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BEFORE THE

CALIFORNIA STATE WATER RESOURCES CONTROL BOARD

HEARING IN THE MATTER OF CALIFORNIA DEPARTMENT OF WATER RESOURCES AND UNITED STATES BUREAU OF RECLAMATION'S REQUEST FOR A CHANGE IN POINT OF DIVERSION FOR CALIFORNIA WATER FIX	**TESTIMONY OF JOSEF TOOTLE, G.E.** **(PART 2 CASE IN CHIEF)**

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

This Part 2 testimony consists primarily of portions of testimony I offered previously in this proceeding but which were excluded from Part 1 by ruling of the Hearing Officers.

1. Spoils Disposal

Section 22.0 of the Conceptual Engineering Rpt. ("CER"), Spoils Disposal Sites, states:

> Significant thicknesses of non-supportive or organic soils must be removed in the course of forebay, pumping plant, and shaft construction. Large volumes (approximately 30.7 million cy) of re-usable tunnel material (RTM), consisting of saturated soils mixed with bio-degradable polymers, are generated by tunneling operations. Large volumes (approximately 8 million cy) of dredge material are also expected to be removed from NCCF and SCCF. Smaller quantities of excess excavated materials are expected at other facility sites, including about 1.9 million cy at IF and approximately 1.6 million cy at each intake site.
>
> Organic materials will be stockpiled for placement over completed disposal areas. Soils that are unsuitable for reuse as restoration material, flood fight material, and engineered fill need to be disposed. These materials will be 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.

(DWR-212, p. 207.)

The numbers here are staggering, even for engineers familiar with large tunneling and excavation projects. The total of 45.4 million cubic yards would be three times that in square yards if the material was spread out to a depth of 1 foot (which it might need to be for drying and conditioning, leaving aside the question of how one might dry out such material in winter), that is 136.2 million square yards or 28,140 acres. Drawings in Volume 2 of the CER shows

possible locations for "disposal areas," principally on Glanville Tract near the Intermediate Forebay (including locations within the Stone Lakes National Wildlife Refuge boundary), on Bouldin Island, and on Byron Tract near the revised Clifton Court Forebay, but these locations have changed before and may well change again. (LAND-65.) The CER provides a list of rules to be followed in siting these facilities but then simply states: "as more information about the nature and volumes of soil generated becomes available, distances and sizes of disposal areas will be refined and identified." (DWR-212, p. 207.)

To further put 45,400,000 million cubic yards of spoils into perspective, consider the fact that the Great Pyramid of Giza contains approximately 3,400,672 cubic yards of material. (See http://www.newworldencyclopedia.org/entry/Great_Pyramid_of_Giza.) The spoils that Petitioners admit will be generated by construction of the proposed twin tunnels will be the equivalent of 13.35 Great Pyramids of Giza.

I have been unable to locate any detailed design and analysis or credible commitments or assurances in the CWF submissions regarding disposal of spoils. It is plainly inadequate to simply say that "these materials will be characterized and disposed of appropriately." Mr. Bednarski does make some comments, but these are limited to reusable tunnel material:

> The excavated material will be saturated with water and might be plasticized due to the use of biodegradable additives (e.g. foam or soil conditioner). [(Reusable Tunnel Material Testing Report, March 2014). Details on disposal and reuse of tunnel material are described in Section 3B.2.18, Appendix A, Recirculated Draft 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.

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

However, Section 3B.2.18, Appendix A, of the RDEIR sets forth only obtuse and generic environmental commitments, not actual analysis of impacts or potential injury to public trust resources, Delta communities, or the public interest generally. (SWRCB-3.) It provides no detail on locations for spoils disposal or the proposed design and construction of structures and systems for disposal of the spoils.

