LAKE HOUSTON DAM – PHASE 1
SPILLWAY IMPROVEMENT PROJECT

COASTAL WATER AUTHORITY: Scope of Work

1 APRIL 2020

Black & Veatch
# Table of Contents

**Project Description** ................................................................. 1

**Phase 1 – Preliminary Engineering** ........................................ 2

Task Descriptions .................................................................................. 2
Task 1 – Project Management ............................................................... 2
Task 2 – Hydrology & Hydraulics ............................................................ 6
Task 3 – Permitting ................................................................................ 9
Task 4 – Field Investigation ................................................................. 17
Task 5 – Preliminary Engineering .......................................................... 22
SCOPE OF WORK (APR 1, 2020)

Project Description

The purpose of the Lake Houston Spillway Improvement Project (LHSIP) is to advance the 2017 Freese & Nichols alternatives analysis to relieve upstream flooding by increased discharge capacity to Lake Houston Dam. The project is intended to incorporate additional hydraulic structures into the facility that provide for preemptive release of water from the reservoir to mitigate upstream flooding in the community of Kingwood Texas and adjacent communities. Modifications to the dam at Lake Houston could include, but may not be limited to, installation of additional crest gates on or adjacent to the existing Ambersen dam and spillway and/or new hydraulic structures that provide for flow releases elsewhere on the embankment dam or within the reservoir rim adjacent to the dam.

The original assessment reviewed three locations for a gated control structure at high level, considering only general sizing required to meet storm flows and order of magnitude costs. The LHSIP will use hydraulic and hydrologic (H&H), geotechnical, cost, and environmental considerations to identify the most feasible alternative and advance it through design and eventual construction.

In Phase 1, effort will consist of development of design criteria and considerations to ensure all stakeholder agendas are accounted for. This will be followed by data collection and analysis to determine physical constraints including flow conditions through bathymetry and H&H models, foundation criteria from geotechnical testing, site conditions through a site survey, and environmental impacts through desktop analysis. H&H analyses will be conducted to examine upstream benefits associated with additional flow release capacity as well as the downstream impacts associated with the flow releases. Once adequate data is available to define constraints around the considered alternatives, we will conduct an alternatives analysis to quantify and compare the costs and benefits of each structure configuration. Concurrently, Phase 1 will begin the permitting process with all necessary agencies to limit any associated delays for permitting of the selected alternative. This effort will carry into Phase 2, which will oversee development of drawing and specifications through final design and issuance to bid.

The timeline associated with the below presented scope is considered aggressive, particularly as it applies to permitting, and based on our experience the schedule may require extension once more details are refined as the project progresses. We will work diligently to deliver all efforts in a timely manner, bringing resources to bear as needed, and communicate to Coastal Water Authority (CWA) any anticipated scope or schedule changes as soon as they are identified.
Phase 1 – Preliminary Engineering

Task Descriptions
The scope of work contained below consists of Preliminary Engineering that allows for analysis and studies to develop concept alternatives for flow releases from Lake Houston and evaluation of developed alternatives with recommendations on a preferred project. In addition, this phase of work will include all environmental clearance and permitting required to issue bid ready documents for construction.

Additional scope of work required to finalize design of the recommended project is covered under Phase 2.

Task 1 – Project Management
This task defines management procedures and actions to be utilized by Engineer to facilitate timely and cost-effective delivery of quality services and products to CWA. This task will consist of project monitoring, administration and project Quality Assurance/Quality Control (QA/QC) activities. The Project Management Plan shall be submitted within 30 days of receipt of the notice to proceed. Project Management tasks are based on an 18-month schedule.

Cost management shall be achieved through application of on-going management procedures that include: preparing a baseline project budget and performing updates.

Schedule management shall be achieved through application of on-going management procedures including preparation of a Baseline Project Schedule and performance of schedule updates.

Task 1.1 – Project Kickoff Meeting
Engineer shall hold a project kickoff meeting at the beginning of the project. The meeting shall be scheduled for about four (4) hours and shall include key professionals from the Engineer’s and CWA’s team. The purpose of the meeting shall be to establish project objectives and critical success factors, define contacts and responsibilities, and discuss work tasks and coordination issues. The Engineer will present the project schedule and discuss the project tasks scheduled for the first three months of the project work.

Task 1.2 – Project Scoping Meetings
The Engineer will meet with CWA staff to develop a comprehensive scope in accordance with established objectives for the work and to establish roles and responsibilities integral to project success. The agreed to scope of services, roles and responsibilities, and communication protocols will be incorporated into the Project Management Plan defined below in Task 1.4A.

Task 1.3 – Available Information Review
The Engineer will review and document available information as provided by CWA. This information could include but may not be limited to: design and/or construction records for the original dam and subsequent modifications to the Lake Houston facilities; site survey and topographic information; aerial photos; bathymetric or survey data of reservoir sedimentation; and any geotechnical information that may be available for the site.
Task 1.4 – Project Management Documents

Task 1.4A – Project Management Plan (PMP)

A draft PMP will be prepared for CWA review and comment. The final Plan will address CWA review comments. The Plan will include the following:

- Project background and description
- Project team, organizational chart, and contact information
- Project communication protocol
- Scope of services and project change control procedures
- Work plan and schedule
- Health and safety plan and emergency action plan
- Project administration and document control procedures

Task 1.4B – Project Schedule

The Baseline Project Schedule will be prepared which includes key tasks, subtasks, milestones, and interfaces. A draft Baseline Project Schedule will be provided to CWA for review and comment. CWA review comments will be addressed, and the final Baseline Project Schedule will be delivered.

The purpose of this task is to manage the schedule element of the project. Engineer shall develop the Baseline Project Schedule which shall form the baseline for comparison with actual conditions as the design and permitting work progresses. Engineer shall develop and monitor the schedule information to identify problem areas early so that corrective action can be initiated in a timely manner.

