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7
8 **BEFORE THE**
9 **CALIFORNIA STATE WATER RESOURCES CONTROL BOARD**

10 HEARING IN THE MATTER OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
11 AND UNITED STATES BUREAU OF
RECLAMATION REQUEST FOR A CHANGE
12 IN POINT OF DIVERSION FOR CALIFORNIA
13 WATER FIX

TESTIMONY OF
JOHN BEDNARSKI
(EXHIBIT DWR- 75)

14
15 I, John Bednarski, do hereby declare:

16 **I. INTRODUCTION**

17 My name is John Bednarski. I am an expert in the BDCP/California WaterFix (CWF)
18 project conceptual engineering design. I am the manager of the Water Supply Initiatives
19 Section at the Metropolitan Water District of Southern California (MWD) and since 2011, I
20 have participated with DWR in the conceptual design and overall engineering program
21 management of the California WaterFix (CWF). My Statement of Qualifications was
22 previously submitted in this hearing as Exhibit DWR-17.

23 I have reviewed the testimony of the opposing parties with respect to the
24 engineering project description for the CWF and alleged impacts to other users of water
25 due to the proposed engineering or construction methods. Specifically, this testimony
26 rebuts certain statements raised in testimony to this Board by 1) Delta Flood Control Group
27 (DFCG) witness Gilbert Cosio, 2) East Bay Municipal Utilities District (EBMUD) witness
28 Xavier J. Irias, 3) Local Agencies of the North Delta (LAND) witnesses Russel Van Loben

1 Sels and Richard Elliot, and 4) Pacific Coast Federation of Fishermans Associations and
2 Institute for Fisheries Resources (PCFFA) witness Deirdre Des Jardins.

3 **II. SUMMARY**

4 My rebuttal testimony is submitted to correct the omissions and misrepresentations
5 presented during the Part 1B hearing with respect to the feasibility of tunnel design and
6 construction methods; impacts to existing levees, existing and planned infrastructure
7 projects, and existing water diversions; and engineering assumptions for sea level rise. My
8 testimony is organized and summarized under the following headings:

- 9 • Large-Diameter Tunnel Projects Have Been Successfully Completed Throughout
10 The World. Testimony before this Board has suggested that the CWF tunnels are
11 of unproven design and construction methods, which could lead to unanticipated
12 negative consequences during construction of the tunnels. A series of large-
13 diameter tunnel projects were surveyed and similarities to the proposed CWF
14 tunnels were identified. In each of these cases, successful outcomes were achieved
15 without incurring risk or injury to project stakeholders.
- 16 • Levees Will Not Be Compromised by Construction. Mr. Cosio's testimony alleges
17 that pile driving and other CWF-related construction activities will compromise
18 existing levees. Mr. Cosio presented no analysis or investigations to confirm that
19 observed structure issues were caused by construction activities. On the contrary,
20 DWR and other agencies have driven piles for a number of projects in the Delta with
21 no damage observed to levees or related structures.
- 22 • Existing and Planned Infrastructure Projects Will Not Be Compromised By
23 Construction. Mr. Irias' testimony alleges that the CWF tunnels will compromise
24 existing and planned infrastructure in the Delta. He claims that both construction
25 and operation of the CWF tunnels will place risks upon such present and future
26 infrastructure. Large-diameter tunnel projects are being constructed world-wide
27 without damaging existing infrastructure. Provisions can be made during design of
28 the CWF tunnels to mitigate or eliminate any of the potential issues that Mr. Irias

1 identified in his testimony. A comprehensive tunnel leakage assessment was
2 conducted by DWR and the results indicated that leakage into, and out of the
3 tunnels will be negligible under the current CWF configuration and operating
4 conditions.

- 5 • Water Supplied By Existing Diversions Affected By Construction Will Be Maintained.
6 Testimony by Mr. Van Loben Sels and Mr. Elliot have incorrectly characterized the
7 disposition of two existing water diversions. Both witnesses claimed “permanent”
8 impacts to their diversions, when in fact, the impacts are temporary. Furthermore,
9 DWR has previously committed to maintaining diversion flow and quality during
10 construction.

- 11 • The CWF Engineering Design Correctly Accounts for Sea Level Rise.
12 Testimony by Ms. Des Jardins alleges that the CWF conceptual engineering design
13 estimates for 18 inches of sea level rise are not realistic when compared to sea level
14 rise estimates for Port Chicago. In fact, the CWF conceptual engineering design
15 used a conservatively high estimate of 55 inches of sea level rise at the Golden Gate
16 Bridge. **However, projected sea level rise decreases moving further upstream, such**
17 **that the 55-inch estimate at the Golden Gate Bridge translates to 18 inches at the**
18 **intake locations.**

19 **III. LARGE DIAMETER TUNNEL PROJECTS HAVE BEEN SUCCESSFULLY**
20 **COMPLETED THROUGHOUT THE WORLD**

21 Testimony before this Board has suggested that the CWF tunnels are of unproven
22 design and construction methods, which could lead to unanticipated negative
23 consequences during construction of the tunnels. DFCG’s witness Mr. Cosio complains
24 about construction impacts to levee stability due to such activities as construction of tunnel
25 shafts, pile driving, and dewatering impacts. (Exhibit DFCG-1, page 6, lines 19-20; pages
26 9-11, pages 15-17.) EBMUD’s witness Mr. Irias gave extensive testimony regarding
27 potential construction impacts to EBMUD facilities crossing the Delta (both current and
28 future facilities), including that the CWF tunnels would cause direct interference with

1 structures, undermining and settlement, soil settlement due to lower groundwater levels,
2 lateral earth movement, seepage into the CWF tunnels, and other impacts. (Exhibit
3 EBMUD-153, page 14, lines 1-17 [summarizing alleged impacts].) Specific claims of
4 impacts from construction of the CWF to levees and to infrastructure projects are
5 addressed in later sections of this testimony. This section addresses the feasibility of large-
6 scale tunnel projects generally.

