, condition assessment of existing utilities, multipurpose buildings and recreational facilities.

This task order (SOW) is for the preparation of the Construction Plans and Specifications, Design Document Report, design calculations, and other supporting documentation for the design and the preparation of the Construction Plans and Specifications, for this project, Rio Puerto Nuevo Roosevelt Avenue Bridge Replacement / Existing Facility Demolition, Contract 2B. This SOW is for a segment of the Rio Puerto Nuevo Channel for the Channel Wall System from STA 118+50 to STA 121+00. The Channel Bottom System shall be from STA 118+50 to STA 121+00. The Channel Wall System shall tie-in to the Channel Wall System designed under Task Order / Contract 2D: Channel Walls at STA 118+50 and 121+00.

This task order also includes the replacement of the existing bridge with a new bridge approximately 191 feet long with two equal spans at a skew angle of approximately 15 degrees. The replacement bridge shall have three lanes in each direction, raised sidewalks on each side, and a raised, closed median. A temporary bridge, detour and maintenance of traffic are expected to be required. Utility relocation will be required as part of the project.

Reference the General Design Memorandum (GDM) in the Appendix F, Government Furnished Information (GFI). A map of the project is shown below in Figure 1.



Figure 1

### 3 ASSIGNMENT OF PERSONNEL

Arcadis requires that appropriately qualified and experienced personnel be utilized to perform tasks and Quality Control (QC) activities. The primary positions responsible for a quality design are the Project Delivery Team (PDT), which is comprised of the Program/Project Manager, Task Managers, Project Engineers/Scientists and Technical Support Staff. These individuals will work with the ARCADIS Quality Control Manager (QCM), to utilize the Responsible Quality Control Reviewer (RQC) for each specific engineering discipline. Day-to-day responsibility for the implementation of the project's quality program falls on the QCM. The QCM will be responsible for the following:

- Ensure that a quality system is established, implemented, and maintained

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- Report on the performance of the quality system for review and as a basis for improvement of the quality system in the form of a monthly report
- Perform QC on quality records including comment resolution and incorporation
- Identify and provide written Non-Conformance Reports for deviations from design requirements or authority standards for approval by the Engineer
- Identify and report non-conformities/non-compliance
- Track, monitor, and report on status of outstanding design-related non-conformance reports
- Submit specified certificates (permanent components and temporary components)

The QCM will provide a monthly quality certificate certifying that, for the previous month, all work has been checked and/or inspected and conforms to the requirements of the contract and that the DQCP is functioning properly and is being followed. The QCM will coordinate with the Responsible Quality Control Review Team (RQCRT) members and provide technical oversight and support in the assessment and evaluation of each deliverable. In general, Arcadis staff will be assigned based on their technical competency in the relevant discipline(s), with the most experienced assigned as QC leads responsible for all planning and staff QC activities.

## 4 PROJECT DELIVERY TEAM

The Project Delivery Team (PDT) is composed of members from the major functional areas (USACE and/or Arcadis) that have input into development of the deliverable for the assigned task. The key members of the PDT are:

- Project Manager (PM)
- Design Coordinator (DC)
- Quality Control Manager (QCM)
- Discipline/Technical Leads (DL)

The Project Manager will develop and coordinate all meetings, records, and communications with USACE. Essentially, the project manager is accountable for all aspects of the project including;

1. **Planning, Executing, and Closing Projects** — defining the project, building its comprehensive work plan, and managing the PDT.
2. **Managing Discipline Teams** — facilitating commitment and productivity, removing obstacles, and motivating team members
3. **Communication** — aligning projects to goals, managing stakeholders, and communicating project status, milestones, and unexpected difficulties effectively.

