

## Lake Oroville Spillways Emergency Recovery

### Board of Consultants Memorandum No. 9 – July 19, 2017

Prepared by the California Department of Water Resources

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## Summary & Response

### Question 1

Question 1 relates to design details associated with the lower part of the Flood Control Outlet (FCO) chute. The lower part of the chute will be constructed with roller compacted concrete (RCC). During the 2018 construction season, structural concrete (concrete and steel reinforcement) will be placed on the RCC lower chute. Since the schedule will not allow the placement of structural concrete within the entire lower chute, the final layers of the RCC (layers at the top of the RCC) that could potentially experience flow will need to have higher strength.

A test section is used to allow the contractor to practice and refine construction techniques for the placement of the RCC and is typical for RCC construction.

DWR proposed and the BOC concurred with the possibility of including a detail to allow aeration. Aeration allows air within the flowing water and could be beneficial to the temporary RCC section to help mitigate for the possibility of cavitation. RCC is typically not as resistance to cavitation as structural concrete.

### Schedule Implications

The BOC is interested in ensuring they are kept informed of the schedule and progress of construction.



# OROVILLE EMERGENCY RECOVERY – SPILLWAYS

## Board of Consultants Memorandum

DATE: July 19, 2017

TO: Mr. Ted Craddock, Project Manager  
Oroville Emergency Recovery – Spillways  
California Department of Water Resources

FROM: Independent Board of Consultants for  
Oroville Emergency Recovery – Spillways

SUBJECT: Memorandum No. 9

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### **INTRODUCTION**

On July 12, 2017, the Independent Board of Consultants (BOC) met via a conference call at 10:00 AM PST that lasted until 11:15 AM with the last 15 minutes of the call focused on questions and answers. The one topic of this meeting was the FCO construction sequence and schedule with emphasis on remediation options. After the conference call, the BOC conducted closed deliberations on a call that lasted for approximately 40 minutes. BOC findings were verbally presented to the group on another conference call that was followed by some additional questions, answers, and discussion. The meeting concluded at approximately 12:15 PM. Representatives from DWR Engineering Division, DSOD, FERC, and industry consultants working on the Oroville Spillway recovery project, including Kiewit Construction, attended this meeting.

During the initial conference call presentation, several topics were presented to the BOC from a 67-page PDF document that contained graphical displays, tabular information and four individual technical memoranda. This document was provided to the BOC in an e-mail attachment the day before the conference call. The content of the document is listed in the table below.

Page	Content	Author
1	Agenda	
2 - 6	FCO Mitigation Options (Alternatives Risk Rating table and a plan view/cross section of each option)	Staff
7-10	Kiewit Construction Memorandum, June 30, 2017, "FCO Chute Construction Sequence"	Petersen

11-22	DWR Technical Memorandum, May 1, 2017, "Spillway Chute – Additional Exploration and Drilling Details	Nichols
23-49	DWR Technical Memorandum, May 10, 2017, "Spillway Chute - Phase 1 Drilling Observations"	Nichols
50-58	DWR Technical Memorandum, July 10, 2017, Structural Assessment of Damage – Friday June 30, 2017 17:30 Blast Near Station 23+00 Spillway Left	Dillon
59-61	Field Sketch of FCO slab and foundation conditions from Sta 25+00 to 27+00, along Centerline	Staff
62-67	DWR Technical Memorandum, May 10, 2017, Lake Oroville Storage and Hydrology	White

The information contained in the PDF document provided background to the discussion; however much of the information about the planned mitigation options was only presented verbally.

The meeting focused on the mitigation options for making the FCO spillway functional for the 2017-2018 seasonal flows. The BOC was informed that it is no longer considered possible to fully complete the spillway chute repair downstream of Station 23+00, based on current construction progress. As a result, interim mitigation measures that will allow the spillway to pass the flows expected during 2017-2018 have been evaluated and these options were presented to the BOC. In general, the proposed interim mitigation measures consist of reducing the lineal footage of reconstruction of the reinforced concrete in the lower FCO Spillway chute, completing the RCC fill to the foundation grade, and constructing temporary RCC gravity walls (spillway training walls) to a height of approximately 10 feet.