7 As part of engineering program for the CWF, the engineering team performed a
8 survey of recent large diameter tunnel projects throughout the world. One of the main
9 objectives was to identify design, construction, and project management issues those
10 projects faced in order to anticipate and manage any similar issues with the CWF tunnels.
11 The projects surveyed are all well documented, recently completed (or substantially
12 completed) large diameter tunnel projects. With the exception of one hard-rock tunnel, the
13 remaining were all soft ground or mixed ground tunnels mined with tunnel boring machines,
14 which is the same design condition for the CWF tunnels.

15 At the outset, it is important to put the proposed diameter of the CWF project in
16 perspective. At a proposed 45-foot outside diameter (OD), the 2 main CWF tunnels are
17 indeed large, but well within the size range of other recent large diameter tunnel boring
18 machine (TBM) projects. Exhibit DWR-6, page 6 graphically shows the bored diameter of
19 10 tunnel projects of approximately 40-foot OD and larger. The largest project is a 58-foot
20 OD, putting the CWF tunnels well within the size range in which tunneling with TBMs has
21 been planned or proven in the field.

22 In addition to strictly comparing the size of the CWF tunnels to other large tunnels
23 throughout the world, the engineering team conducted a detailed survey of recently
24 completed, or substantially completed large tunnel project. The tunnel projects that were
25 surveyed as part of the CWF engineering effort are:

- 26 • Eurasia Tunnel (Turkey)
- 27 • Lee Tunnel (London)
- 28 • Port of Miami Tunnel (Florida)

- 1 • East Side Access Tunnel (New York)
- 2 • Blue Plains Tunnel (District of Columbia)
- 3 • Bay Tunnel (San Francisco, California)
- 4 • Willamette River Combined Sewer Outfall Tunnel (Portland, Oregon)
- 5 • Gotthard Base Tunnel (Switzerland)
- 6 • SR-99 Alaskan Way Replacement Tunnel (Seattle, Washington)

7 Each of project and the challenges they faced are briefly described below.

8 **A. EURASIA TUNNEL**

9 **The Eurasia tunnel project is a transportation tunnel that crosses underneath the**
10 **Bosporus straits, which historically is the division between Europe and Asia.** The tunnel is
11 40 feet inside diameter (ID), which is very similar in size to the proposed CWF tunnels. The
12 Eurasia tunnel project was completed in December 2016, three months ahead of schedule
13 and within budget.

14 **The potential for water seepage was a key technical challenge for the Eurasia**
15 **Tunnel, since it passes about 300 feet under the Bosporus straits.** Water pressure at that
16 point was about 165 pounds per square inch. In contrast, the water pressure at tunnel
17 depth for the CWF tunnels is 60 pounds per square inch (psi). The Eurasia Tunnel also
18 faced complex geology with potential for seismic deformations. **The tunnel also crossed an**
19 **earthquake fault, which was facilitated by installing a seismic joint inside the tunnel.** The
20 construction went smoothly and the tunnel went into operation last year. This project won
21 the International Tunnel Association project of the year in 2015.

22 **B. LEE TUNNEL**

23 The Lee Tunnel is part of a multi-tunnel effort that makes up the Thames tideway
24 project in London. The Lee Tunnel is a 23.6 feet ID combined storm overflow (CSO) tunnel
25 that is 160-feet deep. It is part of a series of tunnels linked together to capture surface
26 storm runoff to divert it to treatment before flowing into the Thames River.

27 The Lee tunnel is a complex project that was completed in December 2015 on
28 schedule and slightly under project budget and received the prestigious Concrete Society

1 Award in Great Britain.

2 Construction of the project in urban London greatly added to the overall project
3 complexities. The project faced issues with worksite availability and logistics, working in
4 the vicinity of a river as well as historic buildings and structures, contaminated soils and
5 groundwater, and also offloading and removing the tunnel material that came out of the
6 tunnels.

7 **C. PORT OF MIAMI TUNNEL**

8 The Port of Miami Tunnel is a transportation tunnel project that was recently
9 completed on time and on budget, and opened to traffic in 2014.

10 At approximately 40-foot ID, the Port of Miami Tunnels are very similar in size to the
11 proposed CWF tunnels. These were twin tunnels at a depth of 120 feet, passing
12 underneath the Port of Miami. Ground conditions for this project were very challenging.
13 The tunnels were mined through very soft limestone material as well as coral, requiring
14 extensive grouting work prior to tunneling. Due to robust geotechnical investigations, the
15 contractor was able to employ additional extensive grouting once the contract was
16 underway to ensure successful tunneling. The success of geotechnical exploration
17 program coupled with an extensive ground improvement program (grouting) minimized
18 project risks and led to successful completion of the project without incident to the
19 construction team or adjacent infrastructure.

20 **D. EASTSIDE ACCESS TUNNEL**

21 The Eastside Access project was a complicated large project with several tunnel
22 components. The project was conceived to enhance the connectivity of the Long Island
23 Railway to Penn Station. The Queens Bored Tunnel component is the focus of the tunnel
24 survey for the CWF. This project consists of four 19-foot diameter rail tunnels, located
25 about 60-feet below ground.

26 Several technical challenges were due mostly to very shallow ground cover and
27 existing infrastructure. The tunnels crossed underneath active railway lines, with abrasive
28 ground conditions and many cobbles and boulders. Due to the poor ground conditions and

1 shallow tunnel cover, a technique referred to as ground freezing was used to stabilize
2 difficult soil conditions prior to tunneling. Additional challenges were also faced due to
3 small work areas, minimal room for safe havens, and labor shortages. Despite these
4 challenges, Queens bored tunnel project was completed successfully without interruption to
5 rail service and without damaging existing infrastructure.