The Design Coordinator's responsibilities will include assessment and evaluation of the following:

- Design reports

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- Analytical approach
- Drawing details for conformity with contract requirements
- Project specifications for conformity with contract requirements
- Design and construction submittals
- Design changes

The PDT assesses the quality control procedures to determine that the performance and contractual requirements are met and integrated into deliverables. This DQCP has been prepared to outline the specific QC procedures that are tailored for the RPN 2B SOW. Roles of key PDT members are indicated in the following chart 1:

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PDT and QC Roles			
Who	What	When	Deliverable
Project Manager	Prepare a comprehensive, task order specific, DQCP as a part of the overall work plan.	Before work begins.	Task Order specific DQCP.
Design Coordinator	Check specific technical discipline areas for accuracy; calculations, designs, plans, and reports – as per appropriate criteria.	Ongoing.	Checked deliverables, prints, reports, etc. (reviewed, corrected, and forwarded for outside review .
Quality Control Review Team	Check technical discipline area for accuracy, calculations, designs, plans, and reports – as per appropriate criteria.	Before submittals and project milestones	Checked deliverables, prints, reports, etc. (reviewed, corrected).
Project Manager Quality Control Manager	Confirms that project conforms to the DQCP.	Before submittals.	Checked deliverables, prints, reports, etc. (reviewed and corrected).
Project Manager	Submittal to USACE.	After QC is complete.	Deliverables/Plans/Specs/Calcs/Reports
Quality Control			
Who	What	When	Deliverable
Quality Control Manager	Monitor QC management, Assign Responsible Quality Control Review (RQC), ensure the DQCP and task-specific checklists are implemented.	Project milestones, Project deliverables and throughout the Project.	Guidance to project delivery team and written report to the Project Management and Senior ARCADIS Management.

**Chart 1.**

The major design discipline Responsible Engineer(s) RE and subsequent Responsible Quality Control (RQC) reviewer(s) responsible for the deliverables are shown below in Table 2. These RQC individuals are responsible for the quality of the task managers' deliverables. QC by these individuals will be a continuous and ongoing process. They will work under the direction of the ARCADIS Project Manager and Quality Control Manager (QCM), and in association with the ARCADIS leaders for Sub Tasks of Design and Quality

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Control. In addition, Responsible Engineers have been selected for each design unit based on specific experience, and are assigned as follows

Role	Person Responsible
Project Manager (PM)	[REDACTED]
Design Coordinator (DC)	[REDACTED]
Quality Control Manager (QCM)	[REDACTED]

Table 1

## 5 PROJECT PLANNING AND MONITORING

For each deliverable, the QCM will develop a quality checklist based on guidance from the USACE manuals, GFI's and guidance documents that will indicate the QC activities to be performed during preparation of each deliverable the personnel assigned to each activity, and target dates. Development of the checklist helps ensure that each of the QC activities is performed and sufficient time is scheduled to allow the activity to take place. It also documents when each activity is completed and by whom.

All engineering submittals, including memoranda, reports and studies, shall undergo quality management reviews in accordance with this documented DQCP. A signed Quality Certificate of Compliance (see Appendix C) shall be submitted for each engineering submittal that confirms that the Responsible Engineer (RE) has performed all internal QC activities in accordance with this DQCP and the Responsible Quality Control (RQC) reviewers will verify that the contents of the submittal are complete and meet the requirements of USACE Guidelines, References and Manuals, (see Appendix G-I) specified Design Standards and directed within the Contracted Statement of Work.

At each design submittal discussed in this section, reviews of the submittal and design results will be conducted. These reviews will include representatives of all functions concerned with the design stage being reviewed as well as other specialist personnel, as required. Each deliverable will be reviewed by a qualified individual not involved in the development of the design to ensure an unbiased look at the work output to verify that the contract requirements are being fully met. These reviews will include consideration of the design's constructability, usability, reliability, maintainability, availability, and operability in addition to safety, cost, project overall schedule and aesthetics.

Responsible Quality Control Review Team (RQCRT) members will conduct QC reviews according to the schedule below and as provided in Appendix E.

- The PM and the QCM will assemble a Responsible Quality Control Review Team (RQCRT).
- Responsible Quality Control (RQC) reviewers will be senior technical staff, qualified to

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review the assigned work product, in addition to meeting the USACE Design Standards and Design Guidelines. (See Appendix G)

- Responsible Quality Control (RQC) reviewers are typically, a department manager or other senior technical staff, with project management experience.
- Responsible Quality Control (RQC) reviewers shall be registered professionals as appropriate for the assigned work product being reviewed.