The Baseline Project Schedule shall be prepared using CWA’s preferred software. The first revision (Revision 00) of the Baseline Project Schedule shall be submitted within 30 calendar days of the issuance of the Notice to Proceed. The Baseline Project Schedule shall link key interfaces such as:

- H&H Activities.
- Permitting.
- Preliminary Field Investigations.
- Benefit-Cost Analysis (BCA) and Preliminary Engineering Activities

The critical path associated with the Project as shown in the Baseline Project Schedule shall be clearly identified.

Task 1.4C – Quality Management Plan (QMP)

A QMP will be develop that includes the following:

- Procedures for preparing and checking deliverables as follows:
  - Design data and other information
  - Technical Memoranda
COASTAL WATER AUTHORITY | LAKE HOUSTON DAM – PHASE 1 SPILLWAY IMPROVEMENT PROJECT

- Draft Reports
- Draft Calculations
- AutoCAD Drawings
- Specifications
- Opinions of Probable Construction Cost (OPCC)

Methods for ensuring compliance

QC documentation forms and procedures

Deliverable review checklists

**Task 1.4D – Risk Management Plan (RMP)**

A RMP will be developed to define the processes and procedures by which risks associated with delivery of the project are defined and mitigated. The RMP will include a risk register that provides a risk ID, a description of cause and effect, and a score that defines the likelihood of occurrence and consequences for a given risk. The risk register will assign responsibilities for development and mitigation of each risk. The risk register will be reviewed in the monthly coordination meetings with CWA staff.

**Deliverables:**

- Revised PMP, QMP, RMP, and Baseline Schedule.
- Final PMP, QMP, RMP, and Baseline Schedule.

**Task 1.5 - Project Management Meetings**

**Task 1.5A – Internal Coordination Meetings**

Conduct bi-weekly internal coordination meetings and/or conference calls with key project team members to discuss current project issues, CWA and other stakeholder needs, coordination requirements, schedules, deliverables, and subconsultant coordination.

**Task 1.5B – Bi-Weekly Project Progress Meetings**

Conduct bi-weekly progress meetings with CWA for the duration of the project to provide updates on project progress, budget and schedule status, project deliverables, current project issues, trend management, and related. Anticipated future activities and needs will be discussed. Engineer activities include arranging the meetings, preparing agendas, conducting the meetings, and taking and distributing meeting notes. Bi-weekly progress meetings will be conducted by phone conference. Monthly progress review meetings defined below will be conducted in person at CWA offices.

**Task 1.5C – Monthly Progress Review Meeting**

Project progress review meetings shall be conducted on a monthly basis and will be scheduled during the week before the monthly Board meetings. Progress review meetings shall be utilized to discuss project technical issues and alternatives, and to keep CWA staff informed regarding the status of the work.
Engineer shall prepare draft agendas for review by CWA a minimum of two (2) days in advance for regularly scheduled meetings. Documents to be discussed at the meetings shall be submitted to CWA as soon as they are available prior to the meeting.

Draft meeting minutes shall be prepared for CWA review within one (10 week of the meeting; minutes shall include a log of action items ("action item log") and decisions made ("decision log"). Following receipt of comments, the final meeting record shall be distributed to the appropriate team members and CWA staff. Meeting records shall also be maintained on the data management site selected by CWA.

**Task 1.5D - Board Meetings**

Engineer shall attend the monthly CWA Board meetings and shall be routinely available to answer questions or provide input, as requested by CWA staff or Board members. Fifteen (15) routine Board meetings will be attended by the Engineer’s Project Manager or delegated representative.

Engineer shall also provide support to CWA with status update presentations to the Board. Engineer shall budget for up to three (3) Board presentations including preparation of agenda item descriptions, exhibits and other presentation materials, and PowerPoint presentation slides.

**Task 1.6 – Project Management Reporting**

**Task 1.6A – Monthly Progress Reports**

The objective of this task is to monitor and report project work, and budget and schedule status. Management and oversight will be provided for project personnel, sub consultants, and administrative support; for day-to-day management activities; and for allocating resources necessary to meet project objectives and deliverable schedule. This responsibility includes coordination of sub consultant participation and monitoring of sub consultants’ MWBE certification status, to achieve the contractual obligation for MWBE participation.

Engineer will submit narrative status reports on or before the 10th of each month. Narrative status reports will be submitted in electronic format. Narrative status reports will include accomplishments from the past month, work projected for the next three (3) months, issues/concerns/information needs, and explanations of any cost or schedule variances.

Monthly performance report updates will reflect actual expenditures for the preceding month, progress-to-date for each task, changes in scope, and an estimated completion percentage for the scope of services. Schedule updates will reflect work progress, changes in scope, changes in schedule, and any other changes that impact project completion. Decision & design change log will be an Excel file that tracks each change, the date of change, and the reason for the change.

**Deliverables:**

- Monthly narrative status report.
- Monthly invoice.
- Monthly decision & design change log update
Task 1.6B - Monthly Invoices

Engineer will organize and tracker project costs and prepare invoices in accordance with the Agreement. Engineer will submit invoices on or before the 10th of each month.

Task 1.7 - Quality Assurance/Quality Control (QA/QC)

Engineer will perform Quality Control (QC) review of all deliverables submitted under this scope of work. All data, TMs, Draft reports, Draft calculations, drawings, specifications, and cost estimates submitted will be accompanied by a form demonstrating and certifying that QC of all deliverables has been performed consistently with the procedures described in the Final QMP.

Task 2 – Hydrology & Hydraulics

Task 2 will include the hydrologic and hydraulic analysis required to support the design of improvements to the Lake Houston spillway and spill gates. In addition, hydrologic and hydraulic analysis will be performed to evaluate the ability of these improvements to reduce flooding upstream of Lake Houston and to minimize downstream impacts. This task will include identifying the appropriate criteria to evaluate the performance of the proposed improvements.

Task 2.1 - Alternatives Analysis

Task 2 will include the hydrologic and hydraulic analysis required to support the design of improvements to the Lake Houston spillway and spill gates. In addition, hydrologic and hydraulic analysis will be performed to evaluate the ability of these improvements to reduce flooding upstream of Lake Houston and to minimize downstream impacts. This task will include identifying the appropriate criteria to evaluate the performance of the proposed improvements.

