

**U.S. ARMY CORPS OF ENGINEERS
GREAT LAKES AND OHIO RIVER DIVISION
NASHVILLE DISTRICT
4th Quarter Fiscal Year 2015**

WHITE PAPER BRIEFING FOR: Southeastern Power Administration (SEPA), Hydropower Customers and Water Supply Users

DATE: 15 Sep 2015

PURPOSE OF PAPER: Provide Quarterly Status Report of the Center Hill Dam Safety project-return of Center Hill Project to normal operations, total cost and schedule of repayment.

PROJECT SUMMARY:

Background: Center Hill Lake was created by an earthen and concrete main dam as much as 248' high and a 125' high earthen auxiliary dam referred to as the "saddle dam". Both dams were completed by 1948 for impoundment. The embankments were built on highly solutioned limestone with open and clay-filled features and are the primary focus of the ongoing Dam Safety modification project. During the time of project design and construction, designers had limited understanding of adequate foundation preparation techniques for earthen embankments founded in karst geology. Seepage problems have plagued the project for many years. Through the 1990's increasing foundation seepage indicators included abnormal piezometer levels, settlement, wet areas and springs. The Dam was among the initial Corps dams classified in Dam Safety Action Classification (DSAC) 1 in 2005, the highest urgency for dam remediation. As an Interim Risk Reduction Measure (IRRM), the lake operation has been targeted 15 to 20 feet lower than normal since 2008.

Status: Figure 1 illustrates the three major construction contracts which comprise the overall dam safety modification project. Construction began in 2008 with a significant foundation grouting contract at the main dam embankment and left rim. In 2012 the second contract, a concrete barrier wall at the main dam embankment, was awarded with substantial completion July 2015. The 2.5' thick concrete barrier extends as far as 310' below the top of the dam into the karst foundation and is the permanent seepage barrier protection for the main embankment. Design and construction documents are complete for the final major construction effort which is the saddle dam repair, a concrete reinforcing Berm downstream of the saddle dam embankment. The structure will be built primarily of Roller Compacted Concrete (RCC) and rock fill will be placed between the existing downstream saddle dam embankment and the upstream face of the concrete Berm. The contract is anticipated to be awarded by May 2016 and completed in 2019. Smaller site restoration contracts are planned consecutively with the RCC Berm.

Schedule for Pool return to normal and project Repayment: Figure 2 shows the remaining key schedule items which will control the lake levels return to normal. After construction of dam safety modifications, a post-implementation evaluation (PIE) is required to verify the implemented risk reduction measures were successful. Relevant data and construction records of completed works are now being compiled to support the PIE. Relevant data includes as-built drawings, GIS-based details with pertinent boring logs, and instrumentation. The risk evaluation of the main dam, with grout curtain and barrier wall in place, is planned in 2016. This task includes an initial assessment by the vertical team including the District, MSC and HQUSACE, representatives from the Risk Management Center and the Dam Safety Center of Expertise. This initial assessment will include an analysis of risk of removing an increment of operating restrictions to allow additional data to be collected. A failure modes analysis and risk assessment is conducted for a full range of pools. The consequence (of failure) data will be reviewed and updated as needed, additional modeling needs

assessed, and quantitative risk evaluated and compared to the original objectives of the project. A draft PIE Report will be documented, multiple reviews conducted, and the final results presented to the senior dam safety oversight group for approval. Final approval authority is the USACE Dam Safety Officer.

If an interim pool raise is allowed before the RCC Berm is completed, the lake may be able to rise approximately 5 feet in 2017. Meanwhile, the Berm construction quality will be monitored as the construction progresses in 2017 and the beginning of 2018. When the Berm reaches the maximum overtopping elevation of 658, estimated in the spring of 2018, a timely determination may be made to remove lake level restrictions. Subsequently, the overall dam safety project PIE will be supplemented with Berm construction information and the appropriate post-project DSAC rating determined in 2019. Fiscal closeout of the project is anticipated in September of 2019.

Costs: The total project certified cost estimate is \$364.2M. This amount includes contingencies. Interest During Construction accrues until each major asset (main dam and saddle dam) improvements are placed in service. Additional Interest During Construction (IDC) is estimated at \$55.2M bringing the total amount to \$419.4M and the SEPA cost share to \$178.2M. The estimated IDC assumes the main dam investments are placed in service by 1 October 2015 (the beginning of FY16). *Assets placed in service during a Fiscal Year are reported in the annual Multipurpose Hydropower Financial Statements issued by 1 November.*

Cost Reduction Efforts: While the overall schedule and cost have grown since the project was initiated, primarily due to Corps risk-based processes implemented after the project was approved, the following cost reduction efforts have been either realized or planned.

