California Water Research

Part 2 Rebuttal Testimony of Dr. Clyde Thomas Williams

I, Clyde Thomas Williams, have previously testified in this matter. My Statement of Qualifications is available as Exhibit DDJ-162. The following testimony is submitted at the request of Deirdre Des Jardins, principal at California Water Research, in the public interest.

Summary of Testimony

My testimony responds to the following:

1. Changes to the project in the Admin Draft Supplemental EIR to eliminate expansion and reconstruction of Clifton Court Forebay.
2. Statements in the Admin Draft Supplemental EIR that other aspects of the project are not changing, which is contradicted by testimony by John Bednarski that the facilities design and alignment is subject to change by the Engineering Design Manager when further geotechnical information becomes available.
3. Statements by Dr. Earle that impacts on wildlife have been evaluated rely on the Final EIR/EIS, which is contradicted by testimony by John Bednarski that borrow areas have not been identified.

I. Clifton Court Forebay Not Being Expanded or Reconstructed

The Admin Draft Supplemental EIR states that the project will not expand Clifton Court Forebay (Exhibit SWRCB-113, p. 3-1:33-35), and that "[t]he addition of the Byron Tract Forebay would eliminate the need to make modifications to Clifton Court Forebay that were included in the approved project." (Exhibit SWRCB-113, p. 3-6:9-10.)

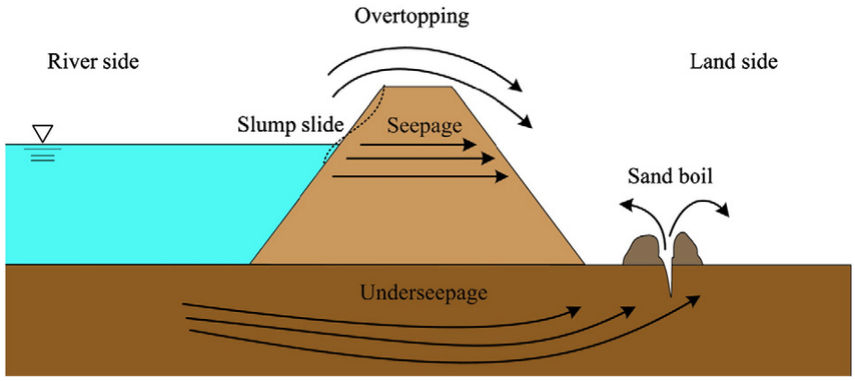
If Clifton Court Forebay is not expanded, and the embankments are not reconstructed, water will continue to be impounded in the existing embankments. There are long-standing issues with both underseepage and seismic safety of the existing Clifton Court Forebay embankments, as described in my technical memo, Exhibit DDJ-302. The investigation by the Department of Water Resources of reports of seepage by Ms. Womack have been cursory and inadequate, as shown by exhibits she submitted for Part 1 of the State Water Resources Control Board's WaterFix water right change petition hearing. The memorandum from Tim Wehling, Chief of the Department of Water Resources' Dams and Canals Section of the Geotechnical and Engineering Services Branch and Erdom Abraham[1] completely fails to consider that there was no excavation of organic soils on the surface when constructing Clifton Court Forebay.

As explained in my technical memo, the Department of Water Resources' *Bulletin 200, volume 3, Storage Facilities* (1974) documents that there were one to twelve feet of unexcavated organic soils on the surface when Clifton Court Forebay was constructed.[2] Studies consistently show that seepage related failures of dams comprise about one half of all dam failures. (Federal

[1] Exhibit DDJ-302 is a copy of the Department of Water Resources, May 26, 2017 memorandum re: Clifton Court Forebay- Landowner Seepage Concerns. Obtained from Susan Womack.

