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22 **BEFORE THE**  
23 **CALIFORNIA STATE WATER RESOURCES CONTROL BOARD**

24 HEARING IN THE MATTER OF  
25 CALIFORNIA DEPARTMENT OF WATER  
26 RESOURCES AND UNITED STATES  
27 BUREAU OF RECLAMATION'S  
28 REQUEST FOR A CHANGE IN POINT OF  
DIVERSION FOR CALIFORNIA WATER FIX

**TESTIMONY OF JOSEF TOOTLE**  
**REVISED**

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1 My name is Joe Tootle, I am a Principal Geotechnical Engineer at ENGEO  
2 Incorporated. I am a registered Civil and Geotechnical Engineer in California and have been  
3 practicing as an engineering consultant for over 20 years. My experience includes the lead  
4 geotechnical design for, and management of, multifaceted projects that have collectively  
5 included more than 100 million cubic yards of earth work; hundreds of miles of roadway  
6 improvements; public infrastructure, including bridges, tunnels, levees, detention basins,  
7 highways and light rail transit corridors; commercial, residential, and retail centers; community  
8 centers; and public buildings. (See also LAND-36.)

9 This testimony addresses three major adverse physical impacts of the California  
10 WaterFix (“CWF”) project that are likely to result in injury to legal users of water. However, in  
11 each case, the Petitioners have not presented enough detail regarding the proposed project,  
12 existing conditions, or proposed mitigation to ensure that there will be no injury or to evaluate  
13 and describe the likely range of injuries in greater detail than what is set forth below.

#### 14 **1. Impacts on Groundwater Use**

##### 15 **a. Background**

16 The CWF project has undergone some modifications and/or refinements over the past  
17 several years. These modifications have been directed at both long-term operational impacts,  
18 as well as potential construction related impacts. In an attempt to address the potential  
19 construction related impact of temporary dewatering, according to testimony presented in  
20 support of the Petition, the CWF project was modified to include impermeable slurry cutoff  
21 walls at specific construction sites to isolate the effects dewatering activities on the  
22 surrounding groundwater. (DWR-218) Slurry cutoff walls are currently proposed for the  
23 construction of proposed intakes, pumping plants, forebay embankments, and tunnel shafts.  
24 Although this modification may be effective at reducing potential construction related impacts  
25 of dewatering, the CWF project has neglected the potential long-term impacts of the slurry  
26 cutoff wall construction at the associated cutoff wall locations.

27 The potential long-term effects of slurry cutoff walls along the tunnel alignments, are  
28 limited to the locations where there is a shaft (DWR-212, Figure 3-1); however, the potential for

1 long-term effects on groundwater uses may also be impacted by proximity to the tunnels. The  
2 conceptual tunnel inverts range from 122 to 135 feet below mean sea level (“msl”) for the  
3 North tunnels and from 147 to 163 feet below msl for the Main tunnels. At these depths, the  
4 tunnels will be constructed using closed-face pressurized soft ground tunnel boring machines  
5 (“TBMs”). (DWR-212, Section 11.2.5.)

6 Although the CWF project is not proposing impermeable slurry cutoff walls along the  
7 entire tunnel alignment, the tunnels themselves may act as a similar barrier to the existing  
8 groundwater flow. The majority of the tunnel liner will be in excess of 40 feet in outside  
9 diameter and consist of precast concrete segmental sections. Given that many water wells are  
10 located in the vicinity of the tunnel alignment and that several of these wells have screened  
11 intervals in the approximate depth range of the tunnels, partial obstruction to the current well  
12 production may likely be observed. (See LAND-58, LAND-59.)

13 To understand the potential impact of constructing slurry cutoff walls in the Delta, it is  
14 important to understand the near-surface soil deposits in the region. The near-surface soil  
15 deposits within the Delta, and along the majority of the project alignment, are generally very  
16 complex and are often characterized as former freshwater marsh deposits traversed by  
17 numerous existing and former delta distributary channels (Atwater 1982).<sup>1</sup> Some of the  
18 complexity can be seen on Atwater’s geologic map of Bouldin, Venice, and Mandevil Islands.  
19 (LAND-37, slide 1.) Many permeable sandy deposits (Qm2e) are mapped within isolated  
20 areas of less permeable mud deposits (Qpm) across the region. In addition, several  
21 concealed former channel alignments are identified that cut across many island interior  
22 locations. (DWR-212, Section 3.3 [\[CER\]](#).)