6 **E. BLUE PLAINS TUNNEL**

7 The Blue Plains Tunnel is part of DC Water’s Clean Rivers Project to reduce
8 combined storm overflows into the area’s rivers. The Blue Plains Tunnel is one of five
9 tunnels in the overall project. This tunnel was completed successfully along with a second
10 tunnel, the Anacostia Tunnel. The Blue Plains Tunnel is 23-feet ID, 160-feet deep, and 4.5
11 miles long. It was completed in 2015, ahead of schedule and under budget.

12 This project overcame unique challenges. These challenges included tunneling
13 immediately adjacent to a river, so the ground conditions were fully saturated, a similar
14 condition that will be experienced with the proposed CWF tunnels. The project tunneled
15 underneath existing infrastructure, without causing ground settlement or structure
16 deformation/damage. In 2013, the project won the Technical Innovation of the Year award
17 at the International Tunnel Association. Additionally, in 2016, the tunnel project received
18 the Engineering News Record (ENR) 2016 Best Project Award for the Mid-Atlantic Region
19 for Water/Environment. In both cases, the awards acknowledged a primary
20 accomplishment of the tunnel project was the “practically undetectable” ground movement
21 associated with the project.

22 **F. BAY TUNNEL**

23 The Bay Tunnel is part of the San Francisco Public Utilities Commission (SFPUC)
24 Water Supply Improvement Program to upgrade the entire SFPUC system water delivery
25 system for enhanced seismic reliability and other reliability issues.

26 The Bay Tunnel is the second largest project within the overall program, which
27 contains approximately 85 individual projects. The tunnel consisted of a 15-foot ID tunnel,
28 5 miles long, and 100-feet deep. The tunnel is unique for a couple of reasons. This tunnel

1 was the first tunnel bored under the San Francisco Bay. Secondly, the tunnel was
2 constructed as a single continuous 5-mile drive with no intermediate shafts, thus very
3 similar to the proposed 8-mile tunnel drives proposed for the CWF tunnels.

4 Notable challenges facing the Bay Tunnel included variable ground conditions,
5 crossing under levees, contaminated soil, disposal of tunnel material, and high groundwater
6 pressure at 50 psi (similar conditions to CWF tunnels). The project was completed in
7 October 2014 on time and within budget.

8 **G. WILLAMETTE RIVER COMBINED SEWER OUTFALL TUNNEL**

9 The Willamette River Combined Sewer Outfall (CSO) Tunnel is a project in Portland
10 to comply with requirements to collect and treat storm discharges into waterways. This is a
11 very large project consisting of two tunnels and two tunnel contracts; one on the east side
12 and one on the west side of the Willamette River. One tunnel is 14-foot ID, 120-foot deep,
13 and 3.5 miles long; the other is 22-foot ID, 150-foot deep, and 6 miles long.

14 Issues facing this project were challenging ground conditions, with rocks, cobbles
15 and boulders, and also the need to perform soil modification deep down in the tunnel shaft.
16 Other challenges included TBM breakout and subcontract changes. Despite these
17 challenges the project was completed in 2012, eight months ahead of schedule and under
18 budget. In 2012, the success of the project was recognized as one of five finalists for the
19 2012 Outstanding Civil Engineering Achievement (OCEA) Award by The American Society
20 of Civil Engineers (ASCE).

21 **H. GOTTHARD BASE TUNNEL**

22 The Gotthard Base tunnel is the longest tunnel in the world. The project consists of
23 twin rail tunnels, each one 35 miles long and about 6,500 feet underneath the Swiss Alps.
24 While this project is a hard rock tunnel, whereas the CWF will be mined through soft and
25 mixed ground, it is comparable to the CWF in overall size and scope. The Gotthard Base
26 Tunnel was constructed over a 17-year period. The two main rail tunnels, additional
27 smaller tunnels were constructed to accommodate safety, ventilation, and cross-passage
28 requirements. In total, the project has bored 95 miles of tunnel. The hard rock, squeezing

1 ground conditions caused the TBMs to get stuck several times. Squeezing ground
2 conditions are not anticipated with the CWF project. The project was completed in 2016
3 within schedule.

4 **I. SR-99 ALASKAN WAY REPLACEMENT TUNNEL**

5 The SR-99 Alaskan Way Replacement Tunnel is a transportation tunnel project in
6 Seattle. The tunnel will replace the elevated viaduct that runs along the waterfront in
7 downtown Seattle. At the time this project was conceived, it was the largest diameter TBM
8 tunnel project in the world, at 57-feet OD and 53-feet ID. The project is currently
9 experiencing about a two-year delay due to several challenges associated with the tunnel
10 boring equipment as well as management and contracting issues that are not relevant here.

11 The mining for this project started in 2013. At about 1,000 feet into the job the TBM
12 broke down. It took approximately two years to fix the situation. The repair required mining
13 a large pit to gain access to the TBM, pulling off the cutter head, replacing the main
14 bearing, and reassembling the TBM in place.

15 The project is now making excellent mining progress. The tunnel is approximately
16 95% mined at this time and the project's new management team expects that they will
17 finish mining this tunnel by June 2017.

18 The unprecedented size of the TBM, at the time, may have contributed to the delay.
19 When this TBM was designed, it was about 30 percent larger than any other TBM ever
20 deployed. (See Exhibit DWR-6, page 6.) From publically available information, it is
21 estimated that approximately 100 tons of additional steel were put into the TBM when it
22 was repaired. Consequently, it is believed that the TBM was initially under-designed when
23 first constructed, and structural issues with the cutterhead and main bearing lead to many
24 of the problems experienced on the project. In contrast, the CWF is within the size range of
25 many recent successful projects and will benefit from advancements in large diameter TBM
26 design that have already proven successful within the 45-foot OD design range. Since the
27 Seattle TBM has been restarted following repair, it has performed very well. There have
28 been no reports of ground deformation, surface settlement or damage to surface

1 infrastructure as a result of tunneling since the repairs took place.