Each design phase and each deliverable, will conclude with an independent quality control review. The primary objectives of the quality control review are to confirm that:

- The engineering concepts are valid.
- The recommended plan is feasible, safe, and functional.
- A reasonable opinion of probable construction cost has been developed.
- The approach to the engineering analysis is correct.
- The submittal complies with engineering policy requirements.
- The submittal complies with accepted engineering practice within USACE.
- The submittal complies with all applicable codes.
- The quality control review will provide formal review of the Survey, Geotechnical Report, Hydrology and Hydraulics Report, Preliminary Design, Intermediate Plans and Specifications, and the Final Plans and Specifications, and/or any other technical submittals utilizing Dr Checks, if desired by the USACE.
- The review will include an evaluation of the level of completion for the respective submittal according to the Scope of Work (SOW) and additional Technical Instructions (Appendix A of the SOW), Submittal Instructions Appendix B of the SOW), Minimum Drawing List Appendix C of the SOW), and the Minimum Calculations List (Appendix D of the SOW), These requirements are outlined in Appendix D: SOW of this DQCP.
- Current design standards used by Puerto Rico Highway and Transportation Authority (PRHTA), Puerto Rico Electric Power Authority (PREPA), Puerto Rico Aqueduct and Sewer Authority (PRASA), and Puerto Rico telecommunication companies including but not limited to Claro, AT T, and Cable TV) are required in preparation of utility relocation designs. These standards and requirements apply to the temporary and final utility relocations.
- All submittals shall be subjected to a Quality Control Review by A-E (QCR) (as depicted in this DQMP), Quality Assurance Review by USACE (QAR), Agency Technical Review by USACE (ATR), and Biddability, Constructability, Operability, Environmental and Sustainability Review by USACE (BCOES), Office of Counsel Legal Sufficiency, Sponsor reviews such as: Department of Environmental and Natural Resources (DNER), Puerto Rico Electric Power Authority (PREPA), Puerto Rico Aqueduct and Sewer Authority (PRASA), and telecommunication companies in Puerto Rico including but not limited to Claro, AT&T, and Cable TV and reviews from any other various stakeholders that may also be provided the opportunity to review and provide technical comments in Dr Checks.

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Responsible Quality Control (RQC) Team Support Reviewers for this project is as follows;

Preliminary, Intermediate, Final and Corrected Final Design Submittals	Responsible Engineer (RE)	Responsible Quality Control Review Support Team RQCRT Members
Team Leader	[REDACTED]	[REDACTED]
Surveying	[REDACTED]	[REDACTED]
Geotechnical Investigation	[REDACTED]	[REDACTED]
Geotechnical Engineering	[REDACTED]	[REDACTED]
Hydrologic and Hydraulic (H&H) Modelling	[REDACTED]	[REDACTED]
Water/Sewer Engineering	[REDACTED]	[REDACTED]
Civil / Site Engineering	[REDACTED]	[REDACTED]
Structural Engineering	[REDACTED]	[REDACTED]
Electrical Engineering	[REDACTED]	[REDACTED]
Construction Estimating and Scheduling	[REDACTED]	[REDACTED]
Value Engineering Report	[REDACTED]	[REDACTED]

**Table 2**

Quality Control reviews will be conducted by independent, technically qualified staff not involved with the project design, value engineering or work effort for each of the Project Deliverables as listed in Table 3 with the QC leads and dates of review.

Responsible Quality Control (RQC) Team Lead Reviewers with Review dates and submittal for this project is as follows;

DESIGN QUALITY CONTROL PLAN

Deliverable	Responsible Engineer (RE)	Responsible Quality Control (RCQ)	QCR Dates	USACE Submittal Due Date
6.4 Final Additional Geotechnical Investigation Report			7-5-2019 – 7-8-2019	7-12-2019
6.1 / 6.2 / 7.1 Draft Preliminary 30% P&S / DDR / CWE / Scour Analysis / Traffic St			7-5-2019 – 7-10-2019	7-12-2019
6.7 Draft VE Work Plan			7-8-2019 – 7-10-2019	7-10-2019
6.8 Final VE Work Plan			7-30-2019 – 7-31-2019	8-1-2019
6.1 / 6.2 / 7.1 Draft Intermediate 60% P&S / DDR / PT C			10-9-2019 – 10-21-2019	10-22-2019
7.3 Pre-Final 100% P&S / DDR / ECIR			4-20-2020 – 5-5-2020	5-6-2020
7.4 Final 100% P&S / DDR / ECIR			9-14-2020 – 9-18-2020	9-21-2020
7.5 Corrected Final			9-27-20 – 9-28-2019	9-29-2020
7.7 Conformed Submittal			9-28-2020 – 10-23-2020	12-26-2020