Hydrology

A comprehensive hydrologic model that combines the San Jacinto and Buffalo Bayou basins will be developed from existing hydrologic models. This combined hydrologic model will be used to determine the inflow hydrographs to Lake Houston for selected design events and to determine hydrologic conditions downstream of the Lake.

This task will include determining, in coordination with CWA, the design events to be used in the evaluation of proposed improvements. It is anticipated that analysis will be limited to up to nine (9) frequency events:

- Return periods of 2, 10, 50, 100, 500-year;
- Up to five (5) extreme historic events (e.g., Hurricane Harvey, Hurricane Ike, and the Memorial Day Flood), including at least one historic event with storm surge effects; and
- A hypothetical Probable Maximum Precipitation event.

As part of this task, the existing San Jacinto and Buffalo Bayou basin hydrologic models will be reviewed and adjusted as necessary. The two modified models will be combined and validated based on historical gage data.

The combined model will be used to perform hydrologic simulations of the selected design events. Results from the hydrologic model will be used as inputs to the hydraulic model.

Hydraulics

A comprehensive hydraulic model of the San Jacinto River that extends from Lake Houston to Galveston Bay will be developed. This model will be developed by expanding and refining existing
The hydraulic model will be validated based on available historical gage data. The hydraulic model will be used to determine flow conditions including flow depth and inundation limits upstream and downstream of Lake Houston under existing and proposed conditions for the design events previously identified.

As part of the hydraulic analysis, concepts for gates and spillway alternatives will be developed and evaluated. A preliminary hydraulic analysis will be performed to develop and size the gate and spillway alternative concepts.

Hydraulic simulations of existing conditions will be performed to establish a baseline for all selected design events. Proposed alternative improvements to the spillway and spill gates will then be incorporated into the model. Simulations of proposed conditions will be performed. Upstream and downstream flow depth and inundation limits will be compared to determine the impact of proposed improvements. Results from this analysis will be used as inputs to the BCA and to inform the alternatives analysis.

Specific actions associated with each subtask are detailed below.

### 201A Determine Evaluation Criteria and Define Design Events
- Develop the criteria by which to measure the success of the project.
- Determine which design storm events to provide level of service based on San Jacinto Regional Watershed Master Drainage Plan (SJRWMDP)

### 201B Review Existing Hydrologic Model of the San Jacinto (SJ) Basin
- Review the model details to ensure they are appropriate for the level of calibration
- Review the CWA water quality hydrologic model and incorporate appropriate elements
- Make any minor revisions to provide appropriate detail at Lake Houston dam and at FM 1960

### 201C Collect, Review, Adjust and Validate Existing Buffalo Bayou (BB) Basin Model
- Obtain G100-00-00 and W100-00-00 models from Harris County Flood Control District (HCFCD)
- Review model detail and combine as needed to represent inflows from G100-00-00 and W100-00-00 watersheds
- Simulate effective models with Atlas 14 500-year rainfall to calculate outflows to Houston Ship Channel
- Make adjustments to the hydrological parameters to accommodate the increased flows

### 201D Develop Comprehensive Hydrologic Model (SJ & BB combined)
- Combine G100-00-00 and SJRWMDP hydrological models to estimate the flows into the Houston Ship Channel.
- Expand hydrologic model downstream of IH10 to Galveston Bay

### 201E Perform Hydrologic Simulations of Design Events
- Simulate design storm events for 10, 50, 100, and 500-year events
- Perform QA/QC of models
201F Review, Adjust and Validate Existing SJ Hydraulic Model
- Review the model details to ensure they are appropriate for the level of calibration
- Review the CWA water quality 2D hydraulic model and incorporate appropriate elements
- Make any minor revisions to provide appropriate detail at dam and at FM 1960
- Update the SJRWMDP downstream of Lake Houston Dam with survey/bathymetric data
- Extend hydraulic model downstream to Houston Ship Channel
- Establish boundary conditions at Morgan’s Point for hydraulic analysis
- Review existing CWA gate operations at Lake Houston dam and incorporate into the analysis
- Simulate flows for up to five (5) historic events. Validate flows with historic events. Incorporate CWA operations into model. Make adjustments to H&H models for calibration to historic events

201G Perform Hydraulic Simulations of Design Events (Existing Conditions Model)
- Simulate design storm events for 10, 50, 100, and 500-year and PMF events
- Simulate coastal surge for appropriate events

201H Develop Concepts for Gates and/or Spillway Alternatives
- Assist in the development of concepts for Gates and/or Spillway Alternatives. Alternatives may include a fixed weir, increased gate capacity, additional gates, and gate operations.

201I Conduct Preliminary Hydraulic Analysis for Selection/Sizing of Structures
- Assist in the selection and sizing of structures

201J Perform Hydraulic Simulations of Proposed Alternatives
- Perform hydraulic simulations of up to three (3) proposed alternatives for the 10, 50, 100, and 500-year and PMF events.
- Simulate up to five (5) historical events to test potential benefit of alternatives
- Perform QA/QC
- Prepare results of simulations for review

201K Evaluate Upstream Impacts of Proposed Alternatives
- Evaluate upstream impacts/benefits for design storms
- Evaluate upstream impacts/benefits for up to five (5) historic events, including one storm surge event,
- Provide modifications to proposed alternatives to maximize upstream benefit
- Evaluate dam operations for proposed alternatives

201L Evaluate Downstream Hydraulic Impacts of Proposed Alternatives
- Evaluate downstream impacts/benefits for design storms
- Evaluate downstream impacts/benefits for up to five (5) historic events, including one storm surge event
- Provide modifications to proposed alternatives to minimize downstream impact
Evaluate dam operations and timing of releases for proposed alternatives
Quantify impacts and benefits to structures along G100-00-00 to Galveston Bay. Consider flows, timing, volume, and velocity impacts
Provide inundation mapping for each alternative for the design storms
Perform QA/QC

**Deliverables:**
- Combined Hydrologic Model.
- Combined Hydraulic Model.
- H&H results in the Preliminary Engineering Report (PER).