The BOC was also informed that on June 30, 2017, a blast at the slope left of the spillway damaged a portion of the spillway slabs and training walls upstream of Station 23+00. It was reported that the structural damage to the FCO spillway is confined to downstream of Station 22+50. Through discussions with the contractor to complete reconstructing the FCO Spillway chute by November 2018, it was determined that the upstream work limits for the reconstruction of the FCO Spillway chute should be moved further upstream from Station 23+00 to Station 20+30. The substantial change in the proposed plan is the demolition and reconstruction of an additional 200 feet of the upper FCO Spillway chute. Overall, with the proposed interim mitigation measure and the recommendation to relocate the upstream work limits, this plan provides a net reduction in FCO Spillway chute construction during construction season one, but still allows the work to be completed in two seasons.

With the aforementioned design and schedule changes, the final repairs to the spillway chute are planned to be completed during the 2018 construction season. This change is not expected to affect the emergency spillway repair schedule.

BOC members present were Eric Kollgaard, John Egbert, Kerry Cato and Paul Schweiger.

### **QUESTIONS FOR THE BOC**

**1. Does the BOC have any recommendations or comments on the proposed FCO limits of work, construction sequence and schedule?**

*Response*

Since it is not possible to fully complete the spillway chute repair downstream of Station 23+00, the BOC is in agreement with the proposed interim mitigation measures that will allow the spillway to pass flows expected during 2017-2018 and recommends that the contractor be authorized to proceed with this plan.

The BOC understands that the RCC slab surface will be placed near the level of the base of the structural concrete slab to be constructed in 2018. The final lift of RCC is to be placed and compacted on the sloping 4H:1V chute surface. To help achieve an erosion-resistant flow surface, the top RCC lift will have a higher cement content for higher early RCC strength. In addition, a chemical treatment is being investigated that may be applied to the finished surface of the RCC that will reportedly improve its resistance to erosion by increasing the surface material strength to 8,000 – 10,000 psi. The BOC is interested in the details of this procedure and the reasoning of how it will be successfully used for this spillway. In addition, the flow surface must also be free of abrupt discontinuities or offsets, but does not need to have a highly-finished surface.

It was reported that a supplemental RCC test section will be constructed to confirm and refine the construction techniques proposed to place and compact the final lift of RCC on the sloping 4H:1V chute surface. The BOC encourages this activity. The contractor may want to consider evaluating the use of a conventional or modified paving machine to place and consolidate the top lift of the RCC. This technique was used at Renwick Dam to construct RCC paved roads with good results. Photographs showing this technique are presented in Figure 1 and Figure 2.



Figure 1. Photographs showing placement of RCC using a conventional mechanical paver machine at Renwick Dam at Icelandic State Park in North Dakota.



Figure 2. Photographs showing RCC placed using a conventional mechanical paver machine at Renwick Dam at Icelandic State Park in North Dakota.

Transverse joints will not be provided in the top lift of RCC but will be in the RCC placements below. It is anticipated that cracking will occur in the top lift but the cracks will have limited opening. It will be important to inspect the slab after initial operation to check for spalls where crack edges may have broken and be prepared to repair any found.

The BOC believes that the temporary RCC training walls may present the greatest difficulty to the plan for constructing the RCC section of the chute in the tight time schedule allotted. It is not clear that the problems of placing narrow fills of RCC on a relatively steep slope are fully recognized. The usual practice of using temporary ramps for delivery of RCC and for movement of operating equipment is not practical because of the steep drop-offs on either side of the chute. The BOC will be interested in hearing more detail regarding the contractor's means and methods to accomplish this construction.

The RCC training walls will be removed for the construction of the reinforced concrete permanent training walls in 2018. [REDACTED]

[REDACTED].  
Specialty contractors are available who have gained experience in these procedures from slot cutting dams to alleviate problems from alkali reactivity. The BOC would encourage making such provisions to facilitate the placement of the permanent structural concrete in 2018.

The BOC recommends that the Design Team take advantage of this opportunity to include an aerator ramp or slot at the upstream end of the exposed RCC foundation. The BOC believes that this would be a highly effective measure to protect the RCC surfaces exposed to high velocity flows. A new spreadsheet for the design of aerators for spillways based on the work of Mr. Henry Falvey is available from Mr. Tony Wahl of Reclamation to help expedite the design.