Table 3

During the stages of design, (Preliminary, Intermediate, Final and Corrected Final) The Responsible Quality Control (RQC) Reviewers for this project will also be supported by additional Responsible Quality Control Review Team (RQCRT) members as a resource and as necessary to complete the QC review for each discipline of the project and as stated below. Coordination between the RQC's and any additional team members listed below will be utilized by the QCM and the PM.

Deliverables, responsible engineers for the deliverables, and deliverable completion dates for this project will be tracked on a design unit and subsequent task basis. These individuals are responsible for the quality of their deliverables. QC by these individuals is on a continuous, ongoing basis.

The responsible engineers will check designs and documents produced by the team applicable to their design discipline. Prior to each Design Review submittal, the QCM and PM shall certify that these documents conform to the contract requirements and have been checked in accordance with this plan.

## 6 QUALITY CONTROL PROCEDURES

Quality control activities for tasks associated with this SOW will be performed under the guidance of the overarching Arcadis Quality Management System (QMS) and any USACE program and task-specific QCPs, except where superseded by USACE requirements. These activities will assist Arcadis in providing quality deliverables aligned with the Government's needs and task order requirements which will, in turn, help ensure effective execution of the construction phases. QC activities will focus on assignment of appropriately qualified and experienced personnel, adequate project planning and monitoring, review and checking of work, and use of appropriate design tools. Procedures for controlling investigation or study activities will also be implemented to ensure efficiency, cost effectiveness, coordination with task objectives, and reliability of data collected, preservation of worker safety, and proper recording and reporting formats.

### 6.1 Work Product Control

The QCM will review the technical requirements for each task order and, with key discipline leads, develop the basis for specific quality control requirements. The QCM will also provide an overview of the scope of work and identify applicable regulatory requirements and design criteria needed during the design process. This process is provided within this DQCP and the requirements and criteria will essentially control and guide the production of the work.

### 6.2 Tools

In addition to relying on the technical competence of the engineering staff and reviewers, use of appropriate tools helps ensure quality in the final deliverable. Tools of potential use on task orders include:

#### 6.2.1 Computer Aided Design and Drafting (CADD)

The application of CADD and related technology can affect every phase of the design process positively. Use of this technology allows improved productivity, clearer drawings, integration of automated design features, and reduced cost and schedules. CADD also allows various design teams and subcontractors to integrate their drawings seamlessly. MicroStation will be used as the CADD platform.

#### 6.2.2 Geographical Information System (GIS)

The application of GIS and related technology can affect each deliverable positively. Use of this technology allows improved productivity and efficiently store and recover important data elements. GIS allows various technical teams and subcontractors to access and utilize relevant data easily. ArcGIS will be used as the GIS platform.

#### 6.2.3 Design Standards

The use of USACE engineer manuals, engineer regulations, engineer instructions, and other appropriate guidance documents shall govern the design approach and standards used for the task order. The objective is to provide a mechanism that facilitates engineering design in the most productive manner, enhance the quality and clarity of any design drawings, provide for uniformity of design drawings, permit interoffice coordination and rapid transfer of documents, and facilitate quality control and QA reviews. Specifically,

technical specifications and general requirements for the performance of the various engineering services required under this SOW. The Arcadis team shall perform tasks in accordance with these requirements. It is expected that the standards will be used by experienced designers and CADD technicians to incorporate their experience in generating engineering drawings in the most productive manner, but not to substitute for both the skill and experience of the designer/technician or the technical judgment of the design engineer.

### 6.3 Work Product Output

Each work product deliverables that may include studies, feasibility study reports, analyses, calculations, drawings, designs, field investigation reports, and cost estimates, etc. will undergo the a QCR. The format of these documents must be in strict accordance with the requirements specified in the task order. Verification of work product deliverables shall occur at any project stage that results in a submittal to the Government such as the draft, draft final stages, and at any interim submittal stage that is specifically required in the task order.