Absent this missing detail on the location and design of spoil handling facilities, it is impossible to quantify the likely injury to waters of the State, including groundwater. Unmentioned is the fact that water quality in the Delta peats below the irrigated zone is very poor as a result of the interaction of pyrite (iron sulfide) in the mineral soils and the organic components of the peat. The Petitioners show no awareness of this issue. Any such materials may likely need to be handled separately and safely disposed of. At least some facilities will likely require liners with leak detection systems. Such liners will disrupt normal infiltration of precipitation and hence groundwater flows even more than unlined stockpiles. Unlined stockpiles, on the other hand, will likely cause local mounding of the groundwater. Lined or unlined stockpiles, and final disposal areas, will also disrupt existing patterns of surface drainage and likely disrupt irrigation systems. Unless treatment and disposal of decant and other liquids is flawless, there will be injury to groundwater resources, the waters of the State, and affected Delta businesses and communities. Simply stating an intention to acquire the required permits provides little assurance that these injuries will not occur.

2. Loss of Ground as a Result of Tunneling Activities, with Catastrophic Impacts on Levees and Islands

Loss of ground is the term that is generally used for the development of either general subsidence or sinkholes as a result of entry of overburden into the tunnel during tunneling operations. While various techniques have been developed to mitigate such incidents, failures still occur, even when using advanced tunnel boring machines of the kind that likely would be used to advance the WaterFix tunnels. Example of such incidents are cited by Nick Shirlaw in a discussion regarding a recent failure in Germany on the Tunnel Talk web site [https://www.tunneltalk.com/feedback.php]:

> *As far as I am aware, this is the fourth incidence of catastrophic segmental lining failure behind a pressurized TBM in the last eighteen years; these being:*
>
> - *Hull wastewater transfer tunnel, UK [1999]*
> - *Cairo, Egypt [2009]*
> - *Okayama, Japan [2012]*

- *Rastatt, Germany [2017]*

I know of two other cases of severe, local, distortion of gasketted, concrete segmental tunnel linings, in Singapore and the USA, where total failure was avoided by providing additional support in the tunnel.

Given the huge number of segmentally lined tunnels built over the last 18 years, the proportion that has failed is tiny; and in each case the failure has been local, without similar problems on the rest of the drive. However, the consequences of each of the failures have been catastrophic.

As with other specialties within Civil Engineering, there are at least two kinds of articles on tunneling. One kind consists of the "promotional pieces" that are placed in magazines by owners, designers and contractors, which give the impression that the project went smoothly; the other kind is more honest newspaper reporting or technical discussions regarding the problems that are common on big engineering projects. The feedback section on the Tunnel Talk web site, from which the quote in the opening paragraph is taken, is a good example of the latter. The complete comment by Nick Shirlaw and a number of other relevant comments are included in Exhibit SJC-286. As is evidenced by reading articles like the ones referenced, it is unlikely that all catastrophic problems can be eliminated by simply following applicable codes and best practices.

Potential loss-of-ground incidents are a particular problem relative to the planned WaterFix tunnels under the Delta because, as is well known, many of the Delta islands and tracts are subsided below the normal range of water levels in the rivers and sloughs and are only kept dry by the levee system. (See, for instance, Figure 14, Chapter 5, of the Economic Sustainability Plan of the Delta Protection Commission [SDWA-139].) More than half of the length of the proposed WaterFix tunnels cross islands that are subsided by as much as 10 feet or more below Elevation 0 feet. Any breach of the levees on these islands leads to flooding of that island with resultant catastrophic disruption to affected communities and business activities. This injury would not be restricted to a single island because even a single flooded island puts pressure on adjacent islands and also causes salt water intrusion that impacts all

water users in the Delta, including local communities and export water users. The WaterFix proponents acknowledge the possibility of settlement of the levee foundation and damage as a result of the proposed tunneling activities. (See, e.g., Bednarski Testimony, DWR-57, p. 26, lines 15-16.) Petitioners also admit the need for further studies "based on the initial assessment from field reconnaissance and engineering surveys, geotechnical exploration and analyses will be performed for levee sections that need further evaluations" (DWR-57, p.26, lines 21-23), and then they discuss potential measures that might be employed to mitigate the injury. (See, e.g., DWR-57, p. 27, lines 10-16.)

However, this focus on potential mitigation measures, though common in the context of an EIR/EIS analysis, does not address the question currently before this Board: whether the proposed project will result in adverse consequences for public trust resources and the public interest generally. In fact, there can be little assurance (and Petitioners have provided none) that the ambitious tunneling activities at critical locations, such as under levees, will not result in serious injury to the integrity of the Delta's complex levee system and other infrastructure essential to public safety and economic productivity in Delta communities.