**Task 3 – Permitting**
The Scope of Work for Task 3 includes the following assumptions:

- This scope presents level of effort and costs for Environmental Assessment (EA) documentation and reporting. If it is determined that an Environmental Impact Statement (EIS) will be required, current scope and cost will require an amendment.
- The Environmental Team will be managed by Black & Veatch with support from Hollaway, Halff, and Gray & Pape, as detailed on a subtask basis.
- Assumes one (1) in-person meeting with project team in Houston area
- Assumes up to three (3) in-person meetings with USACE Galveston district at their office and field visits. These in-person meetings are expected to include a pre-application meeting, a follow up summary meeting after permit submittal, and a site visit with USACE.
- Assumes field team for assisting with wetland delineations, threatened and endangered (T&E) habitat assessment, T&E species specific surveys, Migratory Bird Treaty Act (MBTA) surveys, and documentation.
- The Environmental Team will be granted right-of-entry to the proposed project area prior to beginning fieldwork, including keys and access codes.
- The Environmental Team will be provided shapefiles or KMZ files of the proposed right-of-way that are georeferenced in a mutually agreeable electronic format prior to commencing fieldwork.
- Should the project limits detailed in this proposal or project design change following the commencement of work by the Environmental Team, a change order may be required for any additional work that would be required as a result of the change in project limits and/or project design.
- It is assumed that favorable weather conditions will prevail during field activities, and that no delays associated with weather will occur. If weather delays do occur, costs for demobilization and/or downtime will be provided and billed on a time and materials basis.
- This scope of work does not include costing for mitigation credit purchase or preparation or construction of wetlands. If these tasks are found to be required, the Environmental Team can submit an additional proposal to conduct this work.
Whenever possible, data previously collected during the expansion planning and design effort will be utilized.

**Task 3.1 – Permitting Plan**

The Environmental Team will conduct desktop document reviews and database searches to obtain information pertaining to the existing biological resources within the proposed project area. Data gathered during these initial efforts shall be used to analyze the proposed project area and potential environmental impacts. The Environmental Team will conduct research using the most recent data sources available for each of the biological resources to be analyzed. Data resources to be searched include, but are not limited to:

- United States Fish and Wildlife Service (USFWS) National Wetland Inventory (NWI)
- Aerial Photography from Texas Natural Resources Information System (TNRIS)
- USFWS County List of Threatened and Endangered Species
- Texas Parks and Wildlife Department (TPWD) Natural Diversity Database (NDD)
- TPWD Annotated County Lists of Rare Species
- Natural Resources Conservation Service (NRCS) Soil Survey
- Texas Commission on Environmental Quality (TCEQ) 303(d) List
- USFWS Critical Habitat Mapper
- Texas Historical Commission (THC) State Historic Preservation

In addition to the resources listed above, the Environmental Team requests to be provided with project schematics, shapefiles, project plans, cross sections, and/or other project related materials. This information will facilitate a thorough review of the project area.

**Task 3.2 – Agency Consultations**

The Environmental Team will plan, prepare for, and attend planning meetings with appropriate federal and state agencies, to discuss project planning, explain project activities, and to review documents prepared for the Project. The Environmental Team will provide written coordination with required regulatory agencies as part of the NEPA and permitting process. It is anticipated that at least one Joint Evaluation Meeting (JEM) will be required along with individual agency meeting presentations. The Environmental Team will prepare meeting minutes to be available during the project duration.

Representatives of the Environmental Team will attend meetings up to the specified budget. If additional meetings and agency coordination are required over the budgeted amount, Engineer will submit a cost proposal for additional funds.

**Task 3.3 – Site Reconnaissance**

Halff will lead the site reconnaissance effort, with support from Hollaway on the Freshwater Mussel Survey and Bird Surveys and associated reporting. It is anticipated that environmental surveys will be completed in approximately four to six weeks depending on access and weather. Please note, some environmental surveys are required to be conducted at certain times or year and day. Surveys
will be scheduled based on these requirements while adhering to the project timeline as much as possible.

**U.S. Army Corps of Engineers (USACE) Jurisdictional Delineation**

The Environmental Team will determine if any potentially jurisdictional waters of the U.S. (WOUS), including wetlands, exist within the proposed project area. All wetlands will be delineated in accordance with the procedures mandated in the USACE 1987 Wetland Delineation Manual (Manual) and November 2010 Regional Supplement to the USACE Wetland Delineation Manual: Atlantic and Gulf Coastal Plain (Version 2.0). The Ordinary High-Water Mark (OHWM) of all waterbodies will be delineated in accordance with standard procedures set forth by the USACE. All waterbodies will be assessed for signs of tidal influence. All boundaries shall be surveyed with sub-meter Global Positioning System (GPS) technologies that are consistent with the methodologies generally accepted by the USACE.

It is assumed that lands within the proposed project area are not considered “prior converted cropland”, which may be subject to provisions of the “Swamp Buster Act”, and that coordination with the NRCS is not required. If coordination with the NRCS is required, this can be accomplished at additional cost through a separate cost proposal.

**Listed Threatened and Endangered Species and Habitat Assessment**

The Environmental Team will perform field survey(s) to determine the presence or absence of state and federally-listed T&E species and their critical habitat within the proposed project area. As part of this task, we will perform the following:

- A TPWD NDD and literature review to determine the state and federally-listed species that potentially occur on or adjacent to the proposed project area
- Review of current species lists for Harris County available through the USFWS and the TPWD
- An investigation of the proposed project area to determine the presence/absence of listed species and/or their critical habitat
- Preparation of a draft T&E Species Survey Report documenting the results of the investigations

**Freshwater Mussel Survey**

This survey will consist of recording abiotic data as well as biotic data. Habitat characteristics including, water depth, substrate, water temperature, turbidity, and flow (if any) will be recorded on site. Available data from the nearest TCEQ water quality station (10913 and/or 10914) will be used to supplement this information.

After assessing the habitat, visual and tactile searches will be conducted in the PSA utilizing a transect method to minimize sediment disturbance. These transects will be planned as required by TPWD. In addition to transects in the channel, bed, and banks, the adjacent shoreline will be visually examined for shells. Shells will be identified, measured, documented and photographed where they are found. No shells will be collected during this survey.