23 Historically, it was the nature of Delta distributary channels to regularly breach their  
24 natural levees and change course. This process was presumably active throughout the late  
25 Holocene when the uppermost 15 to 20 feet of existing soils along much of the project  
26 alignment were deposited, so it is likely that there are many concealed former distributary  
27 channels and associated permeable sand and silt lenses within the near-surface soil deposits.

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28 <sup>1</sup> [A true and correct copy of Atwater 1982 is included as Exhibit LAND-40.](#)

1 The sequencing of this complex depositional process is illustrated in LAND-37, slide 2 [Frazier  
2 and Osanik 1969].<sup>2</sup> These former channel alignments often provide both horizontal and  
3 vertical seepage pathways through less permeable fine grained soils. The original natural  
4 channels were often extensively modified by construction of levees and re-alignment during  
5 drainage of the area for agriculture. Many minor distributary channels were covered by man-  
6 made levees and later obscured by agricultural field leveling. (DWR-212, Section 3.3.)

### 7 **b. Tunnels**

8 Although the tunnels have not been specifically designed to act as permanent barriers  
9 to groundwater flow, as have the slurry cutoff walls, they have a similar potential to obstruct the  
10 flow of groundwater. The tunnels will be in excess of 40 feet in out-side diameter and will form  
11 a continuous linear feature of over 40 miles long. (DWR-212, Section 11.1.) This large project  
12 component has a distinct potential to act as an impermeable barrier to the existing  
13 groundwater flow conditions in the immediate vicinity of the proposed tunnel alignment.  
14 Given the previously described complex heterogeneity of the soils along the tunnel alignment,  
15 the effects of the potential groundwater barrier created by the tunnel structure is likely to result  
16 in a permeant and adverse alteration of the current groundwater conveyance conditions,  
17 similar to that of the slurry cutoff walls. As a result, existing water wells in the vicinity of the  
18 proposed tunnel alignment, with screen intervals near the tunnel invert elevation, may  
19 experience significant permanent decreases in well production rates.

20 As shown in the figures in LAND-58 (Sacramento County Wells in Vicinity of Tunnels)  
21 and LAND-59 (San Joaquin County Wells in Vicinity of Tunnels), a very preliminary  
22 investigation showed that there are several wells in the vicinity of the Tunnels that are in  
23 jeopardy of being adversely impacted by the placement of the Tunnels. Not only are they near  
24 the Tunnels, they are also at a depth that is similar to the Tunnels, making the impact more  
25 likely. (LAND-65, Drawings 33-35 [Main Tunnels: Plan and Profile].) This obstruction could  
26 affect both water availability as well as water quality.

### 27 **c. Slurry Cutoff Walls**

28  

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<sup>2</sup> A true and correct copy of Frazier and Osanik 1969 is included as Exhibit LAND-41.

1 John Bednarski explained that the proposed dewatering approach during construction  
2 includes the installation of slurry cutoff walls. (Bednarski Testimony, DWR-57, p. 15, lines 7-  
3 10.) As further described by Gwendolyn Bucholtz, slurry cutoff walls are frequently used in  
4 areas with high groundwater to form a permanent hydraulic barrier within groundwater  
5 aquifers. (DWR-218.)

6 Although construction of slurry cutoff walls prior to dewatering should reduce the  
7 potential adverse effects on surrounding groundwater levels during construction, the presence  
8 of the slurry cutoff walls following construction will continue to act as permeant barriers to  
9 groundwater flow. Slurry cutoff walls function by acting as nearly impermeable barriers to  
10 groundwater flow across the slurry wall alignment. This is the characteristic that allows the  
11 groundwater to be lowered within the construction area while preventing groundwater levels  
12 outside the construction dewatering area from dropping. However, the obstruction of  
13 groundwater flow across the slurry cutoff wall alignment will remain following construction.

14 There exists a substantial possibility that adjacent property owners that rely on drainage  
15 of shallow groundwater for agriculture production and/or use of shallow groundwater aquifers  
16 for irrigation water will be significantly adversely impacted by this introduction of nearly  
17 impermeable barriers to groundwater flow, i.e., by the proposed slurry cutoff walls. Mr.  
18 Bednarski's testimony cites the May 19, 2016 memo from Ms. Buchholz, CH2MHill to Russ  
19 Stein, Department of Water Resources, as concluding that the potential adverse effect to  
20 groundwater due to construction will not be adverse. (DWR-57, p. 15, lines 18-21, citing to  
21 DWR-218.) Ignoring the facial illogic of Mr. Bednarski's statement ("the potential adverse  
22 effects . . . will not be adverse"), the cited memo does not address at all the potential adverse  
23 post-construction effects of the proposed cutoff walls.