2 **J. IMPLICATIONS FOR THE CWF TUNNELS**

3 Based on the survey above, several common issues emerge and will be planned for
4 in the design of the CWF tunnels. Foremost, good geotechnical information is the key for
5 success on any tunnel project. CWF team has learned that there is no way for an owner to
6 get out of ultimate responsibility for the ground conditions. Therefore, a thorough
7 geotechnical investigation is planned for the program, and these investigations will be some
8 of the earliest work to start on the program. Secondly, the need for a proactive risk
9 identification and management program. For CWF's program management team, the
10 Design and Construction Enterprise (DCE), risk management is proposed to be positioned
11 very high in the organization, reporting directly to the program director. Finally, utilization of
12 well tested and thoroughly understood tunneling technologies will minimize the risks of
13 unforeseen tunneling events. As discussed earlier in this testimony, the CWF plans to
14 utilize well proven tunnel technologies that have been thoroughly tested at the size
15 intended for the planned project.

16 Based on the comparison to the highly successful large diameter TBM projects in
17 this survey, the CWF tunnels do not pose any special or unusual challenges that would
18 hinder similar successful completion. In fact, Mr. Irias in his cross-examination testimony
19 (pg 52 line 23) stated that he could not foresee any reason that the tunnels could not be
20 successfully completed. (Part 1B Hearing Transcript, Vol. 26, 52:23.) Additionally, Mr. Irias
21 stated that for his agency's own aqueduct rehabilitation project, EBMUD would be
22 implementing a tunnel concept to replace the currently above-ground portion of the
23 aqueduct that spans nearly 17 miles from Interstate 5 in Stockton to Bixler in the west.
24 (Exhibit EBMUD-153, page 8, lines 3-5.) EBMUD is contemplating a 21-foot diameter
25 tunnel, to be bored with a pressurized face tunnel boring machine, a similar technology to
26 the CWF tunnel plans. (*Id.*, page 8 lines 7-9.) Indeed, many of the surveyed existing
27 projects faced numerous technical and logistical challenges that are not expected with the
28 CWF tunnels. The lessons learned from world-wide tunnel projects will be employed by the

1 DCE. It is anticipated that this thorough planning and design philosophy, embraced by the
2 CWF effort so far during the environmental planning process, will carry forward to future
3 design phases and construction.

4 **IV. LEVEES WILL NOT BE COMPROMISED BY CONSTRUCTION**

5 Mr. Gilbert Cosio, Jr. claims in his testimony that CWF will increase the likelihood of
6 levee failures in the Delta (DFCG-1, page 8, lines 6 through 9). However, he did not
7 provide any engineering analyses to substantiate the above claim. Specifically, he did not
8 provide any analysis or data to support his claims that the proposed CWF construction
9 activities such as pile driving, floodway obstructions, and truck traffic would cause adverse
10 impacts to the levees (DFCG-1, page 8, lines 18 through 28; page 9, lines 1 through 16).

11 **A. PILE DRIVING WILL NOT ADVERSELY AFFECT LEVEES**

12 Mr. Cosio claims that pile construction for the CWF will damage the levees and
13 structures in the North Delta (DFCG-1, page 11, lines 16 and 17). However, Mr. Cosio's
14 testimony did not include engineering analyses or pile driving project case histories to
15 support the above claim. He cited a residential development project in Contra Costa
16 County that used soil densification. Mr. Cosio stated in his testimony that a sandy levee
17 located approximately three miles from the residential project site experienced settlement
18 and foundations of two structures on the levee cracked. (DFCG-1, page 8, lines 23 through
19 26). However, during cross examination, Mr. Cosio indicated that no analyses or
20 investigations were performed to confirm that observed structure foundation cracks and
21 levee settlements were due to the soil densification work. His testimony was merely based
22 on the conclusion that timing of soil densification coincided with observation of levee
23 settlement and foundation cracks. (Part 1B Hearing Transcript, Vol. 25, 250:3-9.)

24 Several intakes and other facilities such as non-physical fish barriers, fish release
25 facilities, a fish research laboratory, and a power plant have been constructed successfully
26 in and around the Delta using both vibratory and impact pile driving methods without
27 damaging nearby levees. Several hundred piles were driven to construct cofferdam and
28 foundations at each of the following intake sites: Alternative Intake on the Victoria Canal

1 owned by Contra Costa Water District (approximately 390 piles), Freeport intake on the
2 Sacramento River owned by the Freeport Regional Water Authority (approximately 520
3 piles), and Sankey Diversion Facility on the Sacramento River owned by the Natomas
4 Mutual Water Company (approximately 270 piles). In each of these cases, no damage to
5 levees and related structures were observed.

6 DWR also has used driven piles for several projects in the Delta. DWR drove
7 numerous piles during the construction of the non-physical fish barriers on Georgiana
8 Slough and at the Head of Old River, and the Skinner Fish Research laboratory near the
9 Clifton Court forebay. Approximately 2,000 concrete piles were driven using impact
10 hammers for the construction of Cosumnes Power Plant, which is owned by Sacramento
11 Municipal Utility District and located approximately 1,800 feet from the Rancho Seco
12 Nuclear Plant in Sacramento County. In each of these cases, no damage to levees or
13 related structures were observed. One of DWR's witnesses on the engineering panel, Mr.
14 Pirabarooban worked on some of the above projects. His roles on these projects were:

- 15 • Georgiana Slough non-physical fish barrier: Senior Engineer responsible for
16 design and construction
- 17 • Skinner fish research laboratory: Reviewer for foundation design
- 18 • Cosumnes power plant: One of the geotechnical engineers responsible for
19 foundation design and construction

20 Engineering consultants who designed the Freeport Intake and Sankey Diversion
21 Facility also performed the conceptual engineering for the proposed CWF intakes. The
22 CWF approach to construction is similar to these other referenced successful projects.
23 Consequently, the Engineering Team anticipates that all work will be constructed without
24 damaging levees or related structures.