If any state-listed threatened mussels are encountered at any point in the survey, GPS coordinates will be taken and provided to TPWD. The landowner will be advised that further coordination will be required with TPWD before any work can continue in the area.
Migratory Bird Treaty Act (MBTA) Surveys

The Environmental Team will complete migratory bird, raptor, and bald and golden eagle nest surveys within the project area during nesting season (March to September). The Environmental Team biologists will record the location of each nest utilizing a sub-metered Global Positioning System (GPS) and take photographs.

If an active nest is encountered, it will be marked and flagged off. The Environmental Team will identify the bird species, stage of the nest (i.e. eggs, hatchlings, or fledglings), nest substrate, and nest habitat (i.e. shrub or tree). If a bald or golden eagle (and any associated nest) is identified within the project area, the Client will be notified immediately, and construction activity will be halted until the USFWS is notified and buffer zones are established.

If active nests are identified, they will need to be avoided during construction activities per any permitting requirements. If needed, the Environmental Team can provide a biological monitor to remain on-site during operations to document compliance and due diligence for a daily rate of $950/day.

Task 3.4 – NEPA Review

Hollaway will lead this effort with support from Halff. To satisfy NEPA requirements set forth by Section 9 and for the purpose of this proposal, the Environmental Team assumes this project will require an EA. If it is determined that an EIS will be required, Engineer will provide a cost amendment at that time. As previously discussed, it is at the discretion of the agencies to determine the applicability of the EA versus the EIS. An EIS is generally required if the proposed action will significantly affect the human environment.

The Environmental Team will prepare an EA to include an analysis of existing conditions of the proposed project area, utilizing collected data from desktop reviews, environmental field The Environmental Team, and other available resources.

Engineer will, in coordination with the project team, develop project alternatives which will include, at a minimum, a no-action alternative and at least one action alternative. The selection of the alternatives to be evaluated in the EA will be determined on whether they will or will not meet the project purpose and need. Engineer will develop a purpose and need statement for the proposed project. The purpose and need statement will be coordinated with the project team and included in the EA.

The Environmental Team will compile and review various environmental data collected from project area by the entire project team. These environmental data will include, but are not limited to the following:

- Topography and Soils
- Construction Impacts
- Land Use
- Indirect and Cumulative Impacts
- Geology, Hydrology and Drainage
- Sediment Quality
- Vegetation
- Air Quality
- Invasive Species
- Coastal Zone Management
- Wildlife and Endangered Species
- Essential Fish Habitat
The document will include, at a minimum, an introduction, background, affected environment, environmental consequences, mitigation, and recommendations. The draft EA will also include various exhibits and maps accurately depicting the proposed project and alternatives, as well as, appendices documenting agency and stakeholder participation with the project. The draft EA will, based on the alternative analysis, determine whether any impacts would have a significant effect on the human environment.

The Environmental Team will prepare a summary of all agency coordination including recommendations, concurrences, and comments. This summary will also include an explanation of compliance with environmental laws and regulations. In addition, the Environmental Team will review the potential impacts to natural resources to prepare a mitigation plan.

After the public review period, the Environmental Team will review and incorporate the public comments, revising the draft EA as appropriate. The Environmental Team will prepare a preliminary final EA and submit for review and consideration.

If the preliminary final EA concludes that the proposed project will not have a “significant” impact on the human environment, Engineer will prepare a finding of no significant impact (FONSI) and submit for review and approval. A final EA and FONSI will then be prepared and signed by the lead agency. If at any point in the process of preparing an EA it is discovered that the project would result in significant impacts an EIS must be prepared. Preparation of an EIS, if required, can be performed at additional cost.

**Task 3.5 – Federal, State, and Local Permitting**

Hollaway will lead this effort with support from Halff. For the purpose of this proposal and based on anticipated impacts to WOUS, including wetlands (greater than 0.5 acres), the Environmental Team anticipates that a USACE Individual Permit (IP) will be provided. As stated, the Environmental Team will request pre-application meetings with the USACE and other agencies to introduce the proposed design plans of the project, to share the projected impacts, to discuss conceptual mitigation alternatives, and to solicit feedback from the agencies into the design of the project early in the permitting process. The Environmental Team will prepare for the meeting by creating graphics and other visual materials necessary to effectively communicate the proposed project plans to the agencies.

In addition, the Environmental Team will coordinate with additional federal, state, and local agencies (i.e. NOAA, USFWS, U.S. Environmental Protection Agency [USEPA], Federal Emergency Management Agency [FEMA]).
Management Agency (FEMA, the TCEQ, and TPWD) as needed to prepare and submit required data and proposed project information for obtaining necessary local, state, and federal permits for the project. This includes, but is not limited to pre-application meetings, public notices, and formal consultations.

The Environmental Team has preliminarily identified the environmental regulatory agencies having potential jurisdiction over the proposed project as well as the associated permits, approvals, clearances, data, and reports. Table 3-1 provides a summary and may not be all inclusive of every permit required.

For the purpose of this proposal and for planning, an estimated timeline and timeline assumptions are provided below.

Coordination with the USACE (and other appropriate agencies) would ideally begin after PER phase. This would include a pre-application meeting to present the overall project, high level design plans, and project purpose.

Field data collection schedule will vary depending on weather and seasonality requirements for certain species surveys. It is recommended the field survey area be finalized as to try to avoid delays in multiple mobilizations.

Preparation of the USACE Permit and NEPA Documentation (as needed) would be conducted concurrently with each other and would be submitted, ideally at 60% design phase. If the design of the project is modified after submittal of the permit, the timeline will be affected.

The USACE review of the permit timeline begins after the application is considered federally complete and includes but is not limited to the following.