24 Yet, Ms. Buchholz's May 19, 2016 memo admits that slurry cutoff walls will prevent  
25 horizontal groundwater flow: "*Groundwater that previously moved horizontally through the soil*  
26 *toward the excavation location would then be redirected by the slurry cutoff wall to move*  
27 *around the wall and construction site.*" (DWR-218, p. 4, italics added.)  
28

1 Any assertion that the proposed slurry cutoff walls will not result in any adverse effects  
2 to groundwater used by overlying property owners necessarily rests on the assumption that  
3 groundwater can flow around the wall. This assumption, in turn, generally requires that the  
4 subsurface soils are homogeneous (as depicted in Figure 1 of DWR-218, p. 8) and that there  
5 are no natural barriers to groundwater flow that may be preventing groundwater from flowing  
6 around the wall. As previously described, however, the near-surface soils, across much of the  
7 project alignment, are highly heterogeneous in nature and include soils that have both  
8 relatively low hydraulic conductivities and relatively high hydraulic conductivities. (Atwater  
9 1982.) This complex heterogeneity means that the desired effect of the slurry cutoff walls (i.e.,  
10 creation of a permanent barrier to groundwater flow) will likely result in a permeant and  
11 adverse alteration of the current groundwater conveyance conditions.

12 **d. Identification of Potential Injury**

13 Given the highly complex nature of the soil deposits along the CWF project alignment,  
14 prediction of the magnitude and extent of the impact is extremely difficult. As previously  
15 discussed, the locations of more permeable soil deposits that may currently be aiding the  
16 drainage of existing agricultural areas or contributing to current well yields, are often difficult to  
17 identify in isolated borings or through historical aerial photograph review due to the reclamation  
18 processes that were undertaken during the last century.

19 Extensive geotechnical explorations that include numerous exploratory borings, cone  
20 penetration test (“CPT”) soundings, and geophysical surveys can easily miss significant  
21 variations in subsurface stratigraphy and aquifer connectivity. Even the most complete studies  
22 may have difficulty predicting all of the potential consequences of altering the groundwater flow  
23 patterns. Given the complex and sensitive nature of Delta groundwater flow patterns and their  
24 critical importance to legal users of water within the Delta, the potential for injury resulting from  
25 the proposed extensive use of slurry walls is particularly high. Certainly, nothing I have seen in  
26 the CWF project documentation, including the Conceptual Engineering Report (DWR-212,  
27 LAND-65), the Bucholtz Memorandum (DWR-218), or the Mitigation Measures included in the  
28 2015 RDEIR/S (SWRCB-3, Appendix A, Mitigation Measures AG-1 [pp. 14-7 to 14-15], GW-1,

1 5, 11 [pp. 7-12 to 7-18]), affords any assurance—much less a credible science-based  
2 assurance—that the project will not result in such injury.

3 Mitigation provided for groundwater interference may be inadequate to prevent injury.  
4 As identified in the 2015 RDEIR/S, the CWF construction impacts would include: groundwater  
5 supply depletion, groundwater recharge interference, groundwater level alteration, and  
6 groundwater well capacity reduction. (RDEIR/S, Impact GW-1.) Although, mitigation of these  
7 potential construction-phase impacts could be achieved through the installation of slurry cutoff  
8 walls as described above, the potential impact of, and proposed mitigation for, the construction  
9 of permanent barriers to groundwater flow (i.e., slurry cutoff walls) is not adequately  
10 addressed. Mitigating the potential temporary construction-phase interference with, or  
11 alteration of, groundwater resources by constructing permanent barriers to groundwater flow  
12 may prevent a temporary injury, but may just as likely create a permanent injury. These  
13 potential permanent impacts do not appear to be adequately addressed by the proposed CWF  
14 project design or mitigation measures.

## 15 ~~2. Spoils Disposal~~

16 ~~Section 22.0 of the CER, Spoils Disposal Sites, states:~~

17 ~~Significant thicknesses of non-supportive or organic soils must be removed in the~~  
18 ~~course of forebay, pumping plant, and shaft construction. Large volumes~~  
19 ~~(approximately 30.7 million cy) of re-usable tunnel material (RTM), consisting of~~  
20 ~~saturated soils mixed with bio-degradable polymers, are generated by tunneling~~  
21 ~~operations. Large volumes (approximately 8 million cy) of dredge material are~~  
22 ~~also expected to be removed from NCCF and SCCF. Smaller quantities of~~  
23 ~~excess excavated materials are expected at other facility sites, including about~~  
24 ~~1.9 million cy at IF and approximately 1.6 million cy at each intake site.~~