[2] Exhibit DDJ-303 is a true and correct copy of California Department of Water Resources, *Bulletin 200, Volume III, Storage Facilities* (1974.) Obtained from the Internet Archive at https://ia800302.us.archive.org/3/items/zh9californiastatew2003calirich/zh9californiastatew2003calirich.pdf

Emergency Management Agency, *Evaluation and Monitoring of Seepage and Internal Erosion, Interagency Committee on Dam Safety*, 2015.[3]) Under-seepage is also known to be a cause of levee failure, and is a widely known risk in delta soils, as shown in the diagram below.



In addition, we now have a better understanding of the mechanics of underseepage in discontinuous layers of pervious soils, such as those under Clifton Court Forebay. The Army Corps of Engineers *Draft Integrated Interim Feasibility Study and Draft EIR/EIS for the San Joaquin River Basin, Lower San Joaquin River, CA*[4] explains the urgency of re-evaluating under-seepage in Delta soils:

> The potential for seepage problems to occur along the existing levees in the project area is created by discontinuous layers of coarse-grained pervious soils (i.e., sands and gravels). These are found at varying depths of up to -100 feet. During high-water events, water from

[33] Exhibit DDJ-304 is a true and correct copy of the Federal Emergency Management Agency guidelines, *Evaluation and Monitoring of Seepage and Internal Erosion, Interagency Committee on Dam Safety*, 2015. Obtained from https://www.fema.gov/media-library-data/1436889238781-1b63946bfcb27bab5d85f7f95a66ce35/FEMAP1032.pdf

[4] Exhibit DDJ-305 is a true and correct copy of US Army Corps of Engineers, *Draft Integrated Interim Feasibility Study and Draft EIR/EIS for the San Joaquin River Basin, Lower San Joaquin River*, CA (February 2015.) Obtained from http://www.spk.usace.army.mil/Portals/12/documents/usace_project_public_notices/LSJRFS_Draft_EIS-EIR_Feb2015.pdf.

> the river can enter the pervious soil layers and then move laterally through these layers under/through the levee. Excessive seepage can erode soil within the levee and lead to a rapid collapse and subsequent breach. Historically, foundation conditions were evaluated assuming homogeneous materials, but the floods of 1986 and 1997 and the resulting levee failures throughout the Central Valley resulted in a revision of the criteria for the evaluation of under-seepage. The risk of levee failure is not due to design deficiency or to lack of O&M of the existing levees, but to a better understanding of the mechanics of under-seepage in the Central Valley. (p. 90, underlining added.)

Due to under-seepage, the Army Corps of Engineers estimated that the "risk and uncertainty" of levee failure could be as high as 50% a year for some of the levees protecting the northern part of Stockton. As part of alluvial and deltaic deposits, channel sand lenses are likely sources of discontinuous layers of pervious ground beneath Clifton Court Forebay and its embankments. Records show that the CCF embankment has similar construction to Delta levees.

Failure of Clifton Court Forebay could have catastrophic effects, not only on Clifton Court Forebay, Byron Tract Forebay, and nearby properties and any occupants, as well as severe environmental impacts. For the project to be a reasonable diversion of water, the underseepage and seismic safety issues must be addressed.

Although no other physical modifications may be made, large amounts of water will continue passing through the Forebay. As was shown with Oroville dam, continued use without complete and adequate assessment of potential failure modes may increase the risk of catastrophic failure. If the State Water Resources Control Board approves the current change petition, the Board must include a permit term mandating that the Department of Water Resources do a full assessment of underseepage and seismic safety issues, submit the assessment for independent engineering review.