Citing potential mitigation measures is not the same as assurances of a reasonable likelihood of no impairment of Delta levees and related Delta infrastructure. This distinction may seem academic in some contexts, but the consequences of a levee failure leading to flooding of one or more islands include not only injury to water users on those islands but also to water users on adjacent islands. Flooded islands exert pressure on not only adjacent islands, but, potentially, all water users in the Delta as a result of salinity intrusion, not to mention economic losses and potential loss of life. In short, this is a classic example of a potential problem that might have a relatively low probability of occurrence but which has very large consequences. Arguing that the probability of occurrence could be made smaller and smaller by the adoption of best practices does not significantly change the risk of significant injury. While similar tunneling activities in other locations may not have the same consequences, the consequences in the Delta, where many water users are linked together by

shared use of the same levee system, are many orders of magnitude greater. Under these circumstances, merely outlining potential mitigation strategies does not address the problem.

It should also be noted that of all the locations along the proposed tunnel alignments, the river and slough crossings, where the water table is higher than it is on the surrounding islands and tracts, are likely more vulnerable to loss of ground incidents. Thus, while good faith efforts can be made to mitigate loss of ground incidents at river and slough crossings, the environment of the Delta makes elimination of the risk extremely problematic. Given the potential for catastrophic injury, after-the-fact apologies and explanations will bring little consolation to Delta communities that depend upon the continuing integrity of the levees and other infrastructure essential to economic productivity and public safety in the Delta.

3. General Inadequacy of Field Investigations and Engineering to Date

The Petitioners have themselves admitted that the engineering design of the WaterFix is only at or about 10 percent completion. This should be considered an inadequate basis for the approval of either an EIR/EIS or a Change in the Point of Diversion Petition in a challenging environment like the Delta. Even the geotechnical site investigations to date do not meet the accepted standards for a project of any size, let alone a major project in the Delta. A registered civil engineer in the State of California who proceeded to detailed design using only the presently available data would likely be judged to not be acting in accordance with the generally accepted standard of care. And, without more detailed designs, the Petitioners' assurances on multiple issues appear to be meaningless.

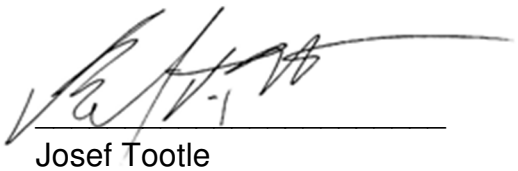
There are many examples of this shortcoming, including the lack of definition of subsurface conditions around excavations which I discussed in my testimony in Part 1 of these proceedings. In that testimony, I noted the variable and tortuous nature of the alluvial deposits that underlie the Delta that render any assurances that adjacent landowners will not be affected problematic, to say the least. The same issue applies to a number of aspects of muck and excavated soils disposal, but the most dramatic example of the significance of the inadequate geotechnical investigations to date is the potential impact on not so much the

advancing of the proposed tunnels but the design, and ultimately the performance, of the tunnel linings, under both static and seismic loads.

As a minimum, the Petitioners could and should have carried out the same kind of investigation along the tunnels alignment that the East Bay Municipal Utility District (EBMUD) performed along the alignment of their proposed cross-Delta tunnels to house the Mokelumne Aqueducts. While this project is at an earlier stage of development than the WaterFix, EBMUD and their engineering consultant engaged the University of Texas to conduct something like a dozen SASW spreads along the alignment. The results indicated that the sediments underlying the Delta were both softer and more variable than the engineering consultant had expected. The sediments were in fact so variable that the University of Texas had difficulty interpreting the results at depths greater than 100 feet. These findings have great significance for the evaluations of seismic site response and for the design of tunnel linings. At a minimum, it would be premature to grant any Change in Point of Diversion Petition until similar studies are carried out along the proposed WaterFix alignment.

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

Executed on the 29th day of November, 2017, at San Ramon, California.



Josef Tootle