25 Based on our conversations with geotechnical and construction engineers who
26 worked on the above referenced projects, the levees and other structures located near
27 these facilities did not experience settlements exceeding the thresholds established or
28 failures during pile driving. Mr. Cosio also confirmed during cross examination that there

1 were no levee issues resulting from the Freeport intake construction. (Part 1B Hearing
2 Transcript, Vol. 25, 230:10-12.)

3 DWR will be implementing well accepted engineering practices, similar to the
4 approaches taken in the successful engineering projects identified above. The projects
5 identified above collected subsurface data and performed geotechnical engineering
6 analyses to select the appropriate pile types and installation methods. Detailed settlement
7 monitoring programs were implemented before and during the construction to ensure that
8 construction induced settlements do not exceed the thresholds established to protect
9 existing levees and other structures located near the project sites.

10 DWR has committed to the same approaches identified above and will perform
11 detailed engineering analyses, including geotechnical studies, to determine the appropriate
12 pile types and installation methods during design for the proposed CWF facilities. (Exhibit
13 SWRCB-102, Appendix 3B, Environmental Commitment 3B.2.1.1.) DWR has also
14 committed to implement monitoring programs before and during construction to protect the
15 levees and other sensitive structures located in the immediate vicinity of the project sites.
16 (*Id.*, Environmental Commitment 3B.2.1.2.)

17 For the CWF, installing sheet piles will be required to construct cofferdams at
18 intakes, Clifton Court Forebay (CCF), and the Head of Old River (HOR) gate site. Based on
19 the cofferdams constructed in and around the Delta for intakes referenced below in the
20 past, it is expected that vibratory hammers would be used to drive approximately seventy
21 percent of the required pile depths and impact hammers would be used to drive the
22 remaining thirty percent of pile depths. Vibratory hammers were successfully used to
23 construct cofferdams for the Freeport intake and Sankey Diversion facility. Vibratory
24 hammers are generally used as alternatives to impact hammers to minimize vibration and
25 noise.

26 To support the intake structure foundations, HOR gate, barge unloading facilities,
27 and control structures near CCF, either driven piles or cast-in-drilled hole (CIDH) piles, also
28 known as drilled shafts would be needed. As the name implies, the CIDH piles are

1 constructed in drilled holes and do not require pile driving. During the next engineering
2 phase, additional geotechnical data will be collected and the type of pile needed to support
3 these facilities will also be determined. To estimate construction impacts for the worst case
4 scenario, driven piles that require impact driving were assumed to be used to support these
5 structures for the EIR/EIS and Biological Assessment impact analyses. (Exhibit DWR-656,
6 Appendix 3.E, Table 3.E-2.) If the CIDH piles are chosen to support intake foundations,
7 HOR gate, and control structures, impact pile driving needed will be reduced significantly
8 and would be limited to the installation of approximately 30 percent depth of cofferdam
9 piles. (*Ibid.*)

10 **B. ENCROACHMENTS INTO THE RIVER CHANNEL WILL NOT**
11 **ADVERSELY AFFECT LEVEES**

12 The following corrects misrepresentations or omissions in responses provided by Mr.
13 Cosio during cross examination on October 28, 2016 regarding Section 408 permitting from
14 the U.S. Army Corps of Engineers (USACE) and the encroachments into the river channel
15 (Part 1B Hearing Transcript, Vol. 25, 223:21- 25, 224:1-12, 255-257:-17). Mr. Cosio
16 indicated during cross examination that USACE would conduct a textbook analysis during
17 their evaluation of DWR's proposed modifications to the levees. Mr. Cosio implied that
18 during this analysis, the USACE reviewers may not, in many cases, be aware of local
19 conditions that pertain to Delta. (Part 1B Hearing Transcript, Vol. 25, 224:6-12.) Mr. Cosio
20 also indicated that the USACE review would focus primarily on flood elevation issues, and
21 not on how the actual details of the proposed modifications would potentially change the
22 existing river flow patterns, sediment deposition, etc. (Part 1B Hearing Transcript, Vol. 25,
23 257:13-17.)

24 Mr. Cosio is incorrect as to the scope and level of detail of USACE's permitting
25 process. The USACE has decades of experience in protecting human safety in the Delta,
26 particularly with respect to levees under their jurisdiction. Construction of the proposed
27 CWF intakes includes alteration to the levee sections that are part of the Sacramento River
28 Flood Control project. Sacramento River Flood Control project levees (also known as

1 federally constructed project levees) are under the jurisdiction of USACE and Central
2 Valley Flood Protection Board (CVFPB).

3 USACE's Engineering Circular, EC 1165-2-216 (Exhibit DWR-657) provides policy
4 and procedural guidance for processing Section 408 permits. Section 408 authorizes the
5 Secretary of the Army to grant permission for an alteration if the Secretary determines that
6 the activity will not be injurious to the public interest and will not impair the usefulness of the
7 project. (*Id.*, Section 6.) EC 1165-2-216 requires among other things that an applicant for
8 a Section 408 permit show that the proposed alteration will not limit the ability of the project
9 to function as authorized and will not compromise or change any authorized project
10 conditions, purposes or outputs. All technical analyses required for facility design, including
11 geotechnical, structural, hydraulic and hydrologic, real estate, and operations and
12 maintenance requirements, must be conducted. The technical adequacy of the design
13 must be reviewed. The design review will be performed at various design phases by
14 USACE District and Regional Offices, and Headquarters. In addition to the USACE's
15 internal reviews, a safety assurance review by an independent panel of experts will be
16 performed as part of the permitting process. To meet the above permit requirements, DWR
17 will have to show in the permit application that proposed alterations to the levee sections
18 and construction activities including encroachment into the river channel and pile driving
19 will not compromise the existing levees. The CWF will not result in substantial adverse
20 changes in water surface profiles, and as a general rule, such substantial adverse changes
21 would not be approved.