Past Actions:

Barrier Wall Construction: Two Value Engineering Proposals, one for an all panel barrier wall and one for savings on the barrier wall tie-in to the main concrete dam, totaled over \$6.7M in contract cost savings.

Planned Actions:

Design for the Saddle Dam Reinforcing Berm included over \$30M in the following cost saving decisions:

- a. Reinforcing Berm less costly than barrier wall at the saddle dam
- b. No Berm grout curtain or spillway gates
- c. Berm fill obtained from on-site stabilization material
- d. RCC instead of convention concrete for the Berm apron, RCC on the upstream face in lieu of grout-enriched concrete, single waterstops along vertical joints (rather than double)
- e. on-site disposal

Cost & Schedule Risk: The following future activities have been identified by the project team to pose the greatest amount of cost and schedule risk. Evaluated risks are part of the certified budget and schedule.

- a. Saddle Dam Berm solicitation delays due to contractor bid protests
- b. Saddle Dam Berm contract cost increases due to quantity overruns in rock excavation and/or contractor claims

Potential impacts of item a. above will be known at contract award estimated in the spring of 2016 and any impacts of b. will not be fully known until the Berm contract completion in 2019. Again, cost and schedule risks were considered during the compilation of the current cost estimate and the schedule summarized in Figure 2.

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Figure 1

Center Hill Dam Safety Project Overview

Saddle Dam
Embankment
RCC Berm

Main Embankment & Left Rim
Grouting and Barrier Wall

Legend

- COMPLETED: Grouting 2008-2011
- COMPLETED: Barrier Wall 2012-2015
- FUTURE: RCC Berm 2016-2019
- FUTURE: Site Restoration 2016-2019