- USACE to review all submitted documents. May request additional information/data. Timeline does not start until they have all information requested.
- USACE to post Public Notice (30 days)
- USACE to submit Public Notice comments to applicant and agent (within 30 days)
- Response to comments (applicant and agent, within 30 days)
- USACE review of responses
- Review of the alternative analysis
- Review of the mitigation plan
- Coordination with TCEQ, USFWS, TPWD, EPA, NOAA as needed
- USACE archeologists review of cultural resources data and submittal. Coordination with the THC

The estimated review time, in the perfect scenario (with no public backlash, no impacts to T&E or cultural resources, and a solid mitigation plan) can range from 13 to 18 months from the day the permit is considered federally complete. However, after Hurricane Harvey and during the current pandemic status, the USACE – Galveston District Regulatory Division has been understaffed and with the influx of development in the region, has experienced longer than normal permit reviews and approvals.
Table 3-1: Draft Permit Table

<table>
<thead>
<tr>
<th>Permit/Clearance/Approval</th>
<th>Agency</th>
<th>Estimated Timeline*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sections 9 of the Rivers and Harbors Act and Section 404 of the Clean Water Act</td>
<td>USACE – Galveston District</td>
<td>12 to 18 months</td>
</tr>
<tr>
<td>Section 7 Endangered Species Act, Essential Fish Habitat, Migratory Bird Treaty Act Consultation</td>
<td>USFWS &amp; NOAA Fisheries</td>
<td>Concurrent with USACE permitting. Can last up to 150 days with Biological Opinion</td>
</tr>
<tr>
<td>Flood Plain Construction</td>
<td>FEMA &amp; Galveston County Engineer (Flood Plain Administrator)</td>
<td>Concurrent with USACE permitting. Requirement unknown at this time.</td>
</tr>
<tr>
<td>National Pollutant Discharge Elimination System (NPDES) - Hydrostatic Test Discharge Permit &amp; NPDES – Construction Stormwater Discharge Permit</td>
<td>USEPA</td>
<td>Requirement unknown at this time. Dependent upon final design and discharge needs. Required for construction duration.</td>
</tr>
<tr>
<td>Section 106, National Historic Preservation Act (NHPA)</td>
<td>THC (SHPO)</td>
<td>Dependent of project specific findings. Results of studies may require additional investigations and may affect timeline. Concurrent with USACE permitting.</td>
</tr>
<tr>
<td>Threatened and Endangered Species Consultations</td>
<td>TPWD</td>
<td>Results of studies may require additional investigations and may affect timeline. Concurrent with USACE permitting</td>
</tr>
<tr>
<td>State Water Quality Certification Process (i.e. TIER I &amp; TIER II)</td>
<td>TCEQ</td>
<td>Concurrent with USACE permitting</td>
</tr>
</tbody>
</table>

*The estimated timeline is based on prior experience and similar projects; however, Engineer cannot predict the exact timeline for this project, as timeframes are contingent upon agency workloads and individual review periods per agency. These timelines start at time of permit submittals and does not include environmental survey and/or permit preparation duration.

Task 3.6 and 3.7 – USFWS/TPWD Coordination

Hollaway will lead this effort with support from Halff. The Environmental Team will coordinate the results of the listed species investigations with representatives of the USFWS and TPWD. The purpose of this coordination is to seek concurrence with the effects determinations and establish whether additional coordination and/or consultation is required.

The Environmental Team does not anticipate needing to complete a Biological Assessment (BA) or Biological Opinion (BO); however, this will be ultimately determined by USFWS. Should it be determined through coordination with the USFWS that either a BA or BO is required; this work can be performed at additional cost through a separate cost proposal.
Task 3.8 – Texas Historical Commission (THC) Concurrence

Gray & Pape will lead this effort. The scope of work for this initial phase is assumed to include between two (2) to three (3) meetings in Houston, Texas or via telephone; up to eight hours of research to develop a brief, initial desktop review of the history of the dam and surrounding areas; and the development of a research plan and a survey scope of work to support cultural resources management evaluation of the project’s potential effects the dam and associated facilities and landscape.

Task 3.9 – TCEQ Section 401 Water Quality Certification

Hollaway will lead this effort with support from Halff. The TCEQ authorizes impacts under Section 401 of the CWA in two tiers: Tier I Checklist or Tier II Questionnaire and Alternative Analysis Checklist. The type of water quality certification is dependent on the extent of impacts to waters of the U.S., including wetlands.

Tier I Project: The Environmental Team will prepare a Tier I Checklist for the proposed project provided that the impacts are less than three (3) acres of waters of the U.S., including wetlands, or less than 1,500 linear feet of streams. In order to qualify for this level of authorization, certain best management practices (BMPs) must be implemented for the proposed project. Additionally, the proposed project cannot impact rare and ecologically significant wetlands.

Tier II Project: In the event that the three acre and/or 1,500 linear feet thresholds are exceeded by the proposed project, the project would impact rare and ecologically significant wetlands or the BMPs proposed do not conform to TCEQ requirements, a Tier II Questionnaire and Alternatives Analysis Checklist will be prepared by Engineer. It is assumed the proposed project will require a Tier II Project Checklist.

Task 3.10 – TCEQ Stormwater Pollution Prevention Plan (SWPPP)

Hollaway will lead this effort with support from Halff. The submittal of a Stormwater Construction General Permit with TCEQ is anticipated. As part of the permitting process and application, Engineer will prepare a draft SWPPP, pre-construction notice of intent (NOI), and post-construction notice of termination (NOT) that will include the following:

- Perform a review of project construction and layout plans:
- Interview personnel knowledgeable about the construction and land clearing required to build the project, and responsible for maintaining the SWPPP during construction;
- Preparation and submittal of a SWPPP;
- Preparation and submittal of a NOI; and
- Preparation and submittal of a NOT due at the completion of project construction.
- The Environmental Team will submit a draft SWPPP, NOI, and NOT to the Client for review and comment. Once comments are incorporated, Engineer will submit the NOI to the TCEQ along with any required filing fee. Filing fees are not included in this proposal and will be provided by the Client. Engineer will provide three (3) final bound copies of the SWPPP to the client to maintain on the project site and for their records.
Task 3.11 – TCEQ Dam Safety

Black & Veatch will lead this effort. The TCEQ authorizes modifications to moderate and high hazard dams. Coordination with TCEQ Dam Safety is anticipated to begin in the H&H and Alternatives Selection process to ensure the selected alternative is compliant with all state and federal dam safety requirements. However execution of the permit will not commence until an alternative is selected. Black & Veatch will communicate directly with TCEQ Dam Safety staff as needed throughout project execution and coordinate meetings with CWA if necessary.