22 As stated in Section V of my Part 1A testimony (Exhibit DWR-57), DWR requested
23 CVFPB to initiate Section 408 permitting process with USACE in December 2015. (Exhibit
24 DWR-203.) DWR will prepare and submit permit application along with engineering plans,
25 hydraulic and geotechnical analyses, and other relevant documents to USACE through
26 CVFPB as required by USACE's Engineering Circular, EC 1165-2-216. (Exhibit DWR-57,
27 page 24, lines 26 and 27 [Written Testimony of John Bednarski]; Exhibit DWR-657
28 [Engineering Circular, EC 1165-2-216].) This process, coupled with the proposed CWF

1 design and its environmental commitments and mitigation measures, will ensure that
2 project encroachments into the river channel will not adversely affect levees.

3 **C. TRUCK TRAFFIC WILL NOT ADVERSELY AFFECT LEVEES**

4 Mr. Cosio claimed in his testimony that truck traffic will cause significant levee
5 damage each year during construction. (Exhibit DFCG-1, page 17, lines 15 through 17.)
6 His testimony did not include engineering analyses or other evidence to support the above
7 claim. First, it is important to correct his misleading statement that “[t]he main roadways
8 (County roads and State highways) used by [CWF] construction trucks in, out, and around
9 the Delta are located on of levees.” (*Id.*, page 17, lines 5 through 7). Among the highways
10 identified for construction traffic (State Routes 4, 12, 160 and Interstate 5), SR-160 is the
11 only highway that is located on top of levees. Since July 2010, DWR has been working
12 with Caltrans through an interagency agreement on improvements needed for State Routes
13 4, 12, and 160 for constructing the CWF facilities. This work has identified the need to
14 improve ingress and egress from the project sites to ensure safe passage of construction-
15 related traffic. This work has also identified the need to consider alternate methods to
16 deliver some of the very large equipment loads due to size or weight limitations on some of
17 the existing State highway infrastructure.

18 Highways in the Delta were constructed in the early and mid-20th century. These
19 highways have carried over several hundred thousands of truck traffic over their life time
20 and are not expected to exhibit significant settlement due to potential truck traffic from CWF
21 construction. For example, the average daily truck traffic on SR-160 at the Hood-Franklin
22 Road (near the CWF intakes) was 68 in year 2014. (Exhibit DWR-658, page 165.) Over
23 the last fifty years, the SR-160 near the CWF intakes would have carried about 730,000
24 truck traffic assuming an average of 40 daily truck traffic (though the average daily truck
25 traffic was 68 in 2014, a lower count of 40 was assumed to account for variations in the
26 truck traffic over the years). Given this historic usage, SR-160 is expected to easily
27 withstand the anticipated increase in truck traffic due to the CWF.

28 As stated in my Part 1A testimony (Exhibit DWR-57, page 26, lines 13 through 28),

1 to the extent possible CWF construction truck traffic will be kept off the levees that are not
2 highway-rated. In the planning phases of the CWF, approximately 6 miles of levee roads
3 (excluding SR-160) were identified for use for construction site access. Prior to
4 construction, existing conditions of levee roads that are identified as potential haul routes
5 and expected to carry significant construction truck traffic will be assessed, monitored and
6 documented through field reconnaissance and engineering surveys. Based on the initial
7 assessment from field reconnaissance and engineering surveys, geotechnical exploration
8 and analyses will be performed for levee sections that need further evaluations. (Exhibit
9 SWRCB-102, Appendix A, Environmental Commitment 3B.2.1.) Should the geotechnical
10 evaluations indicate that certain segments of existing levee roads need improvements to
11 carry the expected construction traffic loads, DWR is committed to carry out the necessary
12 improvements to the affected levee sections or to find an alternative route that would avoid
13 the potential deficient levee sections. As discussed in the Final EIR/EIS, Chapter 19 -
14 Transportation, Mitigation Measure Trans- 2c, all affected roadways would be returned to
15 preconstruction condition or better following construction. (Exhibit SWRCB-102.)
16 Implementation of this measure will ensure that construction activities will not worsen
17 pavement and levee conditions, relative to existing conditions.

18 **V. EXISTING AND PLANNED INFRASTRUCTURE PROJECTS WILL NOT BE**
19 **COMPROMISED BY CONSTRUCTION**

20 In the testimony of Mr. Xavier Irias, he claims construction of the CWF will adversely
21 affect existing and planned aqueducts and existing powerlines due to tunneling during
22 construction and due to tunnel seepage and leakage. Specifically with respect to existing
23 aqueducts, Mr. Irias' written testimony expresses concern that CWF tunnel construction will
24 undermine, cause settlement and reduce ground support for the foundation piles of the
25 Mokelumne Aqueduct. (Exhibit EBMUD-153, page 16, lines 4-27; page 17, lines 1-5.) His
26 concern is that loss of foundation support may structurally damage the Aqueduct and
27 potentially result in loss of water supply to EBMUD customers. Mr. Irias proposed
28 geotechnical investigations and the development of a ground treatment plan to mitigate

1 impacts to the Mokelumne Aqueduct. (*Id.*, page 21, lines 16 through 27; page 22, lines 1
2 through 11.) However, the CWF project is already committed to performing extensive
3 geotechnical studies. (Exhibit SWRCB-102, Chapter 3, Section 3.6.1.10.) Through these
4 studies and the environmental commitments (*id.*, Appendix 3B, Section 3B.2.1 Geotechnical
5 Studies), the CWF project will develop the required ground treatment plan, and ground
6 settlement monitoring and response plan to mitigate impacts to the Mokelumne Aqueduct.
7 DWR is committed to collaboratively working with EBMUD to establish existing baseline
8 conditions and measurements near and around where the CWF tunnel crosses the
9 Mokelumne Aqueduct and proposed Delta Tunnel, work on the ground treatment, ground
10 settlement monitoring and response plans, contract specifications and TBM maintenance
11 procedures to safely allow CWF tunnel to cross under the Mokelumne Aqueduct.