Transitions between the structural slabs and RCC section will be necessary at both the upstream and downstream ends of the exposed RCC (at Sta. 27+75 and Sta. 39+27). The BOC recommends that a physical model study of the proposed interim spillway configuration be performed to evaluate the transition details and the aerator, if it is included in the design. There was no discussion about when the dentate surface repair will occur; the BOC presumes this activity will still occur in the 2017 construction season.

### **Schedule Implications:**

The 67-page document presented to the BOC, in preparation for the July 12, 2017 conference call, contained the contractor's Serial Letter 034 dated June 30, 2017 "...regarding a revision to the FCO Chute Construction Sequence and required milestone dates." These revisions are significant and seem to follow the contractor's presentation made to the BOC on June 21, 2017 during which the BOC was made aware of the contractor's anticipated schedule impacts.

The contractor's Serial Letter 034 contains two critical milestones for 2017 Work. Both RCC Placement and Structural Concrete Placement have "*Expected Completion*" dates of October 15, 2017. Also, the "*Last RCC Placement*" and "*Last Structural Placement*" are both October 31, 2017. These activities appear to conflict and their completion dates should be confirmed.

The BOC looks forward to reviewing the contractor's updated schedules and sequences of work from those presented on June 21, 2017; specifically, quantitative progress on foundation cleanup, RCC placement, chute slab placement, and wall placement should be updated. The BOC would also like to review updated quantities (SY and CY) and production rates.

The BOC recommends a weekly schedule/progress meeting be held between the contractor and DWR management with the goal of determining measurable contractor progress and developing look ahead schedules.

### **BOC Recommendations Summary**

- M9-1      The BOC is in agreement with the proposed interim mitigation measures that will allow the spillway to pass flows expected during 2017-2018 and recommends that the contractor be authorized to proceed with the proposed plan.
  
- M9-2      The BOC encourages additional RCC test section work be performed to confirm and refine the construction techniques needed to place and consolidate the final lift of RCC on the sloping 4H:1V chute surface to provide a hard, durable surface free of discontinuities.
  
- M9-3      The BOC believes that the temporary RCC training walls may present the greatest difficulty to the plan for constructing the RCC section of the chute in the tight time schedule allotted. The BOC will



be interested in hearing more detail regarding the contractor's means and methods to accomplish this construction.

- M9-4 The BOC encourages including provisions in the RCC gravity walls to facilitate their demolition following the 2017-2018 seasonal use of the spillway so that the placement of the permanent structural concrete can be completed within the 2018 construction season.
- M9-5 The BOC would like to be provided details of chemical treatment planned for the RCC flow surface.
- M9-6 The BOC recommends that the Design Team take advantage of this opportunity to include an aerator ramp or slot at the upstream end of the exposed RCC foundation. The BOC believes that this would be a highly effective measure to protect the RCC surfaces exposed to high velocity flows.
- M9-7 The BOC recommends that a physical model study of the proposed interim spillway configuration be performed to evaluate the RCC transition details, and the aerator, if it is included in the design.
- M9-8 The BOC looks forward to reviewing the contractor's updated schedules and sequences of work from those presented on June 21, 2017; specifically, quantitative progress on foundation cleanup, RCC placement, chute slab placement, and wall placement should be updated. The BOC would also like to review updated quantities (SY and CY) and production rates.
- M9-9 The BOC recommends a weekly schedule/progress meeting be held between the contractor and DWR management with the goal of determining measurable contractor progress and developing look-ahead schedules.

Respectfully submitted,



**Eric B. Kollgaard**

Not present

**Faiz Makdisi**



**Kerry Cato**



**John Egbert**



**Paul Schweiger**

Meeting Title: Board of Consultants, Meeting 9  
Date: 07/12/2017

Name	Affiliation
Blackett, Frank	FERC
Boyer, Doug	FERC
Brand, Bruce	FERC
Brown, Dale	DWR
Cato, Kerry	BOC
Craddock, Ted	DWR
Fortner, Mark	GEI
Egbert, John	BOC
Gutierrez, David	GEI
Harder, Les	HDR
Kollgaard, Eric	BOC
Lewis, Liz	GEI
Mihyar, Mutaz	DSOD
Rogers, Mike	MWH Stantec
Schweiger, Paul	BOC
Verigin, Steve	GEI