Permitting Deliverables:

- Permitting Plan
- Environmental Technical Reports
  - Wetland Delineation Report
  - Functional Assessments
  - T&E Report
    - Species specific survey reports
- NEPA Documentation
- Federal Permitting
  - USACE Section 404 Permit
  - USACE/TPWD Coordination reports
- State and Local Permitting
  - TCEQ Water Quality Permit
  - TCEQ SWPPP and associated documentation
  - THC research plan and a survey scope

Task 4 – Field Investigation

The extents of the field investigation including proposed site survey, bathymetry, and geotechnical boring locations, and control points are illustrated in Figure 4.1 below.

Task 4.1 – Safety Plan

The Engineer is responsible for the health and safety of its employees and confirming that Engineer’s subcontractors have a good understanding of all project health and safety requirements. The Engineer will develop a project specific Health and Safety Plan to apply to employees and subcontractors working on the project. It will address safety in the office, site visits, and field investigations.

Deliverables:

- Project Health and Safety Plan.
Task 4.2 – Site Surveys

Engineer shall arrange and perform all surveys required for preliminary design of the facilities described in this scope of work. The bathymetric survey is described in Task 4.4. The Engineer shall provide a five (5) day advance notice of when field work will occur.

Preliminary site survey will include the following:

- Survey of Control Points and Geotechnical Engineering Items
  - Stake six (6) land borings locations for geotechnical investigation and obtain ground elevations. After borings are drilled, re-survey any locations that the drillers moved, and revise the ground elevations accordingly. Provide final coordinates and elevations of said borings.
  - Set three (3) control points to be utilized for the bathymetry survey.

- Subsurface Utility Engineering (SUE) Level ‘C’ and ‘D’
  - Private and public utility research for project limit.
  - Place the 811 ONE CALL prior to survey
  - Provide approximate utility locations based off records plans in plan-view only based on inverts, sizes, and records.

**Deliverables:**

- Base plan drawing with current conditions including a set of field notes and utilities, shown in plan-view.
- Survey Control Map in accordance with City of Houston requirements.

Task 4.3 - Geotechnical Investigation

Engineer shall review all previous geotechnical work and perform any additional geotechnical explorations required to complete the detailed design.

The purpose of the geotechnical investigation will be to develop preliminary geotechnical design recommendations for the identified spillway alternatives. The geotechnical services will include field exploration programs, laboratory testing, and engineering management, analyses and reporting. The following describes the scope of services. The Engineer shall provide a five (5) day advance notice of when field work will occur.

Field Exploration

The following outlines the proposed field exploration program.

**Land Borings and Instrumentation**

A total of six (6) borings are planned with an individual depth of about 50 feet.

- Perform a site visit to observe proposed boring locations and assess site access.
- Mobilize required drilling equipment to the site.
- Drill soil borings and collect soil samples at 2-foot intervals to completion depth.
Estimate cohesive soil shear strength of the soil samples using a pocket penetrometer or Torvane.

Record SPT N-values in granular soils.

Backfill the borings (without piezometers) with cement-bentonite-grout.

Transport collected samples to testing laboratory.

Install one (1) piezometer to measure water levels in the prominent sand strata.

Protect piezometers with steel casing and bollards.

Using the piezometers, conduct falling head test to estimate the in-situ permeability of the screened strata.

Instrument piezometers with automated reading equipment.

Laboratory Testing

Laboratory testing will be assigned once soils samples have been obtained and the field services have been completed. All testing will be performed according to ASTM standards, where applicable, or with other well-established procedures. Laboratory testing will include:

The following laboratory tests are anticipated:

- Soil classification tests including, but not limited to, Atterberg Limits (liquid and plastic limits), moisture contents, and grain size analyses (sieve or hydrometers).
- Strength tests including unconfined compression, unconsolidated-undrained triaxial compression, and multi-stage consolidated undrained triaxial compression.
- One dimensional consolidation tests.
- Soil dispersion testing using Crumb and double hydrometer tests.
- Permeability tests to estimate the hydraulic conductivity of the soils.

Engineering

Engineering will include project management, analyses, and reporting.

Management

- Periodic site visits during field investigation programs.
- Participation in design meetings, workshops and review meetings.
- Coordination and supervision of drillings and sampling operations.
- Coordination of laboratory testing and QA visits to laboratory testing facility.
- Progress and budget reports.

Analyses

- Review PER.
- Review existing geotechnical information as applicable to each alternative foundation.
**Reporting**

- Discussion of field exploration and laboratory testing procedures.
- Borings logs include detailed descriptions of the soils encountered, measured depth-to-water, SPT blow counts, and measured undrained shear strength.
- Laboratory test results.
- Site description generalized soil conditions, and measured depth-to-water.
- Graphical representation of encountered site stratigraphy.
- Groundwater conditions.
- Permeability test results.
- Dispersity test results.
- Consolidation test results.
- Groundwater design considerations for construction and operations.
- Seepage and seepage control considerations.

**Deliverables:**

- Geotechnical Investigation Reports
- Reports from Additional Data Collection Activities

**Task 4.4 – Bathymetry**

Field work described in this task is to support modeling and design through the collection of updated topography. The river survey will strategically update H&H modeling data on river dynamics in the study area. This information is required to support H&H modeling, permitting, and design. The field work should occur as soon as possible, with specific dates yet to be determined.

Engineer will provide a horizontal/vertical survey control point identified during the field survey in proximity to the study area suitable for setting up a real-time kinematic (RTK) GPS base station. Engineer will also provide a water level reference mark in proximity to the study area, with an accurate elevation from which Contractor can manually measure down to top of water for water level monitoring during bathymetric data collection.

Field work will be completed in accordance with standard procedures in order to ensure reliability of results. Each field task will include mobilization and demobilization, processing and analysis of field data, QA/QC, and reporting.