25 ~~Organic materials will be stockpiled for placement over completed disposal~~  
26 ~~areas. Soils that are unsuitable for reuse as restoration material, flood fight~~  
27 ~~material, and engineered fill need to be disposed. These materials will be~~  
28 ~~characterized and disposed appropriately. The presence of hazardous materials~~  
~~or environmental working conditions in or adjacent to potential spoil disposal~~  
~~sites will need to be evaluated. Hazardous materials excavated during~~  
~~construction needs to be segregated from other construction spoils and properly~~  
~~handled in accordance with state regulatory requirements.~~

26 ~~(DWR-212, p. 207.)~~

27 ~~The numbers here are staggering, even for engineers familiar with large tunneling and~~  
28 ~~excavation projects. The total of 45.4 million cubic yards would be three times that in square~~



1 yards if the material was spread out to a depth of 1 foot (which it might need to be for drying  
2 and conditioning, leaving aside the question of how one might dry out such material in winter);  
3 that is 136.2 million square yards or 28,140 acres. Drawings in Volume 2 of the CER shows  
4 possible locations for “disposal areas”, principally on Glanville Tract near the Intermediate  
5 Forebay (including locations within the Stone Lakes National Wildlife Refuge boundary), on  
6 Bouldin Island, and on Byron Tract near the revised Clifton Court Forebay, but these locations  
7 have changed before and may well change again. (LAND-65.) The CER provides a list of  
8 rules to be followed in siting these facilities but then simply states: “as more information about  
9 the nature and volumes of soil generated becomes available, distances and sizes of disposal  
10 areas will be refined and identified.” (DWR-212, p. 207.)

11 ——— I have been unable to locate any detailed design and analysis or credible commitments  
12 or assurances in the CWF submissions regarding disposal of spoils. Mr. Bednarski does make  
13 some comments but these are limited to reusable tunnel material:

14       The excavated material will be saturated with water and might be plasticized due  
15 to the use of biodegradable additives (e.g. foam or soil conditioner). [(Reusable  
16 Tunnel Material Testing Report, March 2014). Details on disposal and reuse of  
17 tunnel material are described in Section 3B.2.18, Appendix A, Recirculated Draft  
18 Environmental Impact Report/Supplemental Draft Environmental Impact  
Statement (RDEIR/SDEIS)]. (Exhibit SWRCB-3.) Treatment and disposal of the  
decant liquids from the excavated material will require permitting in accordance  
with current National Pollutant Discharge Elimination System (NPDES) and  
Regional Water Quality Control Board regulations.

19 (DWR-57, p. 19, lines 2-9.)

20 ——— However, Section 3B.2.18, Appendix A, of the RDEIR sets forth only obtuse and generic  
21 environmental commitments, not actual analysis of impacts or potential injury to other water  
22 users. (SWRCB-3.) It provides no detail on locations or designs and provides no credible  
23 assurance that there will not be injury to other water users.

24 ——— Absent this missing detail on the location and design of spoil handling facilities, it is  
25 impossible to quantify the likely injury to adjacent legal users of water. Unmentioned is the fact  
26 that water quality in the Delta peats below the irrigated zone is very poor. Any such materials  
27 will need to be handled separately and safely disposed of. At least some facilities will require  
28 liners with leak detection systems. Such liners will disrupt normal infiltration of precipitation

1 and hence groundwater flows even more than unlined stockpiles. Unlined stockpiles, on the  
2 other hand, will likely cause local mounding of the groundwater. Lined or unlined stockpiles,  
3 and final disposal areas, will also disrupt existing patterns of surface drainage and likely disrupt  
4 irrigation systems. Unless treatment and disposal of decant and other liquids is flawless, there  
5 will be injury to other water users and to the waters of the State. Simply stating an intention to  
6 acquire the required permits provides little assurance that these injuries will not occur.