### 6.4 Reviewing and Checking of Work

During the execution of a deliverable, a number of review activities shall be performed at designated stages of the deliverable process defined in SOW. Many of these activities can be combined; however, it is critical that personnel cannot solely review their own work. Documentation of the activities will be made on the deliverable quality checklist with detailed comments for each deliverable (see Appendix A).

#### 6.4.1 Document Checking

Checking must be provided for all technical accuracy and correctness, verify any calculations, review drawings/specifications. The checking will address both “method” and “calculations.” This checking will be conducted by independent qualified personnel in the same discipline who was not involved in the preparation of the original documents. This “checker” will be assigned by and be under the direction of the discipline lead for that particular discipline. The general procedures for checking major work elements associated with the task order shall be as follows:

- Ongoing and at completion: Responsible staff checks their work for errors and omissions throughout the project and at substantial completion.
- Checking: QC reviewers check all work. Make revisions in red.
- Concurrence: Responsible staff back-check comments for concurrence.
- Incorporation: Incorporate revisions.
- Verification: QCM will oversee verification and the incorporation of revisions, as appropriate.
- Completed checklists: Completed quality checklists will be maintained by the Task Order Managers. Task Order Managers will maintain copies of checklists with the corresponding sets of marked-up plans for future reference if necessary.

### **6.4.2 Design Technical Reviews**

Design reviews will be conducted as scheduled in this DQCP and/or as needed throughout the design phase of the project. These reviews will be conducted by the project and discipline leads to ensure that the quality of the design project is being met in accordance with the scope of work and proposal and/or contract for this particular project. Corrective actions will be defined and documented. Appropriate follow-up actions will be scheduled by the QCM and documented by assigned personnel when complete.

### **6.4.3 Value Engineering Report**

A Value Engineering Report is included as part of this SOW. A formal value engineering study; a general review of the project to ensure that the client will receive a workable and cost-effective product will be conducted. See Appendix D SOW Section 6.7 Value Engineering Study Workshop.

The A-E shall submit the resume of the Value Engineering Facilitator. The VE Facilitator shall have 10 or more years of experience conducting VE workshops and preparing VE Reports and shall also be a Certified Value Specialist (CVS) certification through SAVE International.

The A-E shall submit the resume for the following VE team members: Civil Engineer, Geotechnical Engineer, Cost Engineer, Structural Engineer, and Hydrologic and Hydraulic Engineer. Each VE team members shall have 10 or more years of experience in their respective discipline of expertise.

### **6.4.4 Coordination and Interference Review**

Review of all documents is conducted to ensure compliance with task order requirements and the proper integration and lack of any interferences or conflicts between the various disciplines. This review is performed by the QCM with the PM after all disciplines for the submittal have been reviewed.

### **6.4.5 Strategic Review**

Meetings may be held to review process data, review methodologies, review assumptions, identify any “fatal flaws” and other potential problems, discuss unusual liabilities, discuss the implementation of this project relative to lessons learned from the implementation of other similar projects, discuss situations peculiar to the site, and/or analyze any other unusual situations or potential problems relative to the project. The strategic review meetings would be scheduled at any point in the implementation of the project as appropriate for the intent of that particular meeting.

## **6.5 Independent Technical Review**

An Independent Technical Review (ITR) of all documents will be conducted prior to each submittal to the USACE and throughout the development of the documents, as specified in the SOW. The PDT will rely on the ITR in producing the submittals. ITR is a part of the project design process and is separate and independent of the QC Review.

The ITR is a critical review and evaluation of documents, material or data that require interpretation or opinions to verify or validate assumptions, plans, results or conclusions. They also serve to verify that the completed work meets the requirements of the task order. The ITR will generally come from senior

professionals of the technical areas. The team members are independent of and have no vested interest in the activities.