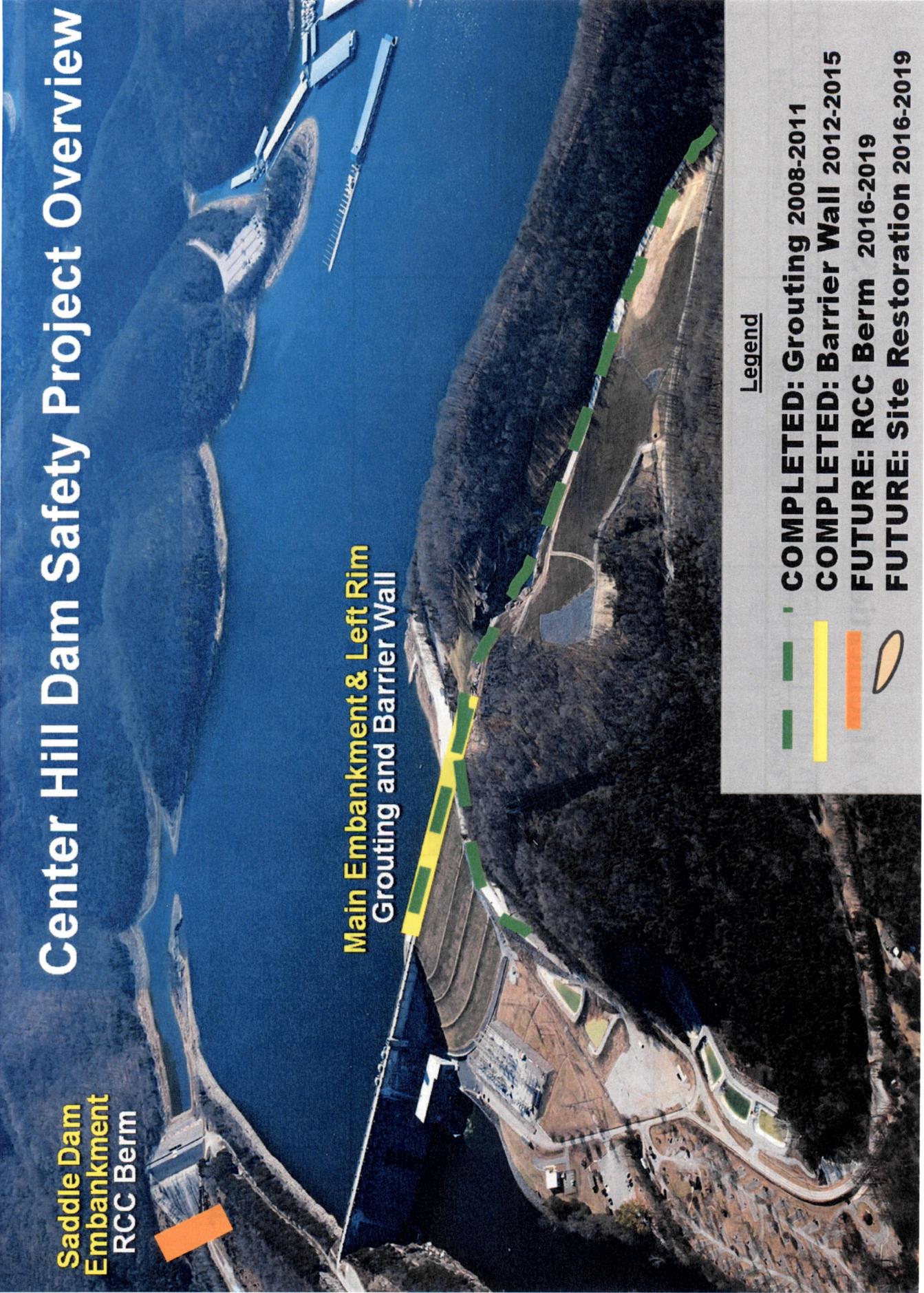
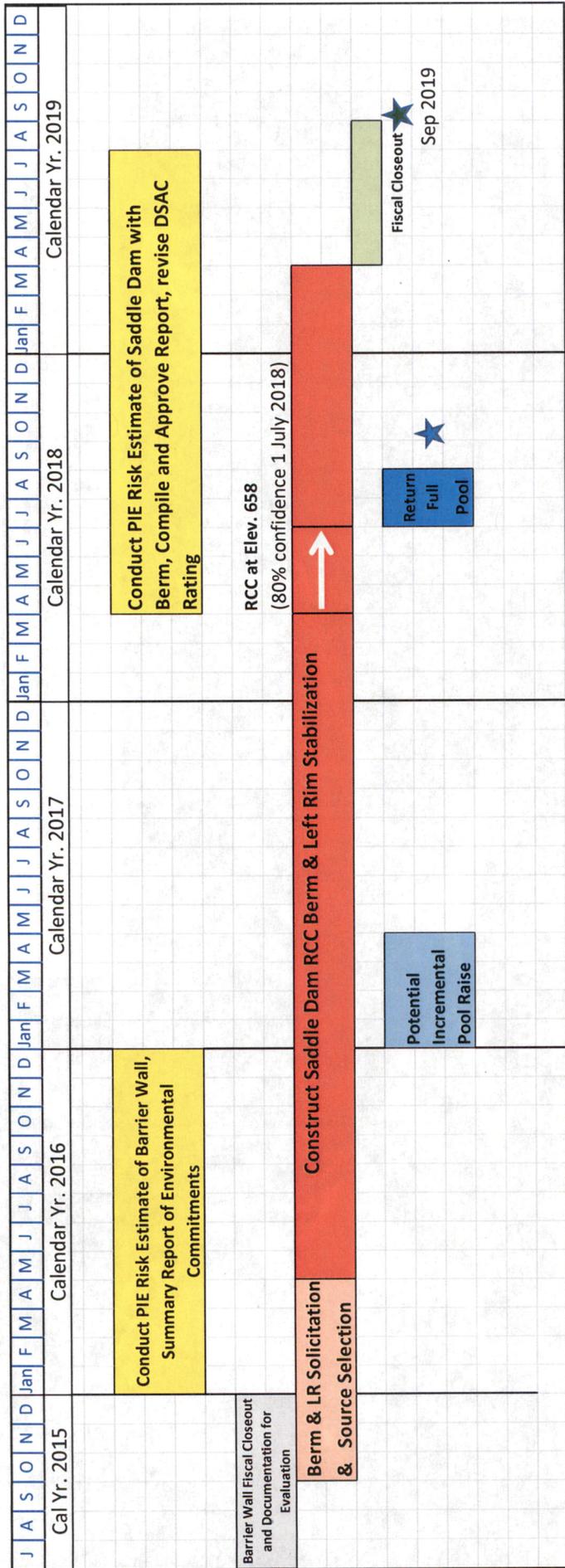


Figure 2

Center Hill Dam Safety Modification Pool Raising Plan/Schedule



Key Dates:

January 2017 - Decision on Interim Pool Raise (Go or No Go)

July 2018 - RCC Berm Evaluated; Pool Restrictions Removed