### 7 **3. Loss of Ground as a Result of Tunneling Activities, with Catastrophic Impacts on** 8 **Levees and Islands**

9 ——— It is well known that many of the Delta islands and tracts are subsided below the normal  
10 range of water levels in the rivers and sloughs and that they are only kept dry by the levee  
11 system. (See, for instance, Figure 14, Chapter 5, of the Economic Sustainability Plan of the  
12 Delta Protection Commission [SDWA-139].) More than half of the length of the proposed  
13 WaterFix tunnels cross islands that are subsided by as much as 15 feet or more below  
14 Elevation 0. Any breach of the levees on these islands leads to flooding of that island with  
15 resultant catastrophic disruption to legal users of water. This injury would not be restricted to a  
16 single island because even a single flooded island puts pressure on adjacent islands and also  
17 causes salt water intrusion that impacts all water users in the Delta including export water  
18 users. The WaterFix proponents acknowledge the possibility of settlement of the levee  
19 foundation and damage as a result of the proposed tunneling activities. (See, e.g., Bednarski  
20 Testimony, DWR-57, p. 26, lines 15-16.) Petitioners also admit the need for further studies  
21 “based on the initial assessment from field reconnaissance and engineering surveys,  
22 geotechnical exploration and analyses will be performed for levee sections that need further  
23 evaluations” (DWR-57, p.26, lines 21-23), and then they discuss potential measures that  
24 might be employed to mitigate the injury. (See, e.g., DWR-57, p. 27, lines 10-16.)

25 ——— However, this focus on potential mitigation measures rather than on a “no injury”  
26 analysis, though common in the context of an EIR/EIS analysis, does not address the  
27 requirement of Water Code section 1701.2, subdivision (d) that petitioners demonstrate a  
28 reasonable likelihood that the proposed change will not injure any other legal user of water. In

1 fact, there can be little assurance (and Petitioners have provided none) that the ambitious  
2 tunneling activities at critical locations, such as under levees, will not result in serious injury to  
3 affected landowners and others who rely on the continuing integrity of the Delta's complex  
4 levee system.

5 Potential mitigation measures are not the same as assurances of a reasonable  
6 likelihood of "no injury." This distinction may seem academic in some contexts, but the  
7 consequences of a levee failure leading to flooding of one or more islands include not only  
8 injury to water users on those islands but also to water users on adjacent islands. Flooded  
9 islands exert pressure on not only adjacent islands, but, potentially, all water users in the Delta  
10 as a result of salinity intrusion, not to mention economic losses and potential loss of life. In  
11 short, this is a classic example of a potential problem that might have a relatively low  
12 probability of occurrence but which has very large consequences. Arguing that the probability  
13 of occurrence can be made smaller and smaller by the adoption of best practices does not  
14 significantly change the risk of significant injury. While similar tunneling activities in other  
15 locations may not have the same consequences, the consequences in the Delta, where many  
16 water users are linked together by shared use of the same levee system, are many orders of  
17 magnitude greater. Under these circumstances, merely outlining potential strategies for  
18 mitigating the injury does not address the problem.

19 ——— It should also be noted that of all the locations along the proposed tunnel alignments,  
20 the river and slough crossings, where the water table is higher than it is on the surrounding  
21 islands and tracts, are likely more vulnerable to loss of ground incidents.

22 ——— Beyond the fact that the Delta is an environment that is particularly sensitive to  
23 "accidents" associated with tunnel construction, two other factors, both well known in  
24 engineering design and construction, contribute to a significant risk of injury to water users.  
25 The first is that there tend to be more problems when large projects are designed and  
26 constructed by design and construction entities, such as the Delta Conveyance Facility Design  
27 and Construction Enterprise, that lack a significant background of experience in the same kind  
28 of project. (See LAND-71, p. 33.) An oft-cited example of this is the design and construction

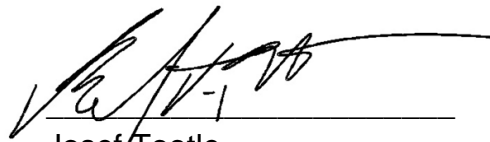
1 of the new East Spans of the San Francisco—Oakland Bay Bridge. Another example,  
2 although in somewhat different circumstances, is the delays and cost overruns that occurred in  
3 the design and construction of Metropolitan's own Inland Feeder Tunnels.

4 ——— The second factor is that more problems tend to arise with the construction of larger  
5 diameter tunnels. The technical reasons for this are well understood, and there are many  
6 actual examples, such as the Eisenhower Tunnels on I-70 in Colorado and the Alaskan Way  
7 Viaduct Replacement Tunnel in Seattle.

8 ——— Thus, while good faith efforts can be made to mitigate loss of ground incidents at river  
9 and slough crossings, not only the environment of the Delta but also organizational factors,  
10 make elimination of the risk extremely problematic. Given the potential for catastrophic injury,  
11 after the fact apologies and explanations will bring little consolation to water users in the Delta.

12  
13 I declare under penalty of perjury under the laws of the State of California that the  
14 foregoing statements are true and correct.

15 Executed on the 1<sup>5</sup>st day of ~~September~~October, 2016, at San Ramon, California.

16  
17   
18 Josef Tootle

References

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