### **6.5.1 ITR Procedure**

The PM and DC are responsible for scheduling the ITR which must be scheduled to coincide with specific task order milestones. The review process shall include the deliverables specified in the SOW. These reviews are used as a Design Technical Review tool to assess the following:

- Consistency with deliverable requirements, acceptance standard, applicable laws and regulations, USACE requirements and compliance with the USACE safety manual (EM 385-1-1).
- Reliability of the technical approach and compliance with USACE criteria. Deviations from standards should be clearly documented and technically supported.
- Conformity with professional standards.
- Substantial changes in the scope of the project.
- Coordination between technical disciplines.
- Initial project directives and specific instructions from the USACE and/or technical manager verified for compliance.
- Validation of assumptions, data, calculations, methods or conclusions and identification of errors or omissions in the deliverable documentation.
- Confirmation that the deliverable is properly organized.
- Validation that the final deliverable meets the requirements of the task order.

### **6.5.2 ITR Documentation**

Documentation of the ITR shall be provided to the QCM by the DC and PM. Documents that have been marked up as part of the ITR shall be initialed by the ITR review team member(s), scanned and retained. The documentation should be retained in the project ITR file and a copy distributed to the PM and QCM.

## **7 MEETINGS AND CONFERENCE CALLS**

### **7.1 Meetings**

Quality control meetings will typically be multi-site meetings linked via telephone and Internet. Meeting minutes will be recorded by the PM or his or her designee, and action items listed and tracked to completion.

### **7.2 Conference Calls**

As needed, progress conference calls will be conducted during the progress of the work. The USACE can be furnished with minutes documenting the items discussed during the conference calls, as appropriate.

## 8 QUALITY INDICATORS

### 8.1 Schedule

Project milestones (See Appendix E) are a critical quality indicator's for this work. Arcadis has dedicated senior-level management and technical staff to this work to ensure that the project deadlines are met. Where appropriate, a time-scale bar chart and/or critical path analysis with key milestones will be prepared for task orders. Major milestones shall be shown to include QCR, in-progress reviews, and other major QC milestones.

### 8.2 Technical Quality, Non-Conformance Work Product

Any departure from quality standards can be discovered during technical reviews, supervision of field tests or inspection completed work or materials will be immediately investigated and appropriate corrective action implemented. Any events of nonconformance must be thoroughly examined and assessed as to the degree of severity of the non-conforming work. Once an assessment has been made, corrective actions will be taken.

Corrective or preventive action measures shall be evaluated, selected and implemented to prevent or reduce the likelihood of future occurrences. These measures must be thorough and will seek to determine the root cause of nonconforming work. Preventative actions should be tailored for each situation, depending on the severity of the nonconformance, and shall be structured to allow for implementation given the available resources. Preventative actions may include job- specific training, bulletins, or guidance documents that are required to effectively implement remedial action.

## 9 QUALITY CONTROL AUDITS

Periodic audits are necessary to ensure that established QC programs are working and that QCR procedures are adequately followed and documented. Audits will be conducted at the direction of the QCM, PM, DC or Program Manager and should be led or conducted by staff with the requisite technical experience for the project being audited. The size and complexity of the project will normally dictate the size of the audit team. The quality assurance audit process will confirm that the project:

- complies with USACE policies and guidelines,
- complies with applicable laws and regulations,
- is within scope and budget,
- meets the programmatic requirements of the USACE,
- is appropriate for the location, and
- complies with health, safety, and functional requirements.

Audit findings shall be properly documented in an audit report. The primary purpose of the audit report will be to identify any variance to the procedures established in this DQCP and any resulting non-conformances found in the work product. Audit reports shall document the scope of the audit, the final results and an evaluation as to the overall effectiveness of the quality program. The report should provide sufficient detail of the findings and recommendations so that remedial measures can be easily implemented. The QCM will

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evaluate the audit report and provide an appropriate response, including a description of any corrective action implemented as a result of the audit findings. As required, follow-up reviews will be conducted by the QCM to evaluate the adequacy of the response and to verify that corrective/preventive action has been implemented, monitored and remedial measures accomplished.

### 10 ELECTRONIC REVIEWS

All QC reviews in consultation with USACE will be performed using an electronic review system as designated. The Arcadis Team plans to utilize the Corps electronic system, Dr. Checks, for managing comments from all scheduled reviews with USACE. An electronic review may involve entering comments, responding to comments, and explaining concurrence or non-concurrence with individual comments.