The multi-beam bathymetric survey will cover an area extending approximately 500 feet upstream of the dam to provide data to update the H&H model. The bathymetric survey will be conducted on a best-effort basis, collecting data where safely navigable, free of obstructions and debris.

**Deliverables:**

- Bathymetric survey map with contours and select spot soundings
- Bathymetric survey map with color-filled contours
- 3D point cloud ASCII (X, Y, Z) data file.
Figure 4-1: Phase 1 Field Investigation Extents
Task 5 – Preliminary Engineering

The alternatives analysis will require development of conceptual site layouts for each considered alternative, including area of impact, site access and utilities, staging and borrow areas, dewatering extents, existing structure tie-in, general facilities layout, and downstream channel alignment. These site plans will be used for estimation of quantities in costing, as well as serve as a feasibility check for each alternative.

Task 5.1 – Stakeholder Management and Public Involvement

To be determined based on clarification from CWA.

Task 5.2 – Alternatives Evaluation Framework & Cost Analysis

Task 5.2A Evaluation Criteria Workshop

The Engineer shall conduct a four (4) hour workshop to discuss the proposed evaluation criteria, weighting, and scoring that will be used in development of a recommended project. Evaluation criteria are expected to include, but may not be limited to:

- The ability of a given alternative to meet the project purpose and needs;
- Environmental clearance and permitting timelines;
- Front-end capital costs for construction, including any environmental mitigation;
- Long-term operation and maintenance costs; and
- Costs and benefits of mitigating flood impacts; and
- Associated risks for consideration in design, construction, and operation.

The workshop will be conducted in-person at CWA offices. CWA will be responsible to identify and convene appropriate CWA staff to participate in the workshop.

Task 5.2B Refine Weighted Matrix Analysis for Alternative Evaluation

Based on outcomes of the Evaluation Criteria Workshop (Task 5.2A), the Engineer shall finalize the weighted matrix evaluation tool used to evaluate up to three (3) considered alternatives. The tool is anticipated to take the form of an Excel spreadsheet that can be used to compare and rank the considered alternatives.

Task 5.2C Complete Weighted Matrix Analysis with Risk Incorporated (Incorporate Cost)

The Engineer shall conduct a detailed cost evaluation of up to three (3) alternatives. Capital construction costs will be estimated bottom up, as a contractor would do, based on assumed means and methods, equipment and labor spread, and production. Other cost factors will include environmental mitigation and benefits related to flood mitigation. Non-cost factors could include such items as ability of a given alternative to meet purpose and need, permitting timeline, ease of operations and maintenance, quality of the work, and similar
Deliverables:

- Evaluation Criteria Workshop slide deck to assist with facilitating the meeting
- Meeting minutes documenting the Evaluation Criteria Workshop, to be delivered no later than one (1) week subsequent
- Weighted Evaluation Criteria Scoring Matrix for up to three (3) alternatives
- Conceptual OPCC for up to three (3) alternatives
- Benefit Estimates for Flood Mitigation for up to three (3) alternatives

Task 5.3 – Environmental Constraints Analysis

Environmental data collected in Task 3 will be used with understanding of concepts for flow releases defined in Task 5 to determine the significance of any required environmental mitigation associated with a given construction alternative. This Environmental Constraints Analysis will include limitations on operation of diesel equipment as impacts air quality and which could have a cost impact to any given alternative. In addition, this subtask will include consideration of stormwater water pollution and prevention and requirements for treatment and discharge of accumulated stormwater and construction make-water. Other considerations will include any requirements for construction phase environmental surveys, training, and/or environmental restoration.

Deliverables:

- Documentation of analysis.

Task 5.4 – Alternatives Analysis

Task 5.4A – Initial Alternatives List

The Engineer shall first develop a complete list of all alternatives for initial ranking of relative feasibility, upstream and downstream impacts, and Association for the Advancement of Cost Engineering (AACE) Class 4 (feasibility level) estimate of cost.

Task 5.4B – Refine Alternatives List

Once all feasible options are identified and researched, the Engineer will select three (3) alternatives to advance in anticipation of the Alternative Selection Workshop. These alternatives will be refined and an AACE Class 2 (feasibility level) estimate of cost developed for comparative impact across the following criteria:

- Cost.
- Upstream impact
- Downstream impact.
- Environmental impact
- Permitting requirements
- Constructability
Task 5.4C – Alternative Selection Workshop

The Engineer shall conduct a workshop with appropriate stakeholders to review the refined alternatives list and preliminary alternative analysis results for final selection of a recommended alternative. During the workshop, the following items will be presented:

- Refined alternatives list.
- Results of preliminary field investigation efforts as they impact each alternative, including geotechnical investigation results, bathymetry, and utilities survey.
- Preliminary BCA results.
- Preliminary H&H analysis results.
- Preliminary Environmental Constraints Analysis results.
- Preliminary stakeholder impacts.
- Preliminary permitting impacts and requirements.
- Ranking of alternatives.

This workshop will seek input from CWA staff and other necessary stakeholders as to the final selection of a design alternative for the proposed spillway. The workshop will be in-person and will take place at CWA offices. CWA will be responsible to identify and convene appropriate CWA staff to participate in this workshop.

Deliverables:

- Preliminary alternatives list.
- Alternatives list and agenda for Alternatives Selection Workshop.
- Alternatives Selection Workshop meeting minutes

Task 5.5 – Preliminary Engineering Report (PER)

The Engineer shall prepare the project PER, which shall document accepted alternative recommendations and other aspects of the preliminary engineering investigation of alternatives. The PER shall form the basis of the project as a starting point for the 30% Design Submittal. The PER shall include in general the following:

- Documentation of the proposed alternatives, selection criteria, and outcome
- Documentation of the benefit-cost analysis process and results
- Summary of preliminary H&H results
- Basic spatial layout of spillway on the project site plan
- General operations description for the proposed spillway
- Design capacity of the proposed spillway
- Foundation design criteria
Deliverables:

- Draft Preliminary Engineering Report.
- Final Preliminary Engineering Report.