II. Changes to the WaterFix Project

The Supplemental EIR/EIS, Table 3-1 states that the other physical characteristics of the Project would not change. (Exhibit SWRCB-113, p. 3-3.) However, the configuration of the

WaterFix Project facilities is currently being revised and is subject to further modification by the Engineering Design Manager, when further geotechnical and preliminary design information are available. The Department of Water Resources' *Request for Qualifications NO. 10138585, California WaterFix Engineering Design Manager* (Exhibit DDJ-254) states that the Engineering Design Manager ("EDM") will "advance the conceptual engineering to set final configuration of the following facilities:"

a. Tunnel sizes, alignments, and grades and determine location and configuration of all shaft sites and other related appurtenances including access roads and barge landings;

b. Intakes, including sedimentation basin, drying lagoons, conduits, and outlets;

c. Intermediate forebay with inlet and outlet structures and control;

d. Forebay near Clifton Court: including conveyance and control facilities to convey water to existing State Water Project (SWP) and CVP facilities;

e. Pumping plant and surge structures

(p. 28-29.)

Metropolitan Water District's WaterFix project engineer, John Bednarski, testified on cross-examination about the above EDM task list in Part 2 of the State Water Resources Control Board's WaterFix Water Right Change Petition Hearing (WaterFix Hearing Transcript, March 9, 2018, p. 13 at 13)[5]. Bednarski stated in part:

> As we get additional information in place, such as the mapping, <u>such as the geotechnical information</u>, such as our meetings with some of the regulatory bodies that we need to meet with in order to get permits, that there could be modifications made to the – the facilities that are presently shown in the mapbooks and the CER. (WaterFix Hearing Transcript, March 9, 2018, p. 16 at 21, underlining added)

Because the required geotechnical evaluation has not been done, I consider it likely that many aspects of the Project will change. Masoud Mansari did a study of managing geotechnical risks of tunnel projects in soft ground. Massari's presentation on the study was titled, *Soft Ground Site*

[5] The March 9, 2018 WaterFix hearing transcript is available at https://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/california_waterfix/docs/transcripts/2018/20180309_transcript.pdf. Incorporated by reference.

Investigation & Managing Geotechnical Risks In Tunnelling.[6] The presentation includes the graph on the following page, showing the number of change orders to the projects he studied as a function of the number of boreholes per linear feet of tunnel route. The number of change orders goes up almost exponentially as the number of boreholes decreases. The boreholes for the WaterFix project are on the extreme lower end of the X axis on Masari's graph.

In addition, while the leakage analysis done to validate the tunnel lining design (Exhibit DWR-659) looks competent, the analysis methodology is based on a 1994 paper by Fernandez[7], who derives his estimates from assumptions for rock tunnels. The assumptions almost certainly don't apply to tunnel linings in soft alluvial deposits beneath the Delta and especially for the connecting tunnel/shaft portions. I would therefore expect that there will need to be significant changes to the tunnel design to ensure that the proposed segmented tunnel lining will not develop leaks under long-term operation. Due to cost escalation issues, an adequate design could require significant changes in the currently proposed tunnel alignment to move the segmented lining to better soils.

Based on my 30 years of experience with underground projects, I think it likely that there will be significant changes to the tunnel and shaft designs and likely significant increases in cost and time. I do not consider a project that is subject to a cost escalation of more than 30% to have a final/biddable/construction design, or even preliminary designs.

[6] Exhibit DDJ-303 is a true and correct copy of Massari, M. *Soft Ground Site Investigation & Managing Geotechnical Risks In Tunnelling*, presentation at Challenges and Innovations in Tunnelling Conference, October 2015.

[7] Exhibit DDJ-308 is a true and correct copy of Fernandez, G., 1994. Behaviour of Pressure Tunnels and Guidelines for Liner Design. Journal of Geotechnical Engineering. 120 (10): 1768 – 1791

III. Borrow areas

Dr. Earle's testimony that the WaterFix projects would not have unreasonable impacts on wildlife relies on the Final EIR/EIS (Exhibit DWR-1014, p. 3:3-10.) But the maps in the Final EIR/EIS and the Admin Draft Supplemental EIR/EIS do not show the proposed borrow areas. John Bednarski stated on cross-examination that the location of the borrow areas for the project had yet to be determined. The top layers of soil in the Central Delta are either peat or silt and clay with significant amounts of organics, and it is inadvisable to dig deep borrow pits because of potential underseepage issues. So locations where there is usable soil for fill will be scarce. My technical memo on borrow fill discusses the issues,[8] which are evaluated in a borrow area geotechnical report by URS for the In-Delta Storage Project on Bacon Island[9], which assumes that borrow pits need to be dug no closer than 15 feet to levee crests, and no more than 15 feet deep. The boring logs for the In-Delta Storage Project and boring logs for two of DWR's boreholes on Bacon Island, show little to no usable borrow within 15 feet of the surface.