### 11 LESSONS LEARNED REVIEW

A “lessons learned” review may be conducted upon the completion of a deliverable or at task order completion by the engineering design team. The intent of the meeting would be to review circumstances that developed during a particular project in order to improve performance and reduce the cost of quality on future projects of a similar nature. The following is a partial list of items which can lead to disputes and costly modifications.

- Failure to coordinate documents prior to submittal,
- Failure to comply with USACE engineer manuals and engineer regulations, and
- Failure to comply with applicable laws and regulations.

### 12 PRELIMINARY 30% DESIGN SUBMITTAL

The Preliminary Design should represent approximately a 30% project completion level. The purpose of the Preliminary Design Submittal is to:

- Ensure that the project is designed in accordance with the USACE Engineering Design Guidelines (See Appendices G-I) and meets the final goals and objectives specified for the project. It is the Design Engineer’s responsibility to evaluate all options for meeting the project’s goals and objectives, when necessary, perform a specific cost analysis for each design component option, and provide a recommendation of the best, most effective option for meeting the goals and objectives
- Provide the independent technical review with information and design details necessary to evaluate the proposed project design from a technical perspective
- Provide the USACE Project Manager, Engineering Technical Lead and Project Sponsor with sufficient detail such that the design can be “locked” in place and no additional project conceptual decisions or assumptions are required
- Ensure design concepts are consistent with the Contract requirements Design concepts are substantiated and justified by adequate site investigation and analysis.

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- Ensure that the proposed design concepts are constructible and are compatible with the available materials and equipment
- Design meets project quality requirements and required design QCR procedures have been followed

Prior to 30% Design submittals, the PM and QCM will check all designs and documents produced by the design team. They will certify that the documents conform to the contract requirements and have been checked in accordance with this plan. The PM and QCM will both sign the title sheet of the submittal, certifying the items listed in Section 10 and Appendix A: Preliminary Design Submittal Checklist.

### 13 VALUE ENGINEERING STUDY

The Value Engineering study is described in 6.4.3 of this document.

### 14 INTERMEDIATE 60% DESIGN SUBMITTAL

The Intermediate Design Submittal includes the design stage(s) leading up to Final Design, review of which will ensure that the concepts and parameters established and represented by the Preliminary Design Submittal are being followed and that contract requirements continue to be met. The Intermediate Design Submittal should represent approximately a 60% project completion level.

Prior to the Intermediate Design submittal, the PM and QCM will check all designs and documents produced by the design team. They will certify that the documents conform to the contract requirements and have been checked in accordance with this plan. The PM and QCM will both sign the title sheet of the submittal, certifying the items listed in Section 10 and Appendix A: Intermediate Design Submittal Checklist.

### 15 PRE-FINAL 100% DESIGN SUBMITTAL

Leading up to the final stage of design is Pre-Final Design Submittal, review of which will ensure that concepts and parameters established and represented in Preliminary and Intermediate Designs are being followed, Engineer's review comments have been addressed, and that contract requirements continue to be met. The team will highlight, check, and bring to the attention of the Engineer any changes to information presented in the Intermediate Design Submittal. The Final Design Submittal should represent approximately a 100% project completion level.

Prior to the Final Design submittal, the PM and QCM will check all designs and documents produced by the design team. They will certify that the documents conform to the contract requirements and have been checked in accordance with this plan. The PM and QCM will both sign the title sheet of the submittal, certifying the items listed in Section 10 and Appendix A: Final Design Submittal Checklist.

## 16 FINAL DESIGN SUBMITTAL

Leading up to the final stage of design is Final Design Submittal, review of which will ensure that concepts and parameters established and represented in Preliminary, Intermediate and Pre-Final Designs are being followed, Engineer's review comments have been addressed, and that contract requirements continue to be met. The team will highlight, check, and bring to the attention of the Engineer any changes to information presented in the Pre-Final Design Submittal. The Final Design Submittal should represent approximately a 100% project completion level.

## 17 CORRECTED FINAL SUBMITTAL

The Corrected Final Submittal is the final stage of the design process, review of which will ensure that all concepts and parameters established and represented in complete accuracy and technical review comments have been resolved and closed out.