12 In written testimony by Mr. Xavier Irias, he expressed concern that seepage into the
13 CWF tunnel during the life of project could carry soil particles resulting in piping and erosion
14 that may cause voids, settlement, and/or potential sinkholes and have an impact on the
15 existing Mokelumne Aqueducts or proposed Delta Tunnels. (Exhibit EBMUD-153, page 18,
16 lines 3 through 15.) During verbal testimony Mr. Irias also expressed this concern but was
17 primarily focused on seepage during construction and when the tunnel is empty, such as
18 for maintenance shut-downs. (Part 1B Hearing Transcript, Vol. 26, 29:1-22.) Mr. Irias did
19 not provide any tunnel leakage analysis to support his concern. To address this concern
20 the Engineering Team commissioned consultant ARUP North America, Ltd. to prepare a
21 technical memorandum to assess potential leakage rates from the California Water Fix
22 tunnel. (Exhibit DWR-659.)

23 With respect to the concern of seepage during construction, or if the tunnel is
24 unwatered for future maintenance, the technical memorandum notes that segmental lining
25 gaskets will avoid the flow of any small particles into the tunnel. This is similar to a typical
26 transportation tunnel, and there is a long track record of large diameter tunnels in similar
27 ground conditions that do not see a loss of ground. A typical specification is to require no
28 visible water inflow above springline, and damp patches only (no flowing water) below

1 springline. (Exhibit DWR-659, page 14.)

2 During tunnel operations, Table 2 of the technical memorandum notes that inflow
3 would occur for the lengths of tunnel where the internal water pressure is lower than the
4 external groundwater pressure, and outflow, or leakage, would occur where the internal
5 water pressure is higher than the external pressure. So overall, for all the tunnels taken
6 together (reaches 1 to 7), the sections subject to inflow will have a total inflow of 3.7 cubic
7 feet per second (cfs), and the sections subject to leakage will have a total leakage of 0.7
8 cfs; overall the entire system has an estimated inflow of only 3 cfs. These inflow and
9 leakage rates are considered minimal and insignificant for 73.5 miles of tunnels. The
10 technical memorandum provided three significant conclusions:

- 11 1. The permeability of the liner has a significant effect on the calculated leakage rates.
12 Leakage rates are noticeably more sensitive to liner permeability than that of ground
13 permeability. The elevation of the tunnel makes almost no difference to the leakage
14 rates.
- 15 2. Under the low differential pressures which will occur with the current alignment and
16 design water pressures, radial cracking is not expected, and the liner permeability
17 will be a function of the concrete, as well as the circumferential and radial joints.
- 18 3. The net load on the segmental lining is anticipated to be external, with the confining
19 pressure of the soil and external groundwater providing a higher load than the
20 internal water pressure. This will maintain the segmental lining in compression
21 (avoiding higher permeability due to micro-cracking) and also keep the gaskets
22 sealed.

23 The Engineering Team plans to further evaluate tunnel leakage rate during the
24 preliminary and final design stages once additional geotechnical and hydrogeological data
25 is available.

26 In addition to the conclusions above the technical memorandum also made a
27 number of recommendations and steps to minimize leakage that correlate with good
28 practices taken to limit inflows in segmentally lined tunnels. These recommendations are

1 summarized here and include:

- 2 1. Specification of a high quality concrete, with low permeability. This will also meet the
3 goal of having a concrete with high durability.
- 4 2. Careful detailing of inserts, such as the plastic sockets used for grout holes.
- 5 3. Specification (and enforcement) of tight build tolerances for the segmental lining. A
6 well-built lining will have better alignment at gaskets and will avoid concrete damage,
7 which will reduce leakage potential.
- 8 4. Establish field quality control measures field to ensure good segment build include
9 dimensional checks on each ring assembled, to ensure that the tunnel diameter is
10 within tolerance; and careful development and monitoring of the grout mix, pump
11 pressure and injection volume to ensure complete filling of the annular void with a
12 grout that provide stability to the lining and minimize displacement after erection.
- 13 5. Design gasket details and segment connections and specify adequate annular void
14 grouting to ensure the gaskets remain adequately compressed when the internal
15 water pressure is applied.

16 For the long term tunnel integrity DWR is committed to developing a maintenance
17 and inspection program that will ensure that on a regular basis the interior of the tunnel is
18 inspected and maintained to specified standard. The program will also include ground
19 surface monitoring.

20 In written testimony Mr Irias expressed concern that the new transmission lines may
21 have adverse impacts on the existing Mokelumne Aqueducts. (Exhibit EBMUD-153, page,
22 19 lines 25 through 27; page 20, line 1 and 2.) Specifically, the concern is that foundations
23 for the proposed CWF transmission lines located near the existing Mokelumne Aqueducts
24 may adversely impact the Mokelumne Aqueducts' foundations or the surrounding levee
25 system from ground movements and settlement. As previously noted, the CWF project is
26 already committed to performing extensive geotechnical studies. (Exhibit SWRCB-102,
27 Chapter 3, Section 3.6.1.10.) Through these studies and the CWF environmental
28 commitments (*id.*, Appendix 3B, Section 3B.2.1 Geotechnical Studies, Section 3B.2.4

1 Electrical Power Line Support Placement) will develop the required ground treatment plan,
2 and ground settlement monitoring and response plan to mitigate impacts to the Mokelumne
3 Aqueduct. CWF is committed to collaboratively working with EBMUD to establish existing
4 baseline conditions and measurements near and around where the CWF power lines
5 crosses the Mokelumne Aqueduct and to locate powerline supports to minimize or avoid
6 impacts to the Mokelumne Aqueduct or levees.