For these reasons, I believe that geotechnical considerations will mandate where the borrow pits are, and such considerations could significantly expand the footprint or reach of the Project in the maps in the Supplemental EIR-EIS. If borrow is obtained locally, it may need to be barged in or trucked to the area where it will be used after appropriate treatment (e.g., dewatering). There will either be unfilled borrow pits all over the Delta, or the tunnel muck disposal pipelines and areas will be moved to where the borrow pits are. Either way the final footprint for borrow areas

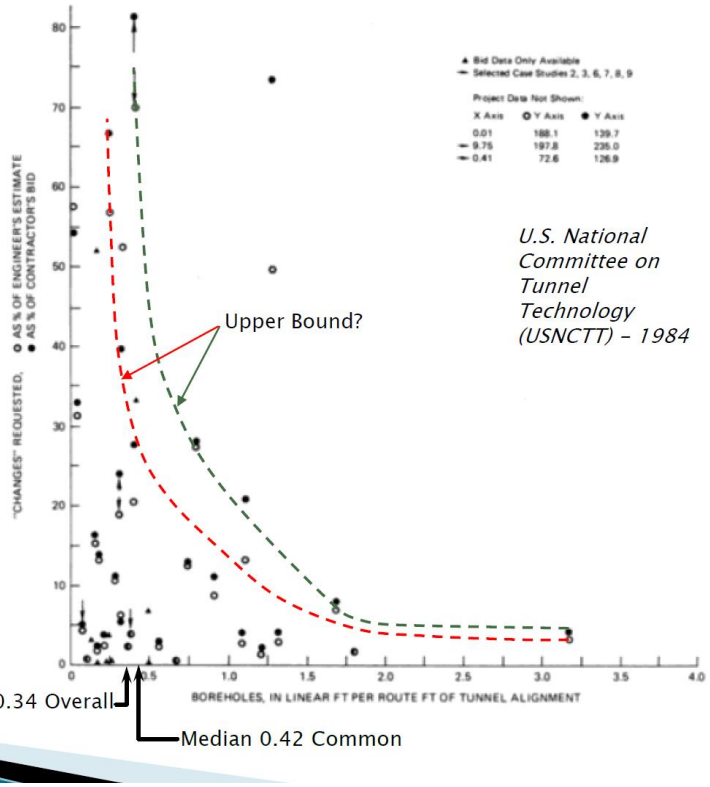
[8] Exhibit DDJ-309 is a true and correct copy of my technical memo for California Water Research, Borrow sources for the California WaterFix, July 2018.

[99] Exhibit DDJ-306 is a true and correct copy of URS Corporation, *In-Delta Storage Program Borrow Area Geotechnical Report*, 2003. Obtained from http://www.calwater.ca.gov/content/Documents/library/Storage/InDeltaStorageReports_2003/Engineering/Borrow%20Area/Borrow%20Area%20Geotechnical%20Report.pdf.

and tunnel muck disposal areas has not been finally determined, nor has the amount of pipeline, truck, and barge traffic.

Cost Overrun vs. Scale of Investigation

- Cost overrun due to geotechnical issues
- 84 projects, including 10 Canadian projects
- Borehole/tunnel ratio of 0.5: potential cost overrun, up to 60%
- B/T ratio > 1.5, not much benefit



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Executed on this 13th day of July, 2018 in Los Angeles, California.

Clyde Thomas (aka Tom) Williams