Prior to the Corrected Final submittal, the Project Manager and QCM will check all designs and documents produced by the design team. They will certify that the documents conform to the contract requirements and have been checked in accordance with this plan. The PM and QCM will both sign the title sheet of the submittal, certifying all checklist in Appendix A have been completed.

## 18 PLANS CHECKING PROCEDURES

The general procedure for checking the work on this project is as follows:

Ongoing and at completion: Prior to providing for QC review, responsible design team staff members check work for errors and omissions throughout the project and at substantial completion.

Checking: QC reviewers (team or peer) check all work. Make comments and mark required revisions in red.

Concurrence: Responsible design team staff review and resolve QC comments for concurrence.

Incorporation: Responsible design team staff incorporate review comments and revisions and highlight each completed comment/revision on checkplans/documents with yellow highlighter as it is made.

Approval: QC reviewers (team or peer) verify incorporation of comments/revisions, as appropriate and highlight each closed comment/revision with a contrasting color highlighter as it is verified.

## 19 FINAL DESIGN REVIEWS

The Project Manager and Design Coordinator will certify that all Final Design document reviews satisfy the following requirements:

## DESIGN QUALITY CONTROL PLAN

- Design Checks have been completed
- Work conforms to the contract requirements
- Any deviations or design exceptions have been approved in writing by the applicable responsible Engineer
- Design QA/QC activities are following this Design Quality Control Plan
- All outstanding issues and written comments from Design Reviews have been resolved
- Designs of project elements or components have been sufficiently developed or completed to the extent necessary for the Final Design to be satisfactory and in conformance with the contract requirements.

## 20 DESIGN REVIEW REQUIREMENTS

The Project Manager will certify that all design reviews conducted both by the design team and by peer reviewers satisfy the following requirements:

- Accuracy
- Adequacy
- Conformance with the contract requirements
- Conformance to District standards
- Compliance with codes and standards
- Cost effectiveness
- Durability
- Life Cycle requirements (as applicable)
- Warranty requirements (as applicable)

## 21 DOCUMENT CONTROL PROCEDURE

Controlled Documents- Controlled documents include officially issued design deliverable documents that have been formally submitted to the District.

Uncontrolled Documents- Uncontrolled documents include all other shared documents including but not limited to progress updates and other documents shared for the purposes of collaboration and sharing of information.

## 22 ISSUING AND APPROVAL OF DOCUMENTS

Documents will be issued through the Project SharePoint site, email, web transfers, or ftp posting of documents. A dedicated library for "Issued Documents" will be the official repository. Only the Project Manager will have write permissions for this library; all others will be restricted to read- only. The Document Control Manager (or duly authorized delegee) will post documents for issue either manually or will approve an automated SharePoint workflow based on the following approval chain.

Posting to Issued Documents library will require approval actions in the following order:

1. Responsible Engineer/Architect– Quality Control Check Document is Ready for Issue)
2. QCM – Quality Control Manager (Quality Process has been followed)
3. PM – Scope Validation (Document meets Scope and is Approved for Release)

## 22.1 Control of Revisions and Obsolete Documents

Issued documents requiring revision will require re-issue through the process described above.

Upon re-issue, the previously issued and superseded document will be removed from the “Issued Documents” area of the SharePoint site and moved to a separate dedicated library for “Superseded Documents.” The “Superseded Documents” will only be used for previously issued documents that have been superseded. Only the Project Manager or duly authorized delegee) will have write permissions for this library; all others will be restricted to read-only. The Document Control Manager will archive superseded documents either manually or will approve an automated SharePoint workflow triggered by a re-issuance action.

Issued original documents and all re-issued revisions will bear a unique document number and revision date. Superseded documents will bear a note indicating a superseded status and the date of obsolescence.

## 23 QA/QC ACKNOWLEDGEMENT FORM

The ARCADIS “QA/QC Acknowledgement Form” is included in Appendix B and an example signed Quality Certificate of Compliance is included in Appendix C.

Arcadis U.S., Inc.

10352 Plaza Americana Drive

Baton Rouge, Louisiana 70816

Tel 225 292 1004

Fax 225 218 9677

[www.arcadis.com](http://www.arcadis.com)

A decorative graphic consisting of three thin orange lines. One is a horizontal line extending across the width of the page. Two others are parallel diagonal lines extending from the bottom left towards the top right.