7 Mr. Irias expressed concern the CWF power transmission lines will cause AC
8 induced interference and potentially lead to corrosion of the Mokelumne Aqueduct and
9 cause operator safety issues. (Exhibit EBMUD-153, page 20, lines 3 through 11.) In verbal
10 testimony Mr. Irias testified "We recognize right now the plan is for the power transmission
11 facilities to mostly be parallel to the twin tunnels, which means crossing both our existing
12 and future. And that would tend to -- if that remains, that would be a lesser concern than if
13 it were going parallel" which is related to the AC induced interference issue. (Part 1B
14 Hearing Transcript, Vol. 26, 32:13-21.) Furthermore, the CWF project is committed to
15 designing the transmission lines per Environmental Commitments, AMMs and CMs (Exhibit
16 SWRCB-102, Appendix 3B, Section 3B.2.3, Electrical Power Guidelines, Section 3B.4.30,
17 AMM 30 Transmission Line Design and Alignment Guidelines) and to use best
18 management and design practices which would include applicable National Association of
19 Corrosion Engineers standards. CWF is also committed to working collaboratively during
20 preliminary and final design to design and construct a temporary grounding and corrosion
21 protection system to minimize impacts to the Mokelumne Aqueduct while the temporary
22 transmission lines are in use.

23 Mr. Irias expressed concern the CWF power transmission lines present a fall hazard.
24 (Exhibit EBMUD-153, page 20, lines 12 through 17.) This concern is addressed by CWF
25 Environmental Commitments, AMMs and CMs (Exhibit SWRCB-102, Appendix 3B, Section
26 3B.2.3 Electrical Power Guidelines, Section 3b.4.30 AMM 30 Transmission Line Design
27 and Alignment Guidelines), which provides methods to mitigate these impacts.

1 **VI. WATER SUPPLIED BY EXISTING DIVERSIONS AFFECTED BY**
2 **CONSTRUCTION WILL BE MAINTAINED**

3 LAND witness Mr. Russel Van Loben Sels claimed during his direct testimony on
4 November 10, 2016 that the existing diversion (S021406) shown on Slide 21 of Exhibit
5 DWR-2 errata will probably be permanently affected. (Part 1B Hearing Transcript, Vol. 28,
6 49:1-11.) He incorrectly stated that this diversion identified as S021406 would be
7 permanently effected because the pump for the existing diversion will be removed and fish
8 screens will occupy the pump site. As shown in Exhibit DWR-2 errata, slide 7 (also Exhibit
9 DWR-660) the footprint for the proposed intake structure that houses the fish screens do
10 not extend to the area where Mr. Van Loben Sels's diversion is located.

11 Another witness for LAND, Mr. Richard Elliot also incorrectly claimed that his
12 existing diversion S016915 located downstream of the proposed Intake 3 structure will be
13 permanently removed (Part 1B Hearing Transcript, Vol. 28, 58:19-20, 59:11-17).

14 As described in my Part 1A written testimony, the existing diversions that are located
15 upstream or downstream of the intake structures and within the State Route 160
16 realignment footprint will not require relocation and are considered to be temporarily
17 affected. The diversions that are located within the intake structure footprints and require
18 relocation are considered to be permanently affected. (Exhibit DWR-57, page 13, lines 11
19 through 17; see also Exhibit DWR-660.) Construction activities associated with
20 realignment of SR 160 that would temporarily affect both Mr. Van Loben Sels's diversion
21 S021406 and Mr. Elliot's diversion So16915 are estimated to take between 12 and 18
22 months. For permitted diversions that are impacted, including these two, the Project will
23 ensure that water deliveries are maintained in the quantities consistent with the applicable
24 water rights. Additional information regarding the measures that would be implemented to
25 mitigate the impacts are presented in my Part 1A written testimony. (Exhibit DWR-57,
26 pages 13 through 15.)

1 **VII. THE CWF ENGINEERING DESIGN CORRECTLY ACCOUNTS FOR SEA**
2 **LEVEL RISE**

3 Testimony by Ms. Des Jardins alleges that the CWF conceptual engineering design
4 estimates for 18 inches of sea level rise are not realistic. (Exhibit PCFFA-81errata, page 8,
5 lines 16-19.) Ms. Des Jardins cites to sea level rise estimates for Port Chicago for 2030
6 and 2060 to show that the 18-inch sea level rise estimate used for the intake locations and
7 cited in the Conceptual Design Report are low in comparison. A fact that is missing in Ms.
8 Des Jardins' comparison is that sea level rise estimates decrease as one moves from sea
9 level upstream, and the estimates she cites for Port Chicago are irrelevant to the proposed
10 CWF intake locations on the Sacramento River.

11 For the CWF conceptual design, an analysis was done in 2009 to establish the
12 design flood water surface elevations and flood protection elevations for the facilities.
13 (Exhibit DWR-661.) This analysis used a conservatively high estimate of 55 inches of sea
14 level rise at the Golden Gate Bridge. (*Id.*, page 7.) However, projected sea level rise
15 decreases moving further upstream, such that the 55-inch estimate at the Golden Gate
16 Bridge cannot simply be added to the estimated flood water surface elevation at the facility
17 locations. (*Id.*)

18 The Conceptual Design Report explains how sea level rise is estimated at 18 inches
19 at the intake locations, and how this estimate was added on top of the 200-yr flood level
20 estimate plus an allowance for free board and, as applicable, wind-driven waves to develop
21 the flood protection elevations for the intakes. (Exhibit DWR-212, pages 50-51.) These
22 estimates will be reviewed and updated during the next engineering phases.

23 **VIII. CONCLUSION**

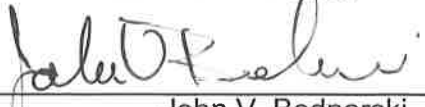
24 Based on the foregoing, I believe that the engineering design and construction for
25 the CWF will not result in any of the alleged injuries addressed in this testimony or
26 otherwise significantly adversely affect other users of water.

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Executed on this 22nd day of March, 2017 in Los Angeles, California.



John V. Bednarski